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## **A Guide for Preparing Safe Operating Procedures (SOPs)**

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A GUIDE FOR PREPARING SAFE OPERATING PROCEDURES (SOPs)

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ABSTRACT

Sandia National Laboratories' Safe Operating Procedures are written for activities that involve the use of explosives, dangerous chemicals, radioactive materials, hazardous systems, and for certain types of operational facilities which present hazards. This guide states SOP requirements for Sandia Livermore in detail and gives a format for writing an SOP.

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## A GUIDE FOR PREPARING SAFE OPERATING PROCEDURES (SOPs)

### Introduction

A Safe Operating Procedure (commonly known as an SOP) is a written plan of a project, test, or experiment that assesses its potential hazards and explains how the hazards have been eliminated or minimized. The SOP is prepared to assure maximum safety in tests and operations involving explosives, gases under pressure, radioactive and toxic materials, special nuclear materials, or any other potentially hazardous activities. As a written document the SOP permits management to review and approve a somewhat detailed plan of an experiment based on the experimenter's assessment of the associated risks. It also permits Hazards Control Division specialists to review the plan and to suggest modifications that would better control possible health and safety hazards.

This guide states the requirements for an SOP and gives a format for the information it should contain. Details of the review procedure are included, from initial draft to annual review. There is also a short paragraph on a closely related subject, the disposal of hazardous materials from an experiment. Questions concerning any of these may be directed to the Hazards Control Division.

### Operations Requiring an SOP

The following two publications state the safety policy of Sandia National Laboratories:

1. Industrial Safety, Fire Prevention and Environmental Health Manual, SC-M-70-889
2. Pressure Safety Practices Manual, SAND76-0424 (Revised)

An SOP should be considered for each SNLL-controlled operation with a potential risk for causing injury to personnel or damage to property. The necessity for an SOP is determined jointly by the division supervisor responsible for the test or procedure and Hazards Control personnel. Examples of the types of operations requiring an SOP include:



- experiments involving high-pressure gas systems;
- experiments with high-energy electrical systems (large current, high magnetic fields, high-energy storage, high voltage in a vacuum, etc.);
- use of ionizing and nonionizing radiation (Class IIb and Class IV lasers always require an SOP);
- machining pyrophoric materials;
- operation of accelerators; experiments with toxic materials, radioactive materials, liquid alkali metals, or thermite;
- all projects involving explosives.

The SOP is required by DOE 5480.1 for radiation experiments. Army Material command manual 385-100 is the accepted DOE guidance for the use of explosives.

Organizations planning tests involving any of these or other hazardous activities should contact Hazards Control Division early in the planning phase of the activity.

### Procedures and Approvals

The person responsible for the project, test, or experiment prepares the SOP and submits it in typed, rough draft form to the concerned divisions for their review and concurrence and then to the Hazards Control Division for review. The final draft must be approved by the supervisor of each division involved and acknowledged by other personnel assigned to the project. The final document is then submitted to the Hazards Control supervisor for approval. Operations may not start until all approvals have been obtained. Ten days to two weeks should be allowed for the drafts to be circulated, reviewed, and signed.

Copies of the approved SOP should be distributed to all those responsible for seeing that the SOP is followed, and two copies should be sent to the Hazards Control Division. Note: The project division, not Hazards Control, is responsible for typing and distributing all the drafts and the approved SOP.

SOP's which describe explosive experiments require both line supervisor and department manager approval in addition to Hazards Control supervisor approval and the acknowledgments. However, the line supervisor or Hazards Control may request department approval on any experiment.

When division supervisors are reassigned, a new signature page should be prepared and then signed by them. Newly assigned personnel should sign the signature page with an acknowledgment.

Procedural disagreements are resolved by Hazards Control. When such disagreements occur, all operations are discontinued until a satisfactory compromise is accepted by all parties. The line supervisor is ultimately responsible for the safety of an operation.

### Control Numbers

The Hazards Control Division assigns a control number to each SOP, which the SOP retains throughout all revisions. A revised SOP is identified by its control number, a revision letter, and the date of the revision. The original date should be used if a revision does not exist.

#### Examples:

SOP-SNLL-886 Jan. 4, 1981	(New SOP)
SOP-SNLL-886 Revision C, Feb. 11, 1981	(Revised SOP)

### Types of SOP's

#### A. Facility SOP

The facility SOP usually provides only a general assessment of hazards at the facility. Individual operations at or in the facility may also require a specific SOP. Hazards associated with individual operations may have unique conditions which need to be assessed.

#### B. General Hazard SOP

This type of SOP is used to review the hazards and establish safe operating procedures for generic operations or activities.

