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Subject: Sigma Complex baseline doc update

Attachments: 5_Sigma_Complex_.doc

5_Sigma_Complex_.doc (191 KB)

Kirk, attached is the updated Sigma Complex NEPA Determination Document.

JI
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LA-UR-01-3040

Title: ESH-20 NEPA Determination Document 5
TA-3 Sigma Complex

Los Alamos
NATIONAL LABORATORY

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1.0 Introduction

This document describes the *National Environmental Policy Act of 1969* (NEPA) operational envelope for operations, capabilities, and parameters analyzed for TA-3 Sigma Complex, a key facility in the *Site-Wide Environmental Impact Statement for the Continued Operation of Los Alamos National Laboratory* (SWEIS; DOE 1999a). The principal buildings and structures for this key facility are shown in Table 1. The purpose of this document is to determine whether a proposed project for this facility has NEPA coverage in the SWEIS as implemented by the Department of Energy (DOE) in the Record of Decision (ROD) for the SWEIS. As long as the TA-3 Sigma Complex operates within the bounds of the impacts projected by the SWEIS, the facilities are in compliance with NEPA. If there is potential to exceed projected impacts, further NEPA review would be required.

Table 1. Principal Buildings and Structures of the TA-3 Sigma Complex

Technical Area	Principal Buildings and Structures
TA-3	Sigma Building: 03-66 Press Building: 03-35 Beryllium Technology Facility: 03-141 Thorium Storage Building: 03-159 Butler Building: 03-169

Under the Laboratory Implementation Requirement (LIR) entitled “NEPA, Cultural Resources, and Biological Resources (NCB) Process,” (LANL 2000a) proposed projects are screened by the authorized facility NCB reviewer as part of the NCB assessment. The screening requires the facility NCB reviewer to decide

- if the project is new or modified from a previous determination and
- if DOE has already made a determination that covers the proposed project.

The Facility NCB Reviewer uses the Facility NEPA Determination Document (LANL 2000b) for screening. Table 2 summarizes the capabilities, and the operations examples for the capabilities, that were published in the SWEIS to estimate the impacts. If the facility NCB reviewer finds that the proposed activity is one of the capabilities in the SWEIS and is within one of the operations levels for that capability as shown by Table 2, the reviewer could determine that the proposed activity is covered by the SWEIS and does not require further NEPA analysis.

However, a proposal that does not match a capability description in Table 2 or that is not included with one of the operations levels for that capability in Table 2 could still be covered by the SWEIS. The SWEIS analysis is based on information in background documents prepared for each of the key facilities; these background documents provide more detailed descriptions of the ongoing and potential operations for each key facility. In addition, the levels of activity called the “operations envelope” for each of the capabilities reflects scenarios that were developed for each capability to provide an estimate for calculating potential impacts. The SWEIS was not intended to set stringent limits on the level of activity for a particular capability. In most facilities the operations envelope for every capability would not be reached at one time because of the ebb-and-flow-like nature of the work at LANL. Thus it would be possible to exceed the level for one capability and still be within the parameter limits for the facility or the LANL operations limit. If the proposal reviewer can demonstrate this, the proposal would still have NEPA coverage through the SWEIS. This document presents the procedure for a more detailed review and supporting information from the SWEIS and background documents.

Table 2. TA-3 Sigma Complex [a]

Capability	Operational Examples[b]
1. Research and Development on Materials Fabrication, Coating, Joining, and Processing	1.1 Maintain and enhance capability to fabricate items from metals, ceramics, salts, beryllium, enriched uranium, depleted uranium, and other uranium isotope mixtures including casting, forming, machining, polishing, coating, and joining.
2. Characterization of Materials	2.1 Maintain and enhance research and development activities on properties of ceramics, oxides, silicides, composites, and high-temperature materials. Characterize components for accelerator production of tritium. 2.2 Analyze up to 36 tritium reservoirs per year. 2.3 Develop library of aged non-SNM materials from stockpiled weapons and develop techniques to test and predict changes. Store and characterize up to 2500 non-SNM component samples, including uranium.
3. Fabrication of Metallic and Ceramic Items	3.1 Fabricate stainless steel and beryllium components for about 80 pits per year. 3.2 Fabricate up to 200 tritium reservoirs per year. 3.3 Fabricate components for up to 50 secondaries per year. 3.4 Fabricate nonnuclear components for research and development: about 100 major hydrotests and 50 joint test assemblies per year. 3.5 Fabricate beryllium targets. 3.6 Fabricate targets and other components for accelerator production of tritium research. 3.7 Fabricate test storage containers for nuclear materials stabilization. 3.8 Fabricate nonnuclear (stainless steel and beryllium) components for up to 20 pit rebuilds per year.

a: Source: Modified from SWEIS 1998 Yearbook (LANL 1999).

2.0 Procedure

A proposed project can be screened by the Facility NCB reviewer or ESH-20 reviewer to determine if it is included in the descriptions in Table 2. Under that procedure, if a proposal does not clearly fit those descriptions of capabilities and operations levels, it will be referred to ESH-20 for review under this procedure, which requires more familiarity with SWEIS supporting documentation and projected additive impacts of other proposed work at LANL. The ESH-20 reviewer will use the data on TA-3 Sigma Complex facilities and capabilities from the SWEIS document and the background documentation. The supporting documentation on the TA-3 Materials Science Laboratory facilities and capabilities is presented in Sections 3 and 4 below.

A flow chart that summarizes the procedure for the ESH-20 reviewer to use in screening a proposal is presented in Attachment 1. Upon receiving a proposal, the reviewer should answer the following:

1. Is this a new capability? Review the detailed descriptions of the TA-3 Sigma Complex and capabilities from the SWEIS (Section 3 of this document) and from the background documents (Section 4 of this document).

   a. If this is a new capability, go to 4.
   b. If this is not a new capability, go to 2.

2. Does the proposal fit within one of the operations levels for that capability in the SWEIS? Compare description to second column of Table 2.
   a. If the proposal is within the operations levels for that capability, go to 5.
   b. If the proposal is not within the operations examples, go to 3.

3. Is the proposal within the facility operations data envelope? Work with the facility manager and other Environment, Safety, and Health subject matter experts (SMEs) to calculate if the proposal is within the envelope of facility operations data (Table 3).
   a. If the proposal is within the facility operations data envelope, go to 5.
   b. If the proposal is not within the facility operations data envelope, go to 4.

4. ESH-20 will prepare a NERF to complete the NEPA process.

5. Proposal is covered by the SWEIS. Attach explanation/calculations to NCB Screening Checklist (Attachment 2) to complete the NEPA process.

Table 3. TA-3 Sigma Complex Operations Data

Parameter	Units [a]	SWEIS ROD
Radioactive Air Emissions: • Americium-241 • Uranium-234	 Ci/yr Ci/yr	 $9.3\text{-}0 \times 10^{-9}$ 1.30×10^{-9} 6.20×10^{-9}
NPDES Discharges:[b] • Total Discharges • 03A-022 • 03A-024	 MGY MGY MGY	 7.3 0 7.3
Wastes: • Chemical • Low-level waste • Mixed low-level waste • TRU waste/Mixed transuranic waste	 kg/yr m^3/yr m^3/yr m^3/yr	 10,000 501 0

a: Ci/yr = curies per year; MGY = million gallons per year.
b: NPDES is National Pollutant Discharge Elimination System

3.0 SWEIS Data for TA-3 Sigma Complex

This section provides information from the SWEIS. Section 3.1 is a description of the TA-3 Sigma Complex facilities from Chapter 2 of the SWEIS. Section 3.2 is a description of the capabilities at TA-55 at the time the SWEIS was written, while Section 3.3 is a description of the capabilities under the preferred alternative as selected under the Record of Decision.

3.1 SWEIS Description of Facilities

The Sigma Complex consists of the main Sigma Building (Building 66) and its associated support structures, including the Beryllium Technology Facility (Building 141), the Press

Building (Building 35), and the Thorium Storage Building (Building 159). The Sigma Complex supports a large, multi-disciplinary technology base in materials fabrication science. This facility is used mainly for materials synthesis and processing, characterization, fabrication, joining, and coating of metallic and ceramic items. These capabilities are applied to a variety of materials, including uranium (depleted uranium and enriched uranium), lithium, and beryllium; the Sigma Complex is equipped to handle such materials safely. The current activities focus on limited production of special (unique or unusual) components, test hardware, prototype fabrication, and materials research in support of DOE programs in national security, energy, environment, industrial competitiveness, and strategic research. The Sigma Complex also provides support to research and development activities conducted elsewhere at LANL by constructing special pieces of equipment and test items.

The Sigma Building is designated as a Hazard Category 3 nuclear facility. The Sigma Building was built in 1958 and 1959, with an addition constructed in the late 1980s. It contains four levels and approximately 168,200 square feet of floor space (15,626 square meters). The Sigma Building is composed of four sectors. Three sectors built in the late 1950's were not constructed to current seismic design criteria (seismic upgrades are included in all alternatives). The fourth sector, built in the late 1980's, meets current seismic design criteria. Hazardous chemicals such as concentrated acids and caustic solutions are used and stored at the Sigma Building. Sigma Building air exhausts through six major exhaust stacks and through numerous roof exhausts. Aqueous waste from enriched uranium processing and liquid chemical waste are routed to the RLWTF at TA-50. Most of the liquid waste from the Sigma Complex is generated from the electroplating operation at the Sigma Building. Electrodeposition solutions are now vacuum distilled and re-used; the sludges are managed as RCRA wastes. The Beryllium Technology Facility (3-141), formerly called the Rolling Mill Building, was built in the early 1960's and encompasses approximately 20,213 square feet (1,878 square meters) on three levels. This building does not have a hazard designation. The two sectors of the building meet current seismic design criteria. The building houses powder metallurgy activities, filament welding, ceramics research and development, and rapid solidification research. Fabrication work using beryllium and uranium/graphite fuels is performed here. The beryllium area has a permitted, monitored stack equipped with a HEPA filtered exhaust air system. The Press Building (3-35) was built in 1953 and contains approximately 9,860 square feet (916 square meters) of space located on one floor and a partial basement. This building does not have a hazard designation and was not evaluated for seismic capability. A 5,000-ton (4,536-metric-ton) hydraulic press used for work with depleted uranium is operated here. One stack exhausts through HEPA filters. The exhaust stream is monitored for radioactive emissions. Aqueous waste from uranium processing and other nonhazardous operations is routed, via a pipeline, to the RLWTF at TA-50. The Thorium Storage Building is designated as a Hazard Category 3 nuclear facility. Thorium is stored here, in both ingot and oxide form. This building is very small and was not evaluated for seismic capability.

3.2 SWEIS Description of Capabilities (Baseline)

The primary activities conducted within the Sigma Complex are described below. The manner in which these activities would vary under each of the alternatives is described in chapter 3 (of the SWEIS).

3.2.1 Research and Development on Materials Fabrication, Coating, Joining, and Processing

Materials synthesis and processing work addresses research and development on making items out of materials that are difficult to work with. The processes include applying coatings and joining materials using plasma, arc welding and other techniques. The materials used in fabrication are also reprocessed (i.e., separated into pure forms for reuse or storage).

3.2.2 Characterization of Materials

Materials characterization work includes understanding the properties of metals, metal alloys, ceramic-coated metals, and other similar combinations along with the effects on these materials and properties brought about by aging, chemical attack, mechanical stresses, and other agents.

3.2.3 Fabrication of Metallic and Ceramic Items

Materials fabrication includes work with metallic and ceramic materials, and combinations thereof. Items are fabricated out of uranium, both depleted and enriched in uranium-235. Stainless steel, lithium, various ceramics, and beryllium items are also fabricated. Items are fabricated on a limited production basis as well as one-of-a-kind and prototype pieces. One specific set of applications for this technology is the fabrication of nonnuclear weapons components. The responsibility for production of these components was assigned to LANL on the basis of the *Nonnuclear Consolidation Environmental Assessment* (DOE 1993). This environmental assessment (EA) addressed the upgrades and interior modifications necessary for this assignment, and these upgrades and modifications are expected to continue through completion under all of the SWEIS alternatives.

3.3 SWEIS Description of TA-3 Sigma Complex Activities – No Action Alternative

Under the No Action Alternative, the following activities would occur at TA-3 Sigma Complex.

3.3.1 Research and Development on Materials Fabrication, Coating, Joining, and Processing

LANL would continue to fabricate items from metals, ceramics, salts, beryllium, enriched uranium, depleted uranium, and other uranium isotope mixtures. Activities include casting, forming, machining, polishing, coating, and joining.

3.3.2 Characterization of Materials

LANL would continue research and development activities on properties of ceramics, oxides, silicides, composites, and high-temperature materials; analyze up to 24 tritium reservoirs per year; and develop a library of aged non-SNM materials from stockpiled weapons and develop techniques to test and predict changes. Up to 250 non-SNM samples, including uranium, would be stored and characterized.