#### C. Specific SOP

An SOP of this type describes the hazards and safe operating procedure for a specific experiment. Most SOP's at SNLL are of this type. They are usually one-of-a-kind activities.

## Annual SOP Review

An annual review of all current SOP's is performed by the using organization, together with Hazards Control, to make any necessary revisions (see Industrial Safety, Fire Prevention and Environmental Health Manual, SC-M-70-889, page 1-2D). Originating organizations are notified by Hazards Control, usually during the month the review is due. The yearly review provides the opportunity to add and delete participants, change division numbers if required, and generally update the SOP to reflect the current status. Whether new signatures should be acquired when updating the SOP is at the discretion of the division supervisor. Operators are expected to review the SOP periodically although a signature is not required.

Hazards Control maintains records to validate that a review was performed. This may only consist of a form letter attesting to review and signed by the line supervisor and Hazards Control consultant.

When a project or experiment is completed and the SOP is no longer needed, the SOP should be cancelled by notifying the Hazards Control Division. Obsolete SOP's are maintained in file for three years. During that period of time they may be reactivated.

## Disposal of Hazardous Waste

Arrangements should be made to dispose of hazardous materials that are by-products of the project or experiment. Hazards Control Division is responsible for waste disposal, but the project division should identify all materials chemically and by the location where they were produced. Examples of hazardous materials are solvents with flash points less than 140°F, photo laboratory chemicals, paints, chemicals, explosive debris (unexploded test parts), vacuum pump oil contaminated with metallic residue or chemicals, expended batteries, etc.

## Guidelines for Format and Content

The generic SOP consists of the following sections:

- I. Introduction
- II. List of Responsible Personnel
- III. Hazards Assessment
- IV. Hazards Control
- V. Emergency Procedures
- VI. Test Sequence or Assembly Procedure
- VII. Exhibits
- VIII. References
- IX. Appendices
- X. Signature Page

Sections I - VI and X are required for every SOP; Sections VII - IX are optional.

The content guidelines below are written in the same format the SOP should have. For further guidance copies of SOPs are available from Hazard Control.

SOP-SNLL-XXXX Month-Day-Year (date of this version)

FOR

(TITLE OF OPERATION)

## I. Introduction

In the opening section write an overview of the test or operation. Include the scope of the SOP, purpose of the test, results expected, requirements governing activities at other locations, SOP review requirements.

### Examples:

- A. Brief description of test, process, or operation and the objectives.
- B. Location of the assembly, test, or operation.
- C. Organizations involved (number and name). Other governmental and manufacturing participants, if any.

In preparing the introduction, remember that some of your audience will be unfamiliar with the background, objectives, and purposes of the experiment. Failure to be complete reduces the probability that your SOP can be reviewed with understanding.

## II. Responsible Personnel

List persons who will be responsible for seeing that all provisions of the SOP are observed (project leader, range officer, technician, etc.). Name those approved to handle explosives and other hazardous materials and equipment. Include a paragraph which states that the authorized persons have read the SOP, understand it, and will work within its constraints.

## III. Hazards Assessment

List the types and sources of hazards and associated hazardous characteristics of materials and equipment (consider impact on environment):

- A. Toxic: Chemicals, solvents, mixtures, acids, caustics, vapors, gases, airborne pollutants, reactions with other materials, etc. (Refer to Environmental Health Section of SC-M-70-889.)
- B. Flammables and Combustibles: Liquids, vapors, gases, fibers, dusts, and compounds, etc. (Refer to Fire Prevention Section of SC-M-70-889.)

- C. Explosives (includes high explosives, propellants, ammunition, pyrotechnics, and chemical explosives): Nomenclature, types, sizes, weights, combinations, sensitivity, chemical and/or physical description, mechanical functions and electrical characteristics (electrostatic) etc. (Refer to Explosives portion of Industrial Safety Section of SC-M-70-889.)
- D. Missiles: Fragments, pellets, rocks, dust particles, bullets, blanks, etc.
- E. Pressure: Overpressure, blast pattern, shrapnel, high velocity jets, compressed gases/liquids, etc. List appropriate pressure safety analysis reports (PSARs) if not listed in the Reference Section. (Refer to the Pressure Safety Practices Manual, SAND76-0424 (Revised). Consult your pressure advisor.)
- F. Temperatures: Low temperatures, high temperatures, heat caused by burned fuel, solar, or electricity, steam, etc.
- G. Equipment: Moving parts, blades, chains, etc.
- H. Material: If material compatibility is an important feature of the system, include details of materials to be used and why, etc.
- I. Electrical: Static charge, capacitors, arcing, etc.
- J. Radiation (ionizing and nonionizing), radioactive material, lasers, microwaves, ultraviolet light.
- K. Noise, etc.

#### IV. Hazards Control

In this section elaborate on the preceding section by describing the interlocks, enclosures, monitors, factors of safety, compatibility considerations, shielding ventilation etc., that have been incorporated into the experiment to eliminate or minimize the hazards. Explain (1) how all the hazards mentioned in the Hazards Assessment section have been anticipated or circumvented, and (2) why there is no risk or how the risks have been minimized by the use of administrative controls. Point out the factor of safety (F/S) of the pressure vessels. If engineered safety features (e.g., warning lights) or administrative access control procedures will be used, describe the system and explain how administrative control will minimize risks. Include a schematic flow diagram of systems handling toxic or flammable materials or operating at high pressure. Show values, pressures, engineered safety features, materials etc.

- A. General: Handling, transportation, and storage procedures; load limits, limitations on buildings, storage period, personnel limits, safe separation distances, etc.



- B. Grounding: Static electricity, electric tools, test equipment, correct polarity, use of Ground Fault Circuit Interruptors, etc.
- C. Special Precautions: Precautions unique to the hazardous materials used such as handling, environment, temporary storage, surveillance, containment fixtures, missile barriers, leak testing, etc.
- D. Special Equipment: Special assembly and handling fixtures, special tools, gauges, wrist straps, fire extinguishers, ladders, scaffolds, etc.
- E. Testing Equipment: An Alinco Igniter Circuit Tester should be used to check electric explosion devices unless other equivalent devices are authorized for use.
- F. Personal Protective Gear: Clothing (arctic, tropic, underground, laboratory), glasses, face shields, breathing apparatus, dosimetry hearing protective devices, etc.
- G. Environment: Overhead electrical wires, safe separation distances, shock waves, noise, toxics, nonionizing and ionizing radiation, aircraft, heat, cold, dust, wind, solar reflection, etc.

#### V. Emergency Procedures

Procedures should be described for corrective actions to be taken in the event of emergencies, technical mishaps, accidents, misfires, aborts, equipment and power failures, earthquakes, etc. As a reminder to involved personnel, state that a telephone call on the SNLL emergency number 2-2222 notifies Security, Medical, and Hazards Control; that in the event of a fire, a call on the emergency number can notify the LLNL Fire Department by a request to the Security person answering the phone; and that a pull box, if located nearby, can be used to notify the LLNL Fire Department.

#### VI. Test Sequence or Assembly Procedure

This may be the most difficult part of an SOP to convey to the reviewers. The key is to remember that your readers will normally consist of a Hazards Control consultant (Industrial Hygienist, Health Physicist, Fire Marshall, or Safety Engineer) and his division supervisor, your division supervisor, operators, and perhaps a department manager. Assume that some of these individuals may not have a prior technical and scientific understanding of the project. Describe step by step the procedures to be carried out during the test, in a manner that someone unfamiliar with the test can understand. Omit details that do not contribute to the understanding of the test.

## VII. Enclosures

Exhibits, which are usually numbered, may be grouped in the "Exhibit Section," or placed throughout the text immediately after the point where they are mentioned. Exhibits and illustrations generally are used to clarify or demonstrate certain points in the procedure. They also may be used as references. They may include schematics, flowcharts, figures, documents, graphs, photographs, letters and memos, maps, and tables.

## VIII. References

Indicate the old SOP Number if this SOP supersedes another. List associated SOP's, if any. Reference appropriate DOE, Military, or Sandia National Laboratories manuals, Pressure Safety Analysis Reports, directives, standards, engineering drawings, specifications, source documents, equipment manuals, manufacturers' manuals, etc. Since an SOP is a working document, it is preferable that references be a separate section, rather than appear as footnotes. Pertinent abstracts of other source documents can be made appendices of the SOP or, if appropriate, they may be included in the SOP itself.

## IX. Appendices

Appendices, which are usually lettered, include supplemental information too detailed or lengthy to be included in the main body of the text.

## X. Signatures

Every SOP needs a signature page or pages.

Your division supervisor is directly responsible for the safety of the individuals involved. His signature signifies that he agrees to the plan and approves of the risk control methods described in your SOP. If individuals from several organizations are involved in an experiment, each person's division supervisor must review and approve the SOP.

The Hazards Control Division supervisor's signature indicates his review and approval.

Your department manager's signature is also required when explosives are involved or at the request of your division supervisor or the Hazards Control Division supervisor.

As an indication that the SOP has been reviewed and understood, remember to include the signatures of those directly involved in the experiment i.e., the experimenter, the Certified Pressure Installer, test coordinators, and operators.

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