3.3.3 Fabrication of Metallic and Ceramic Items

LANL would, on an annual basis, fabricate stainless steel and beryllium components for approximately 50 plutonium pits, 50 to 100 reservoirs for tritium, components for up to 50 secondary assemblies (of depleted uranium, depleted uranium alloy, enriched uranium, deuterium, and lithium), nonnuclear components for research and development (30 major hydrotests and 20 to 40 joint test assemblies, beryllium targets, targets and other components for accelerator production of tritium research, test storage containers for nuclear materials stabilization, and nonnuclear (stainless steel and beryllium) components for up to 20 plutonium pit rebuilds. In addition, all of the alternatives include construction, renovation, and modification projects that are underway and planned in the near term for the purpose of maintaining the availability and viability of the Sigma Complex:

Sigma Building Renovation. These renovations, described further below, are required to keep the building in good operating condition for current missions.

Nonnuclear Consolidation/Pit Support and Beryllium Technology Support. This was previously reviewed under NEPA (DOE 1993. Typical activities to be included for the Sigma Building (SM–66) in all alternatives to ensure continued availability of the existing capabilities are:

- Perform seismic upgrades including adding shear walls and reinforcements.
- Replace the roof.
- Replace and upgrade the graphite collection systems.
- Replace the cooling water pump and piping.
- Modify the industrial drain system.
- Replace and upgrade electrical components.
- Perform site work such as relocating a fire hydrant, repairing the dock area, and removing unneeded exterior equipment.

In addition, at one of the shops (SM–106), the baghouse on the ventilation system will be replaced with new ductwork and a high-efficiency particulate air (HEPA) filter system. It is recognized that project plans can change over time. If this alternative is selected, the construction projects proposed under this alternative, as described above, would be reviewed prior to construction to determine whether additional NEPA analysis is required. current levels of operation: surface science chemistry, corrosion characterization, electron microscopy, x-ray, optical metallography, and spectroscopy.

3.4 SWEIS Description of TA-3 Sigma Complex Activities (Preferred Alternative)

The following is the description of activities under the preferred alternative which was adopted in the ROD for the SWEIS (DOE 1999b).

3.4.1 Research and Development on Materials Fabrication, Coating, Joining, and Processing

Under the Expanded Operations Alternative, as under the No Action Alternative, LANL would continue to fabricate items from metals, ceramics, salts, beryllium, enriched uranium, depleted uranium, and other uranium isotope mixtures. Activities include casting, forming, machining, polishing, coating, and joining.

3.4.2 Characterization of Materials

LANL would continue research and development activities on properties of ceramics, oxides, silicides, composites, and high-temperature materials at a level slightly increased over that for the No Action Alternative. In addition, LANL would analyze up to 36 tritium reservoirs per year; and develop a library of aged non-SNM materials from stockpiled weapons and develop techniques to test and predict changes. Up to 2,500 non-SNM samples, including uranium, would be stored and characterized.

3.4.3 Fabrication of Metallic and Ceramic Items

LANL would, on an annual basis, fabricate stainless steel and beryllium components for approximately 80 plutonium pits, 200 reservoirs for tritium, components for up to 50 secondary assemblies (of depleted uranium, depleted uranium alloy, enriched uranium, deuterium, and lithium), nonnuclear components for research and development (50 to 100 major hydrotests and 50 joint test assemblies, beryllium targets at a slightly increased level over the No Action Alternative, targets and other components for accelerator production of tritium research, test storage containers for nuclear materials stabilization, and nonnuclear (stainless steel and beryllium) components for up to 20 plutonium pit rebuilds. In addition, all of the alternatives include construction, renovation, and modification projects that are underway and planned in the near term for the purpose of maintaining the availability and viability of the Sigma Complex, as described under the No Action Alternative, section 3.1.5. of the SWEIS. It is recognized that project plans change over time. If this alternative is selected, the construction projects proposed under this alternative (as described above), would be reviewed prior to construction to determine whether additional NEPA analysis is required.

4.0 Background Document Information for TA-3 Sigma Complex

This section presents information form the “Background Information for TA-3 Sigma Complex for the Site Wide Environmental Impact Statement, Los Alamos National Laboratory (LANL 1996).

4.1 Background Document Description of Facilities

The Sigma Complex is an exclusion area within the Laboratory located in TA-3 that includes buildings TA-3-66, TA-3-141, TA-3-35, and several smaller utility and storage structures. The Sigma Complex encompasses over 200,000 square feet of Laboratory space.

The complex was incrementally constructed during the 1950s and 1960s and has been used for a variety of nuclear materials missions. Today the facility is primarily used for materials synthesis and processing, characterization, and fabrication of metallic and ceramic items including those made of depleted uranium (DU) in support of the Stockpile Stewardship and Stockpile Management programs sponsored by DOE Defense Programs (DP). The current mission focuses on limited production, test hardware, prototype fabrication and materials research for the nuclear weapons program, but also includes complementary materials activities related to energy, environment, industrial competitiveness, and strategic research.

The three main buildings at the Sigma Complex are: The Sigma Building (TA-3-66, also known as SM-66; the SM designator refers to South Mesa), the Rolling Mill Building (SM-141), and the Press Building (SM-35). Bulk DU is stored within the Sigma building as supply and feed stock. Thorium (^{232}Th) is stored in both ingot and oxide form in a smaller building (SM-159) that is surrounded by fencing with its own controlled access to ensure material accountability and limit worker radiation dose. The quantities of DU and thorium exceed the Category 3 quantities listed in Table A-1 of Attachment 1 to DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports.*

Past activities in the Sigma Complex included processing all isotopes of uranium. Therefore, much of the equipment is radioactively contaminated at very low levels. Nonradioactive hazardous material used include a number of chemicals and metals such as beryllium.

4.2 Comparison of Missions/Programs Under the No Action and *Expanded Alternative*

4.2.1 Stockpile Management

In support of the Stockpile Management program, the Sigma Complex will:

- Provide the capabilities to support the fabrication of non-nuclear components for up to 50 War Reserve (WR) pits per year plus necessary associated process proof units,
- Supply up to 50 developmental canned sub-assemblies (CSAs) per year, and
- Supply components to support 20-40 joint test assemblies (JTAs) per year.

In support of the Stockpile Management program under the preferred alternative, the Sigma Complex will:

- Develop capabilities to support the fabrication of non-nuclear components for up to 80 WR pits per year plus necessary associated process proof units. The number of WR pits that will be supported by the Sigma Complex is based on the expanded operations production rate of 80 pits per year given in the SWEIS Background Information document for TA-55.
- Supply up to 100 developmental CSAs per year plus associated process proof units. The number of CSAs that will be supplied is based on the High Case single shift production capacity assumed in the “Stockpile Management Preferred Alternatives Report” (DOE, 1996).
- Supply components to support up to 50 JTAs per year.

Several key programs individually support the Stockpile Management program. A brief description of each of these programs follows.

4.2.2 Pit Process Development and Fabrication Activities

The Sigma Complex provides the non-nuclear beryllium and stainless steel components used in the manufacture of pits. As a result of the Nonnuclear Reconfiguration Project (DOE, 1993), LANL has been tasked to supply non-nuclear components to support pit production in the DOE

Complex, whether it be at TA-55 or elsewhere. The number of WR pits that will be supported by the Sigma Complex is based on the assumed production rate of 50 pits per year given in the "Stockpile Management Preferred Alternatives Report" (DOE, 1996). Therefore, the Sigma Complex must be able to support the manufacture of up to 50 WR pits per year plus necessary associated process proof units.

Beryllium component production operations involve machining, foundry, metallography, and recycle processes. Shells for WR applications are machined from beryllium blanks (ingots). The blanks are either commercially purchased or are recycled from beryllium scrap resulting from machining or powder operations. Scrap and recycle beryllium is vacuum induction melted and cast into blanks. Machining operations will be dry to reduce waste and facilitate the recycle of spent machining chips. It is estimated that during machining operations, approximately 50% of the blank material will be removed and sent to recycle. During machining, small samples of beryllium are analyzed through metallography and transmission electron microscopy (TEM). Components that require joining are welded with pressurized gas metal arc (PIGMA) or electron beam welders. Parts can also be joined or heat-treated with two brew furnaces.

4.2.3 Canned Sub-Assemblies (CSAs)

It is assumed that the Sigma Complex has a standing capacity to produce up to 50 CSAs per year. Functional capabilities for this process, referred to as the 'Secondary Factory,' include operations to physically and chemically process, machine, inspect, assemble, certify, and disassemble secondary materials. Physical processing may include melting, casting, forming, pressing, mechanical working, heat treating, outgassing, and sintering. Material properties tests are also performed. Remediation and disposition of wastes generated from these processing operations must also be included.

The secondary materials include DU, DU alloy (Binary), enriched uranium (EU), lithium hydride (LiH), lithium deuteride (LiD), and other materials.

4.2.4 Joint Test Assemblies

The Sigma Complex has the capability to build components for JTAs. The manufacturing process involves forming, machining, cleaning, and joining of materials and components. Materials are stainless steels and various other simulants in support of all the weapons systems in the enduring stockpile. The No Action alternative will be to support the construction of 20-40 JTAs per year.

4.2.5 Stockpile Stewardship

In support of the Stockpile Stewardship program, the Sigma Complex will:

- Develop capabilities to support the fabrication of non-nuclear components for up to 50 pits per year plus necessary associated process proof units,
- Support up to 30 major hydrotests per year,
- Produce tritium reservoir hardware in support of research at the rate of 50-100 units per year,

- Provide support for hydrotests, uranium research and development, JTAs, requalification of processing capabilities, and prototyping of secondary components. Perform work for other groups at LANL, as well as outside organizations within the DOE, in the areas of uranium development, alloy development, coating deposition, and component fabrication (these activities are referred to as ‘Work for Others’ (WFO)), and
- Produce Be targets in support of inertial confinement fusion (ICF) programs.

In support of the Stockpile Stewardship program under the preferred alternative, the Sigma Complex will:

- Develop capabilities to support the fabrication of non-nuclear components for up to 80 pits per year plus necessary associated process proof units. The number of pits that will be supported for research purposes in the Stockpile Stewardship program is 80 pits per year, as assumed for the Stockpile Management program (Section 2.1.2.1).
- Support 50-100 major hydrotests per year,
- Produce tritium reservoir hardware in support of research at a rate of 200 units per year. In support of reservoir metallography, the maximum number reservoir units to be analyzed would not exceed 36 per year. This upper limit would account for LANL providing backup support for SRS.
- Continue to provide support for hydrotests, uranium research and development, JTAs, requalification of processing capabilities, and prototyping of secondary components. Perform WFO in the areas of uranium development, alloy development and component fabrication, and
- Continue to produce Be targets in support of ICF programs.
- Continue to maintain the capability to work with HEU, as well as with DU.

Several key programs individually support the Stockpile Stewardship program. A brief description of each of these programs follows.

4.2.6 Pit Manufacturing and Research and Development Activities

The Sigma Complex provides the non-nuclear beryllium and stainless steel components used in the manufacture of pits. The number of pits that will be supported for research purposes in the Stockpile Stewardship program is 50 pits per year, as assumed for the Stockpile Management program).

4.2.7 Hydrotest Program

Hydrotests will be supported at the Sigma Complex for up to 30 major tests per year.

4.2.8 Tritium Reservoirs

Capabilities will be established to fabricate 50-100 tritium reservoirs per year to support research. This effort will include associated leak testing, but not radiographic inspection or proof testing. The fabrication process includes all associated joining operations. Remediation programs and the means for disposal of generated wastes are currently in place.

To support the metallography of tritium contaminated reservoirs, up to 24 units, including three in support of the Savannah River Site (SRS) will be analyzed per year at the Sigma Complex. The time required to analyze a unit is approximately 4 months. Therefore, several units will be analyzed simultaneously.

4.2.9 Ceramic Coatings & Studies of Erbium Oxide

The capability of coating components with erbia oxide is required for the manufacturing of certain weapons. The focus on the research is the development of single- and poly-crystalline coating materials. This activity will be linked to several universities where students will study the fabrication and properties of materials.

4.2.10 Processing of BeO

Beryllium oxide processing capabilities will be maintained at the Sigma Complex.

4.2.11 Inertial Confinement Fusion Support

Fabrication of beryllium and beryllium alloy ICF capsules are performed by arc melting material, then extruding to rod. These arc melting and extruding operations are performed at the Sigma Complex. The rod is machined at MST-7. Processing and characterization of beryllium materials is an expertise which is required at the Sigma Complex to support the Beryllium Technology non-nuclear Pit Support and Stockpile Stewardship missions.

4.2.12 Uranium Development

Near-net-shape casting capabilities for all forms of uranium have been developed and employed to reduce the amount of material removed in machining. Molds are designed with replaceable inserts to greatly reduce the amount of waste from processing streams. Chemical recovery processing improvements will be developed and incorporated to greatly reduce waste effluents, increase worker productivity, and maximize process efficiency.

4.2.13 Alloy Development

Vacuum Arc Remelting (VAR) has been developed and used for the production of alloy ingot. This technology, which was developed and demonstrated at Rocky Flats, will be maintained in the Sigma Complex. Plasma torch technology will be utilized for the recycling of scrap binary material.

4.2.14 Component Fabrication

LANL will employ large plate rolling services from a commercial source. Experience with a commercial vendor has proven to be reliable, cost effective, and capable of meeting stockpile quality specifications.

4.2.15 Highly Enriched Uranium

The capability to work with highly enriched uranium (HEU), as well as with DU, will be maintained.

4.2.16 Enhanced Surveillance

The Laboratory will develop a library of aged materials from stockpiled weapons and utilize new technologies to characterize and predict the aging process and dynamic behavior of appropriate materials. Up to 250 non-SNM weapons materials samples and components will be stored at Sigma. The capability to store uranium components will be maintained.

Increase the size of the library and engage a larger cross section of new technologies to accelerate the process of predicting material aging behavior. Up to 2500 non-SNM weapons materials samples and components will be stored at the Sigma Complex. Uranium components could also be stored at the Sigma Complex.

4.2.17 Materials Research and Development Support

This program includes general support for research and development activities in the areas of refractory metals, lightweight ceramics, Be plasma spraying, microstructures and properties of high temperature structural oxides, nitrides, carbides, silicides, and composites is continuing at the Sigma Complex. Specific planned research and development activities include:

- Lightweight ceramic armor consisting of boron carbide materials bonded to metals and or polymers.
- Structural ceramics and high temperature structural silicides to be used in the manufacturing of fiberglass.
- Carbon dioxide abatement in flue gases.
- Fissile materials disposition.
- Space nuclear fuels research.
- More efficient and environmentally benign processes of synthesis and fabrication of salt and other materials.
- Microwave processing of ceramic materials.

A modest increase would occur in the level of general support for research and development activities in the areas of refractory metals, lightweight ceramics, Be plasma spraying, microstructures and properties of high temperature structural oxides, nitrides, carbides, silicides, and composites.

4.2.18 Nuclear Materials Stabilization and Packaging

Proof of stabilization and packaging technologies will be conducted with surrogate materials at the Sigma Complex. However, packaging of nuclear materials will not be performed at the Sigma Complex.

For the preferred operations alternative, actual manufacturing of storage containers could occur at the Sigma Complex.

4.2.19 Accelerator Production of Tritium

The Sigma Complex will fabricate accelerator cavities and targets, as well at proton beam steering components in support of the accelerator production of tritium (APT). In addition, corrosion related studies and determinations in support of this program will be conducted at the Sigma Complex.

For preferred operations alternative, fabrication, inspection, materials compatibility, and characterization for much of the APT system could occur at the Sigma Complex.

4.2.20 Advanced Manufacturing Industrial Partnership Programs

General support exists at the Sigma Complex for various programs with industrial partnerships in the areas of computer modeling, directed light fabrication, metal oxide coatings, deep penetration welds on reflective materials such as Be and Al.

A modest increase would occur in the level of general support for various programs with industrial partnerships in the areas of computer modeling, directed light fabrication, metal oxide coatings, deep penetration welds on reflective materials such as Be and Al.

4.3 Discussion of Operational Capabilities as They Support Programs

Operational capabilities at the Sigma Complex have been grouped into the six major categories as shown in Table 4 below. The description of the capabilities and the specific programs they support is discussed below.

Table 4: Sigma Complex Operational Capabilities and Programs

	Core Capabilities					
Programs	Synthesis	Processing	Machining	Assembly	Characterization	Facilities
Stockpile Management	X	X	X	X	X	X
Stockpile Stewardship	X	X	X	X	X	X
Enhanced Surveillance	X	X	X	X	X	X
Materials R&D Support	X	X	X	X	X	X
Nuclear Materials Stabilization and Packaging	X	X	X	X	X	X
Accelerator Production of Tritium	X		X	X	X	X
Advanced Manufacturing Industrial Partnership Programs	X	X	X	X	X	X

4.3.1 Synthesis

4.3.1.1 Description

Chemical Synthesis Laboratory. The chemical synthesis laboratory is a generic laboratory located in SM-141. The laboratory is equipped with a large ventilation hood, bench top workspace, three sinks, and high temperature furnaces. The laboratory is used for small-scale chemical synthesis research using solvent-based preparation of precursors for solid state synthesis of inorganic materials. The inorganic materials include erbia, barium salts, lead, calcium, strontium and copper for high temperature superconductors, and niobium nitrides.

Foundry. The foundry provides the capability of melting and casting metallic materials, and can support a single operation using up to 2000 kg of depleted uranium and small quantities of enriched uranium and other alloys. Several large casting furnaces are arranged in a large high-bay area equipped with an overhead crane.

Electrochemistry. The Electrochemistry Operations include electrochemistry, electroplating and surface finishing. The operations are located in the P-area of SM-66 and comprise a multi-functional capability that serves LANL and supports outside DOE/Government agencies.

The Electrochemistry Operations host a full range of plating capabilities from plating of radioactive components to anodizing of aluminum. The major operations performed in the electroplating laboratory include anodizing, brush plating, chromating, chrome plating, chemical milling, copper plating, gold plating, lead plating, nickel plating, silver plating, tin plating, oxide coatings, electropolishing, chemical polishing, and etching. The plating capabilities range in scale from 930 liter baths to benchtop operations. As well, research continues on developing non-hazardous plating baths for silver and gold.

Powder Metallurgy and Beryllium Technology. The major processes associated with powder metallurgy and beryllium technology are vacuum melting, inert gas and centrifugal atomization, powder classifying, hot isostatic pressing (HIP), HIP can fabrication, powder loading, HIP can evacuation and sealing, decanning, machining to final shape, cleaning and inspection. Since the processing to near net shape requires a large amount of work related to demonstrating the reliability and reproducibility of the process, and verification of the necessary beryllium mechanical properties and welding characteristics, a number of additional activities related to the process technology are performed. These include metallography, mechanical testing and nondestructive inspection. New process technologies such as plasma spray joining of beryllium components will be pursued.

4.3.1.2 Programs Supported

As indicated in the Table 4, synthesis supports all programs.

4.3.1.3 Radioactive Materials

Depleted and enriched uranium is used in synthesis activities; however, the chemical synthesis laboratory does not use radioactive materials.

4.3.1.4 Nonradioactive, Toxic, or Hazardous Substances

Synthesis work has frequently used the thermal decomposition of metal nitrates, carbonates, and organic chelate compounds in air or oxygen. Simple organic solvents like methanol, ethanol, and toluene were used as non-reacting solvents in the chemical preparation. Also, simple amines, like diethylamine and triethylamine, are used to control the pH of aqueous solutions. Simple inorganic acids (nitric and hydrochloric) are also employed.

Hazardous or toxic chemicals are not used in beryllium processing. A small inventory of beryllium powder will be maintained, and subjected to strict controls in handling. One such control will be the use of a glove box for powder screening and HIP can loading.

4.3.1.5 Hazardous Energy Sources

The chemical synthesis laboratory includes several muffle furnaces (1100 degrees C maximum) and one high temperature furnace, (1600 degrees C maximum). The muffle furnaces utilize 110 VAC power and the high temperature furnace uses 208 VAC, 30 Amps, 3-phase power. The foundry has several high temperature furnaces.

4.3.2 Processing

4.3.2.1 Description

Salt Laboratory. The salt laboratory provides capabilities to carry out processing and characterization needed to fabricate parts of salt and other materials in dry inert gloveboxes. These capabilities include crushing and grinding, powder processing, pressing, and machining.

Pressure Forming Laboratory. The pressure forming laboratory is used to fabricate ceramics. The laboratory contains a uni-axial pressure forming press, operating in the range of 5,000 to 10,000 psi, and a hot vacuum press, operating at up to 25 tons and up to 2,000 degrees C. Future expansion of the laboratory is planned to include a cold isostatic press capable of pressures up to 30,000 psi, and an injection molding system.

Robotics Spray Laboratory. In the robotics coating laboratory a robot is used to improve the reproducibility of sprayed on coatings. In this process the robot controls a spray gun which sprays uniform coatings of ceramic slurries. These coatings are typically air dried and then fired around 500 to 700 degrees C. In this laboratory the ceramic slurries used for spraying are also synthesized. In the case of erbia, erbium nitrate is mixed with erbia powder. Commercially available ceramic slurries, such as Ludox, are also sprayed in the laboratory.

4.3.2.2 Programs Supported

As indicated in Table 4, processing supports all programs except for APT.

4.3.2.3 Radioactive Materials

Processing makes no use of radioactive materials.

4.3.2.4 Nonradioactive, Toxic, or Hazardous Substances

Erbium nitrate chemistry requires the decomposition of erbium nitrate which releases various nitrous oxides.

4.3.2.5 Hazardous Energy Sources

The pressure forming laboratory contains a uni-axial pressure forming press and a hot vacuum press as discussed above. The spray robot is located inside a chamber which confines the spray and automatically applies the breaks to the robot if a door is opened. The robotics spray laboratory also employs furnaces to fire coatings up to 700 degrees C. The main furnace is connected to a 480 V line and the smaller furnace used to produce erbia powder operates on 120 V.

4.3.3 Machining

4.3.3.1 Description

The machine shop is located in the north end of SM-66 and occupies 8,500 square feet. The machine shop is equipped to perform a wide spectrum of manufacturing processes on graphite tooling and components in support of Laboratory programs. Manufacturing processes range from modifications to existing components or commercially procured hardware, to the fabrication of parts or subassemblies that interface with systems already in place, to the production of complete systems/assemblies.

In addition, a completely equipped metal/ceramic shop is located adjacent to the graphite machine shop and provides support in the way of tooling and fixturing as required.

An integral part of the machine shop's fabrication activities is the ability to accurately characterize component features, dimensional relationships, and process integrity. In order to maintain the highest levels of quality and consistency, a wide variety of inspection equipment is employed. This equipment includes hand and bench tools that can be used independently of or in conjunction with laboratory-grade granite tables, height gages, rotary tables, sine plates, gage blocks, an optical comparator, and/or the coordinate measuring machine (CMM).

4.3.3.2 Programs Supported

As indicated in Table 4, the machine shop supports all programs.

4.3.3.3 Radioactive Materials

Machining capabilities for radioactive materials currently include those necessary to support the foundry and forming areas. A conventional lathe and keen-type milling machine are occasionally used to machine metallographic samples and blanks from depleted uranium alloys.

4.3.3.4 Nonradioactive, Toxic, or Hazardous Substances

Occasionally, requests for machining fibrous alumina are received. This material is used as a furnace liner at TA-55, and has hazardous properties similar to those of asbestos.

4.3.3.5 Hazardous Energy Sources

Some of the machining equipment has a high kinetic energy source due to high speed rotating equipment.

4.3.4 Assembly

4.3.4.1 Description

Welding and Joining. Welding and joining operations are performed in all of the R and S areas of SM-66. Capabilities will be maintained to perform the following welding and joining operations:

Arc welding operations including:
- Gas tungsten arc welding
- Manual, semi-automatic, automatic orbital tube welding
- Gas tungsten arc - cold wire feed
- Plasma arc cutting and welding
- Gas metal arc welding, including PIGMA
- Electron beam welding operations

Laser beam welding operations including:
- Welding
- Cutting
- Brazing
- Ablation

Resistance welding operations including:
- Micro-resistance welding
- Resistance forge (upset) welding
- Confined and unconfined pinch welding
- Spot and stud welding

Brazing and soldering operations including:
- Vacuum furnace brazing
- Induction brazing
- Brazing and soldering using all applicable processes

Solid state joining operations including:
- Inertia welding
- Solid state bonding

Cleaning. A variety of cleaning capabilities exist at the Sigma Complex. All components require cleaning prior to plating, and many materials and components require cleaning before welding and or final assembly. Cleaning operations include surface treatments with pH controlled solvents, degreasers, and mechanical polishing and scaling techniques.

Microwave Joining. During microwave joining ceramic materials are joined using microwave energy. Typical ceramics joined are oxides such as alumina or silicides such as silicon carbide.

4.3.4.2 Programs Supported

As indicated in Table 4, assembly supports all programs.

4.3.4.3 Radioactive Materials

Direct welding of radioactive SNM materials or the encasement of such is permitted under existing SOPs or special work permits up to and including uranium and uranium alloys. No radioactive materials are used in the Microwave Joining program.

4.3.4.4 Nonradioactive, Toxic, or Hazardous Substances

Welding of beryllium and lead are covered under existing SOP operations or by the use of special work permits. Microwave Joining uses hexane, an organic solvent. In addition, compressed gases are routinely used to provide special processing atmospheres.

4.3.4.5 Hazardous Energy Sources

The many hazardous energy sources associated with the welding and joining processes used are covered under existing SOPs. They include but are not limited to, laser light, electron beams, high pressure, stored mechanical energy, electrical energy, visible light, flammable and explosive chemicals.

Microwave joining employs a 6 kW power supply to generate microwaves. This is about seven times more powerful than a typical home microwave operating at about 600 to 900 Watts. The microwave frequency used is 2.54 GHz which is the same as home microwave ovens.

4.3.5 Characterization

4.3.5.1 Description

Mechanical Testing Capability. Mechanical test equipment includes test frames for performing a variety of tensile and compressive tests on research and fabrication materials ranging from beryllium to uranium. These tests are performed in support of the Sigma Complex missions to perform research, development and fabrication of all non-nuclear materials required for pit support, rebuild, beryllium, stockpile support, surveillance and quality assurance programmatic activities. The types of tests that are supported include elevated temperature, reduced temperature, fracture and fatigue crack growth, impact, drop weight tear, environmental influence on fracture behavior, thermal and mechanical loading, and constant load or constant stress.

Corrosion. A general capability for corrosion characterization and associated studies has and will continue to exist at the Sigma Complex. The metallography laboratory is an important part of characterization.

Powder Characterization Laboratory. The powder characterization laboratory (PCL), located in SM-66, is a service analytical laboratory for powder characterization and thermo-physical characterization. Characterization methods include particle sizing, Brunauer-Emmett-Teller (BET) surface area measurement and isotherms, helium pycnometry, mercury porosimetry, tap, immersion, and bulk densities, x-ray, diffraction, thermogravimetric analysis, differential thermal analysis, differential scanning calorimetry, thermal dilatometry, and evolved gas analysis. The PCL consists largely of the commercial instruments needed to conduct these characterization tests.

Electron and Optical Microscopy Characterization. The Sigma Complex has two scanning electron microscopes (SEMs) used in the characterization of surfaces and chemical composition in the metallography laboratory. In addition, this capability will be upgraded with the purchase of a new electron microprobe. Characterization activities are performed in support of the various welding, forming, joining, and casting operations conducted at the Sigma Complex, as well as in response to miscellaneous requests from throughout the Laboratory.

4.3.5.2 Programs Supported

As indicated in Table 4, characterization supports all programs.

4.3.5.3 Radioactive Materials

A commercial anti-static device is used to release the buildup of static electricity on a high temperature thermogravimetric balance. This device contains a sealed source of polonium 210. In the future, non-destructively temperature tests will likely be conducted on depleted uranium samples.

Mechanical tests will be performed on depleted uranium and uranium alloy specimens. When test are performed, temporary radiologic controlled areas are established and procedures are conducted in accordance with SOP MST-6-66.0001 or its equivalent.

4.3.5.4 Nonradioactive, Toxic, or Hazardous Substances

Several organic solvents are routinely used in the powdered characterization laboratory for tests. These include methanol, ethanol, isopropanol, hexane, heptane, and mineral oils. The Powdered Characterization Laboratory also uses compressed gases to generate specific testing atmospheres. The gases are nitrogen, helium, air oxygen, argon, and 6% hydrogen in argon. Small amounts of inorganic acids are also used, mainly nitric and hydrochloric acids. Liquid mercury is required for the mercury porosimetry.

Mechanical tests will be performed on beryllium and beryllium alloy samples. Procedures will be followed in accordance with SOP MST-6-66.0053 or its equivalent.

4.3.5.5 Hazardous Energy Sources

The powdered characterization laboratory contains thermal analysis instruments utilizing electric furnaces that reach maximum temperatures of either 1200 degrees C or 1600 degrees C. Most furnaces operate with 110 VAC power. The dilatometer furnace operates with 208 VAC 20 Amps, single-phase power. The x-ray diffractometer uses a 40 kV generator to produce an enclosed x-ray beam. The mercury porosimeter generates hydraulic pressures up to 60,000 psi on small mercury samples. The Horiba optical particle sizer contains a low power laser (5 MW HeNe) as part of the commercial unit. Compressed gases (listed above) are used by many of the analytical instruments.

The hydraulic test machines could be considered to pose a hazard if operated improperly. All operators will have the required training in safe machine operation.

4.3.6 Facilities Support

4.3.6.1 Description

The Sigma Complex is an exclusion area within the Laboratory located in TA-3 that includes buildings TA-3-66, TA-3-141, TA-3-35, and several smaller utility and storage structures. The

Sigma Complex is a generator of low-level radioactive, mixed low-level, and chemical waste. The infrastructure and supporting systems at the Sigma Complex are essential for maintaining the operating reliability, safety, and environmental integrity of the site.

The supporting systems for SM-66 include the following:

- A once-through heating and ventilation system for all laboratory areas. Some administration areas have recirculation systems.
- Domestic and industrial water supplies.
- Industrial waste drains are routed to a hold tank and then pumped to the radwaste pipeline system for waste disposal at TA-50-1.
- A pressurized circulating cooling water system.
- Steam supply and condensate return lines.
- Fire protection.
- Natural gas.
- Compressed gases, including argon, helium, and hydrogen.
- Compressed air.

The supporting systems for SM-141 include the following:

- Three separate heating and ventilation system for different parts of the building. A separate HEPA filtration system provides compliance with Federal and State emission standards for beryllium.
- Domestic and industrial water supplies.
- Industrial waste drains are routed to a hold tank and then pumped to the radwaste pipeline system for waste disposal at TA-50-1.
- Two independent cooling water systems for the rolling mill.
- Steam supply and condensate return lines.
- Fire protection.
- Compressed gases, including argon, helium, and hydrogen.
- Compressed air.

The supporting systems for SM-35 include the following:

- The high bay press room has filtered, steam heated air that discharges through Aerosolve 95 filters.
- Once through heating and ventilation system with HEPA filtration for radiation protection on the exhaust.
- A pressurized circulating cooling water system.
- Temperature activated water sprinklers and an integral water-flow activated alarm system.
- Compressed air.

4.3.6.2 Programs Supported

As indicated in Table 4, facilities support is used by all programs.

4.3.6.3 Radioactive Materials

Uranium is present within the facilities infrastructure.

4.3.6.4 Nonradioactive, Toxic, or Hazardous Substances

The support infrastructure contains metals, beryllium, and a host of electroplating chemicals, solvents and chemicals from other metallography and characterization laboratories.

4.3.6.5 Hazardous Energy Sources

Large fans, pumps, and high-energy electrical switching equipment are associated with the building ventilation and safety support systems.

5.0 References

DOE 1993: “Nonnuclear Consolidation Environmental Assessment, Nuclear Weapons Complex Reconfiguration program,” US Department of Energy, DOE/EA-0792, Washington, D.C. (June 1993).

DOE 1996a: “Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management,” US Department of Energy, Albuquerque Operations Office DOE/EIS-0236 (September 1996).

DOE 1996b: “Stockpile Management Preferred Alternative Report,” US Department of Energy, Albuquerque Operations Office, Albuquerque, New Mexico (July 1996).

DOE 1999a: “Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory,” US Department of Energy, Albuquerque Operations Office DOE/EIS-0238 (January 1999).

DOE 1999b: “Record of Decision: Site Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory in the State of New Mexico,” 64FR50797, Washington, D.C. (September 19,1999).

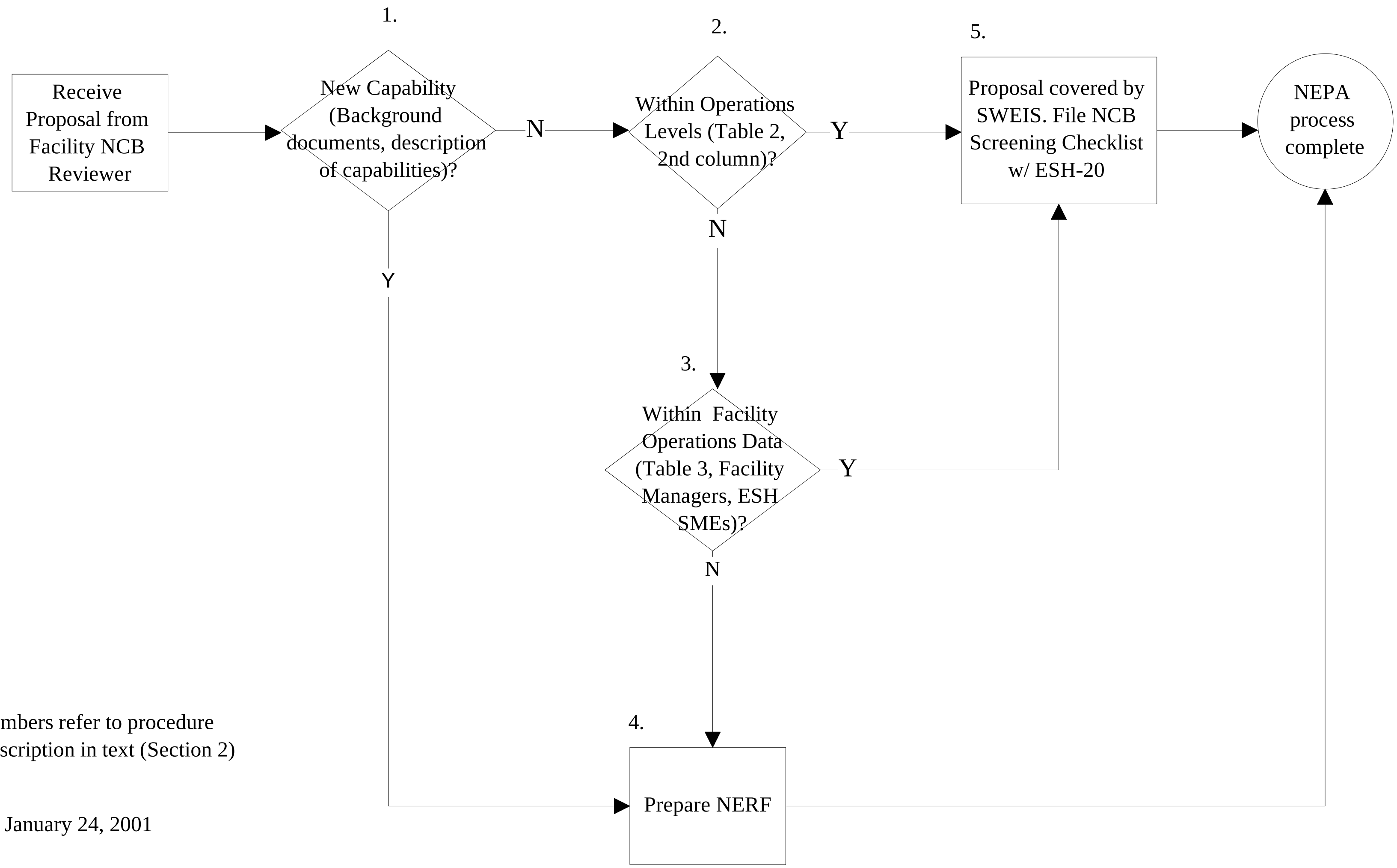
LANL 1996: “Background Information for the TA-3 Sigma Complex for the Site-Wide Environmental Impact Statement,” transmitted to Mr. Thomas Anderson, GRAM, Inc., by Doris Garvey, Project Leader, Site-Wide Environmental Impact Statement (December 2, 1996).

LANL 1999: “SWEIS 1998 Yearbook: Comparison of 1998 Data to Projections of the Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory,” Los Alamos National Laboratory LA-UR-99-6391 (December 1999).

LANL 2000a: “NEPA, Cultural Resources, and Biological Resources (NCB) Process Laboratory Implementation Requirement,” Los Alamos National Laboratory LIR 404-30-02.0 (January 20, 2000).

LANL 2000b: “Facility NCB Reviewer Determination Document 5, TA-03 Sigma Complex.”

Attachment 1. ESH-20Screening Flow Chart



Numbers refer to procedure description in text (Section 2)

January 24, 2001

Attachment 2: NCB Screening Checklist

REVIEWER: DATE:

PROJECT TITLE:

PROJECT IDENTIFIER/Reference No:

DESCRIPTION/Comments:

Air or water emissions to environment: Yes ☐ No ☐
Describe issue or resolution:

LOCATION: FMU No: FMU No:

TA:__ Building:_____ TA:__ Building:_____ TA:__ Building:_____
TA:__ Building:_____ TA:__ Building:_____ TA:__ Building:_____
Other: _____

CRITERIA:

2a. 1. Schedule or location modified to avoid T&E concerns?	Yes ☐	No ☐
2. After project modification is there an unresolved T&E issue?:	Yes ☐	No ☐
3. For T&E <u>buffer</u> areas, map of project footprint is attached or has been sent to ESH-20?	Yes ☐	No ☐
2b. Floodplain issue:	Yes ☐	No ☐
2c. Wetland issue:	Yes ☐	No ☐
Wetland BMPs implemented?	Yes ☐	No ☐
2d. Modifications to a historic building:	Yes ☐	No ☐
2e. Archaeological resources affected:	Yes ☐	No ☐
Sites within project area were avoided (notify ESH-20 and provide map):	Yes ☐	No ☐

3a. NEPA Documentation:

CX (specify): LAN-__-_____ LAN-__-_____

Site-wide EIS (specify): Facility NCB Document No.: _____ Operations Level (Use Table 2): _____

3b. Conditions that preclude a cx or SWEIS reference:

Connected action:	Yes ☐	No ☐
Extraordinary circumstances	Yes ☐	No ☐
Siting/expansion - Treatment, Storage, Disposal facility?	Yes ☐	No ☐
Uncontrolled releases of contaminants	Yes ☐	No ☐

Reviewed by ESH-20 NCB staff:

NEPA:	Name	Date	Comment:
Biological Resources:	Name	Date	Comment:
Cultural Resources:	Name	Date	Comment:
Other:	Name	Date	Comment: