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Style, Content and Format Guide for Writing Safety Analysis Documents

Volume 2: Safety Assessment for DOE Non-Nuclear Facilities

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STYLE, CONTENT AND FORMAT GUIDE FOR WRITING SAFETY ANALYSIS DOCUMENTS

Volume 2: Safety Assessment Reports for DOE Non-Nuclear Facilities

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Abstract

The *purpose* of Volume 2 of this 4-volume style guide is to furnish guidelines on writing and publishing Safety Assessment Reports (SAs) for DOE non-nuclear facilities at Sandia National Laboratories. The *scope* of Volume 2 encompasses not only the general guidelines for writing and publishing, but also the prescribed topics/appendices contents along with examples from typical SAs for DOE non-nuclear facilities.

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ACKNOWLEDGMENT

This document is intended to be a resource for preparers and writers of safety documentation for Sandia National Laboratories' non-nuclear facilities. Technical contributions were made by J. Mahn, R. Silver, Y. Balas (ESI) and W. Gilmore (ESI).

PREFACE

This Volume 2 is the second of four volumes that comprise the *Style, Content and Format Guide for Writing Safety Analysis Documents*. The four volumes that comprise the Guide series are as follows:

- Volume 1: Safety Analysis Reports for DOE Nuclear Facilities (SAND93-7047/1)
- Volume 2: Safety Assessment Reports for DOE Non-nuclear Facilities (SAND93-7047/2)
- Volume 3: Safety Analysis Documents for DOE Accelerator Facilities (SAND93-7047/3)
- Volume 4: Safety Analysis Documents for DOE Environmental Decontamination, and Decommissioning Activities (SAND93-7047/4)

NOTE: Volumes 3 and 4 will be developed when appropriate guidance is issued on the format and content of safety analysis documents for accelerator facilities, and environmental restoration, decontamination, and decommissioning activities.

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GLOSSARY OF TECHNICAL TERMS

<u>Term</u>	<u>Definition</u>
Authorization Basis	Those aspects of a facility design basis and operational requirements relied upon by DOE to authorize facility operation. The authorization basis is described in documents such as the facility Safety Analysis Report and other safety analyses; hazard classification documents; Technical Safety Requirements, Technical Specifications or Operational Safety Requirements; Basis for Interim Operation; DOE-issued safety evaluation reports; and facility-specific commitments made in order to comply with DOE orders or policies.
ALARA	As Low as Reasonably Achievable.
DBA	Design Basis Accident - An accident postulated for the purpose of establishing functional requirements for safety-related structures, systems, components, and equipment.
DBE	Design Basis Earthquake.
D&D	Decontamination and Decommissioning.
ESF	Engineered Safety Feature.
HRA	Human Reliability Analysis.
NEPA	National Environmental Policy Act.
OBE	Operating Basis Earthquake.
ORPS	Occurrence Reporting and Processing System.
SA	Safety Assessment - A report documenting the adequacy of safety analysis for a nuclear facility to ensure that the facility can be constructed, operated, maintained, shut down, and decommissioned safely and in compliance with applicable laws and regulations.
SOP	Safety Operating Procedures.
SPMS	Safety Performance Measurement System.

GLOSSARY OF TECHNICAL TERMS (CONTINUED)

<u>Term</u>	<u>Definition</u>
SSCs	Structures, Systems, and Components.
UBC	Uniform Building Code.
USGS	United States Geological Survey.
Verification	The Act of confirming, substantiating, and assuring that an activity or condition has been implemented in conformance with specified requirements.
Validation	Assurance that an activity or task has correctly achieved its intended purpose or objective.

CHAPTER 1

GENERAL GUIDANCE ON SNL SAFETY ASSESSMENT REPORTS

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CHAPTER 1: GENERAL GUIDANCE ON SNL SAFETY ASSESSMENTS

1.1 INTRODUCTION

SAs must not only provide required technical content, but must present it in a high-quality style.

The SA format selected for SNL non-nuclear facilities is the prerogative of the author.

Style guide objectives are designed to lead to high-quality SAs that warrant DOE approval.

Personnel assigned to develop data for safety assessments (SAs) for DOE non-nuclear moderate hazard class facilities at Sandia National Laboratories (SNL) must be familiar with the guidelines governing the required technical content for SAs. Often overlooked, however, is the importance of presenting this technical content in a **style** that simplifies the DOE review process and facilitates DOE approval. SNL is therefore issuing this Volume 2 style guide to help avoid nonapproval of SAs due to stylistic shortcomings.

The format used in this style guide is acceptable for SNL non-nuclear facility SAs. However, this format should not be viewed as "required." Preparers and writers should consult other applicable documents, such as DOE/AL5481.1B, and the Risk Management and NEPA Department before deciding on the best format to use. Achieving consistency among SNL non-nuclear facility SAs is a desirable goal; however, the format chosen for the SA is the prerogative of the author and is subordinate in importance to document content.

1.2 OBJECTIVES

The objectives for *Volume 2: Style Guide for Writing Safety Assessments for DOE Non-Nuclear Facilities* are:

1. Help SNL personnel prepare and write SAs that meet not only DOE-required content guidelines but also state-of-the-art stylistic standards;
2. Provide guidance on applying the *graded approach* to determine the content of an SA; and
3. Establish consistent style and format to facilitate development of SNL safety documents and their internal review and approval.

SAs that reflect the standards fostered by these objectives are more likely to achieve DOE approval than those that do not reflect these standards.

1.3 SCOPE

Volume 2 encompasses four chapters that contain general and specific information to help writers prepare SAs.

The focus in Volume 2 is on stylistic instructions rather than on technical content. Volume 2 does contain technical content of the kinds prescribed by federal reference documents and normally found in SAs. However, this technical material is generally not as detailed as that found in guidance documents that specifically focus on SA technical content requirements. The technical content presented is used mainly to provide instructions about documentation **style** techniques.

Volume 2 consists of four major chapters:

1. Chapter 1 — General Guidance on SNL Safety Assessments. This chapter contains information on the general philosophy of Volume 2 and establishes the bases for using this guide.
 2. Chapter 2 — Contents of SNL Non-Nuclear Facility Safety Assessments. This chapter offers guidance to help preparers and writers of SAs to:
 - Provide technical content in the topic format prescribed in DOE/AL Order 5481.1B including application of the graded approach, and
 - Display the technical content in a way that meets state-of-the-art stylistic standards easily achievable using available computer software.
 3. Chapter 3 — Publications Guidelines for SNL Safety Assessments. This chapter has guidance on preferred grammar, style, format, and desk top publishing techniques.
- NOTE: Stylistic standards are based on *Shipley Associates Style Guide*, Revised Edition, reprinted 1992.**
4. Chapter 4 Appendices. This chapter explains the contents of appendices that need to be included in the document.

1.4 REFERENCE DOCUMENTS

Various statutes, rules, and regulations govern the safety basis and operation of non-nuclear facilities.

Preparers of SAs must become familiar with the various statutes, rules, and regulations governing the safety basis and operation of a non-nuclear facility.

NOTE: Throughout this style guide, the word "facility" refers to a facility, process, or operation.

Referencing of applicable codes, standards, DOE orders, and other safety requirements made law by federal state, and local governments along with citation in SAs of site-specific or facility-specific policies and procedures are thereafter considered to be *commitments* by the facility owner/operator to the regulating agency. Therefore, such references and citations must be well-focused and limited to specific aspects related to control of the hazards or operational safety issues at the site or facility.

Each chapter of an SA should contain its own reference section. Also, the SA should contain a **master cross-reference matrix** that links references noted in SAs to the references cited.

Safety-related documentation referenced in the SA should fall under the same document control system as the SA. The objective is to ensure that any changes to references will be evaluated in the same depth as the SA itself.

SA management should include an administrative record of supporting SA documentation to ensure that all applicable documents are reviewed in order to determine the impact of a change.

Site-specific support documents (e.g., policies, procedures, or documents involving data applicable to multiple facilities) may be referenced in a SA. These then become subject to the same review and update requirements as the facility SA.

1.4.1 Reference Documents for General Safety Guidance

The main federal reference documents governing non-nuclear facility safety are:

DOE 4330.4A
DOE 5000.3B

The two federal documents providing primary general guidance on content and preparation of SAs for non-nuclear facilities are the latest issues (including all changes, attachments, and memoranda) of:

<u>Document</u>	<u>Title</u>
DOE Order 5481.1B	<i>Safety Analysis and Review System</i>
AL Order 5481.1B	<i>Safety Analysis and Review System</i>

DOE 5400.3
 DOE 5480.11
 DOE 5480.19
 DOE 5480.28
 DOE 5481.1B
 AL 5481.1B
 DOE 5500.1B
 DOE 5500.2B
 DOE 5500.3A
 DOE 5820.2A
 29 CFR 1910.119
 29 CFR 1910.120

1.4.2 Reference Documents for Secondary Safety Guidance

The federal documents providing nuclear facility safety requirements are the latest issues (including all changes, attachments, and memoranda) of:

<u>Document</u>	<u>Title</u>
DOE Order 4330.4A	<i>Maintenance Management Program</i>
DOE Order 5000.3B	<i>Occurrence Reporting and Processing</i>
DOE Order 5400.3	<i>Hazardous and Radioactive Mixed Waste Program</i>
DOE Order 5480.11	<i>Radiation Protection for Occupational Workers</i>
DOE Order 5480.19	<i>Guidelines for the Conduct of Operations at DOE Facilities</i>
DOE Order 5480.28	<i>Natural Phenomena Hazards Mitigation</i>
DOE Order 5481.1B	<i>Safety Analysis and Review System</i>
AL Order 5481.1B	<i>Safety Analysis and Review System</i>
DOE Order 5500.1B	<i>Emergency Management System</i>
DOE Order 5500.2B	<i>Emergency Categories, Classes, and Notification and Reporting Requirements</i>
DOE Order 5500.3A	<i>Planning and Preparedness for Operational Emergencies</i>
DOE Order 5820.2A	<i>Radioactive Waste Management</i>
29 CFR 1910.119	<i>Process Safety Management of Highly Hazardous Chemicals</i>
29 CFR 1910.120	<i>Hazardous Waste Operations and Emergency Response</i>

Structure the SA on a "graded approach" rather than on an encyclopedic approach, present only relevant data, and cover generic subjects briefly.

The graded approach selected depends on the magnitude of the consequences of the identified hazards.

The graded approach to be taken also depends on the complexity of the facility.

1.5 GRADED APPROACH

Those who prepare information for SAs should keep in mind the graded approach concept. The level of effort, sophistication of analysis, and thoroughness of documentation should be graded or proportioned commensurate with:

1. The magnitude of the consequences that may be realized from identified hazards;
2. The complexity of the facility and the safety systems relied upon to maintain an acceptable level of risk; and
3. The stage of the facility life cycle.

The graded approach also includes consideration of the following:

- Relative importance to safety, safeguards, and security;
- Programmatic mission of the facility; and
- Any other relevant issues.

1.5.1 Magnitude of Consequences of Identified Hazards

Regarding item 1 above, the graded approach means that the greater the potential consequences, the more penetrating, thorough, and well-documented the analysis must be. For facilities involving only modest hazards, analysis may be relatively simple.

1.5.2 Complexity of Facilities and Safety Systems

Per Item 2 above, examples of **highly complex** facilities include:

- Facilities having many interdependent components or systems, and
- Fluid flow processes having extensive instrumentation and control systems or significant system and component redundancy.

These highly complex facilities require extensive analysis and documentation to address all safety issues.

Examples of **moderately complex facilities** are characterized by such processes as:

- Solids handling activities (machining, assembly, etc.) of simple unit movement from one discrete step to another, and
- Research and development operations involving a variety of simultaneous activities.

Examples of **low-complexity facilities** are:

- Vaults, waste storage tanks, etc. not routinely involving hazardous material processing operations, and
- Laboratories processing only a few simple analyses.

Low-complexity facilities generally require only minimal analysis and documentation to adequately address all safety issues.

1.5.3 Stage of Facility Life Cycle

Regarding item 3 above, application of the graded approach to account for facility life cycle involves consideration of three kinds of facilities:

1. New facilities;
2. Operational facilities with expected long remaining lifetimes; and
3. Operational facilities with expected near-term end of operations and closure.

In preparing an SA for an operating facility with an expected long remaining lifetime, writers should focus on continued maintenance of operational safety. A detailed account on the commitments to completed phases of the facility life cycle is not necessary, except where the details are needed to support current and expected safety decisions.

The focus for a short-term facility is on safety during phase-out. For an existing facility where operations will be curtailed in the short term, the SA must contain at least the minimum information necessary to demonstrate operational safety during the phasing out of operations.

The graded approach to be taken may also stem from the current stage of a facility's life cycle.

The focus for a facility with a long life cycle is on continuing safety.

For a permanently shutdown facility, SA preparers must address the safety of decommissioning activities and programs.

NOTE: The graded approach selected per the above guidelines must also consider the relative importance of safeguards, security, and the programmatic mission to the overall safety of the facility.

1.6. GENERAL INSTRUCTIONS FOR WRITING SNL SAs

General instructions are based on becoming familiar with the entire Volume 2 style guide. However, in this Chapter 1 section, preparers and writers of SAs may find helpful the outline suggested for presentation of SA chapter data. Readers also may find value in the subsection presented on presentation of visual aids (figures, tables, pictures, etc.).

1.6.1 Familiarization with Style Guide

To prepare, write, and publish an SA properly, become familiar with the information contained in this style.

Those assigned to prepare, write, and publish SAs should first become familiar with DOE Order 5481.1B, AL Order 5481.1B and with the general philosophy provided in Chapter 1 of this style guide. Then, consult the specific style information relating to the DOE-required topics addressed in Chapter 2, the publications guidelines provided in Chapter 3, and finally appendices as discussed in Chapter 4.

Chapter 2 focuses on stylistic treatment of the topics the DOE requires to be included in SAs.

Chapter 3 provides general publication guidelines for SAs.

Chapter 4 identifies the appendices and their contents.

Consult guidance provided in DOE Order 5481.1B and AL Order 5481.1B for more detailed instructions on required SA technical content.

Preparers and writers of SAs should keep in mind that this Volume 2 is primarily a style guide rather than a comprehensive guide to the SA technical content required by DOE. This style guide presents technical content while stressing the **style of presentation** of the technical content. The technical content instructions are extensive, but may not be as detailed as other available guidance such as that provided in DOE Order 5481.1B and AL Order 5481.1B. SA preparers and writers should consult these documents to ensure effective early planning.

1.6.2 Sequence Outline for Presentation of Data

The outline selected for SA chapters should be used consistently for each chapter, and it should present the most important data first, and only then the supporting data.

Effective style also requires consistent use of the same format for each chapter in the SA.

SA information too often tends to be haphazardly presented. Although the data, results, and conclusions presented may be scientifically sound, an inconsistent format and style of presentation among the SA topic chapters soon distract the reader.

For example, issues may be presented in one chapter but not in another. Or, objectives and scope may be presented for one DOE-required topic but not for another topic. Presentation of the results (noninterpretative) may be mistakenly presented as conclusions (interpretative).

The format selected should present the most important ideas first (i.e., issues, requirements, objectives, and scope), then present the supporting and summarizing information. In this way, readers will be aimed at the beginning of the SA toward the writer's desired direction, and they will be more accepting of important findings, results, and conclusions detailed later in the SA.

Some readers are interested only in any conclusions presented in the SA.

Any conclusions to be presented also should be summarized up front. Some readers are interested **only** in the conclusions. These readers dislike searching the entire document to find conclusions at least "summarized" up front, even if they presented in depth later in the document.

Building SA chapters in this way is the best format for starting and guiding the reader in the desired direction. This kind of organization makes complex data and results seem more **connected** to the objectives and scope and thus more **logical**. Without it, the reader might not see where the SA data and results are leading, and any findings and conclusions presented may actually surprise rather than convince the reader.

1.6.3 Treatment of Visual Aids

Drawings, figures and tables should be

Treatment of visual aids in SAs is very important. Visual information should be designed to "stand alone" independent of the text. How to

designed to “stand alone” independent of the SA text.

present visual information is covered in detail in Chapter 3, but some general guidelines are summarized here as follows:

- Simplify the drawings and art work by showing only the necessary information.
- Provide a reference number and a title in bold type for each visual aid (drawing, figure, table, art work) presented.
- Add an explanatory caption in italics after each visual title (as is done in this style guide).
- Reference the visual aids by consecutive numbers, based on each chapter, in the text in the SA.
- Connect all visual aids presented by providing explanations in the text.

NOTE: Consult *Shipley Associates Style Guide*, Revised Edition, reprinted 1992, for detailed guidance on how to present visual information.

See Glossary of Technical Terms for definitions of acronyms.

1.6.4 Use of Acronyms

Definitions of acronyms (e.g., SNL is the acronym for Sandia National Laboratories) that may be used in SAs are given in the *Glossary of Technical Terms*. (See Table of Contents for page number where this glossary may be found.)

Generally, adhere to the following guidelines when using acronyms in SAs:

- Preferably, use the complete name the first time the subject is mentioned in the text, and follow that with the acronym given in parentheses. Or, the acronym may be noted first, followed by the definition in parentheses.

NOTE: Be consistent throughout the SA. Do NOT vary the style for presenting and defining acronyms.

General rules for using acronyms.

- After presenting and defining the acronym, the acronym alone may be used thereafter.
- Re-identify the acronym when not doing so would lead to confusion or reader delay.

Following are examples of a typical application of the above guidelines:

Example 1
Present the term
then the acronym.

This section is an overview of Sandia National Laboratories (SNL) noise sources. However, except for noise baseline data collected for the Albuquerque International Airport (AIA), existing data are limited. SNL has not monitored noise onsite to date, but the international airport data may be applicable.

Example 2
Present the acronym
then the term.

This section is an overview of SNL (Sandia National Laboratories) noise sources. However, except for noise baseline data collected for the AIA (Albuquerque International Airport), existing data are limited. SNL has not monitored noise onsite to date, but the international airport data may be applicable.

CHAPTER 2

CONTENTS OF SNL NON-NUCLEAR FACILITY SAFETY ASSESSMENT REPORTS

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CHAPTER 2: CONTENTS OF SNL NON-NUCLEAR FACILITY SAFETY ASSESSMENTS

Chapter 2 provides guidance to preparers, and writers of SAs at SNL on presenting required SA technical content in the topic format required by the DOE.

The style of presentation may be the deciding factor in DOE approval of SAs.

See Chapter 1, Section 1.4 for general guidelines for referencing documents in SAs.

2.1 INTRODUCTION

This Chapter 2 contains guidance on the preferred presentation style for technical content of SAs. Chapter 2 is designed around the topic format required by the DOE for technical content presentation in SAs. Some guidelines presented in this Chapter 2 refer to guidelines given in Chapter 1.

NOTE: Before acting on the guidelines given in this Chapter 2, please study the general introductory guidelines given in Chapter 1.

As noted in Chapter 1 of this style guide, the style of presentation reflected in an SA may be the deciding factor in SA approval or rejection by the DOE. Presentation style can create a good impression, or, if the style is faulty, can convey the impression that data, results, conclusions, or recommendations displayed are questionable and perhaps lack validity. An adverse effect of style may well lead the DOE to withhold SA approval.

Effective application of state-of-the-art style techniques to SAs is an attainable goal and a sure way to encourage DOE approval. Planners, preparers, and writers of SAs at Sandia National Laboratories should therefore become adept in applying the style guidelines suggested throughout this chapter. This information is intended to simplify the DOE review process and facilitate DOE approval of SAs.

2.1.1 Regulatory Basis and Reference Documents

The main documents that establish the basis for non-nuclear facility SAs are:

- DOE Order 5481.1B, Safety Analysis and Review System
- DOE/AL Supplemental Order 5481.1B, Safety Analysis and Review System

In addition, the following documents contain information relevant to preparation and documentation of non-nuclear facility SAs:

- ES&H Manual Supplement GN470083, An Introduction to the Fundamentals of Safety Analysis
- SAND95-0320, Qualitative Methods for Assessing Risk
- SAND94-0920, Generic Safety Documentation Material

See Section 1.4.

Chapter 1, Section 1.4 presents information on how to reference documents in SAs.

2.1.2 SA Purpose

Primary purpose of a SA.

The primary purpose of an SA is: **To document the mission of a moderate hazard DOE non-nuclear facility, operation, or process, the intended conduct of operations, and the safety evaluations performed to determine if the facility, operation, or process can be built, operated, and maintained without undue risk to the health and safety of the public and workers, and without significant impact on the environment, or potential risk of program disruption, or economic loss.**

The SA has the following supporting purposes:

Supporting purposes of an SA.

- To be the principal document that identifies the significant hazards and potential accidents associated with a non-nuclear facility and its systems, components, equipment, or structures;
- To establish the design and operational means to mitigate the significant hazards and potential accidents; and
- To define the safety basis, document the logic of its derivation, demonstrate adherence to the safety basis, and justify its adequacy.

The SA must be detailed enough to lead a knowledgeable reader to a conclusion that the facility/operation/process can be built, operated, and maintained with an appropriate degree of safety.

Therefore, the SA information must be accurate about current operations, up-to-date about the state of the technology, and organized in a format that provides easy access to this information.

The individual responsible for the SA should periodically review and update the SA, as necessary, to ensure it reflects the current state of the facility, operation, or process.

2.1.3 SNL Objectives

SNL objectives of interest to the SA writer are the SA objectives and this style guide's Chapter 2 objectives.

2.1.3.1 SA Objectives

SAs provide the bases for DOE approval of new moderate hazard, non-nuclear facilities and operations, and major modifications to existing facilities and operations.

NOTE: Throughout this style guide, the word "facility" refers to a facility, process, or operation.

The objectives of an SA are as follows:

1. Establish the safety basis of a facility.
2. Document the results of a safety assessment of the design, construction, and operation of a facility.
3. Define the performance capabilities of structures, systems, components (SSCs), equipment and personnel.
4. Justify the ability of the SSCs and personnel to perform their intended safety functions under normal, abnormal, accident, and specified failure conditions.
5. Define, through analysis, those SSCs/activities that impact safety.
6. Provide guidance for setting maintenance standards and developing operating procedures for a facility.

SA objectives are formulated to achieve DOE approval of SAs.

Keep in mind that although this style guide contains information on required DOE technical content for SAs, it is not meant to be a "complete" guide to content. This style guide calls out required content primarily to illustrate various points about style presentation for SAs.

2.1.3.2 Chapter 2 Objectives

The SNL objectives for Chapter 2 of this style guide are designed to meet SA objectives, and are as follows:

1. Provide specific guidance on the preferred style for presenting technical information required by the DOE for SAs.
2. Facilitate the DOE approval process for non-nuclear facility SAs submitted by SNL.

2.1.4 Scope

Chapter 2 scope encompasses all required parts and subjects specified by DOE/AL Supplemental Order 5481.1B.

Chapter 2 scope encompasses the following **preliminary introductory material** that should be part of a SA:

- Cover Page Contents
- Cover Page Style
- Table of Contents
- List of Tables
- List of Figures
- List of Acronyms (or Glossary of Technical Terms)

Chapter 2 scope of this style guide also covers the following DOE-required topics for SAs:

- Introduction
- Summary/Conclusion
- Site Description and Assessment
- Description of Facility
- Description of Operations
- Accident Assessment
- Safety Related Documentation (Appendices)

Base SA preparation on a "graded approach" rather than an encyclopedic approach.

Also, present only relevant data and cover generic subjects briefly.

Some activities and programs may need to be addressed in

2.1.5 Graded Approach

Those responsible for preparing information for inclusion in SAs should keep in mind the *graded approach* concept. The level of effort, sophistication of analysis, and thoroughness of documentation should be graded or proportioned commensurate with:

1. The magnitude of the consequences that may be realized from identified hazards;
2. The complexity of the facility and the safety systems relied upon to maintain an acceptable level of risk;
3. The stage of the facility life cycle;
4. The relative importance to safety, safeguards, and security; and
5. The programmatic mission of the facility.

NOTE: See Chapter 1, Section 1.5 for a complete discussion of the graded approach to writing SAs.

2.1.6 Facility Safety Programs and Activities

SNL non-nuclear facilities management typically establishes various activities and programs to ensure protection for the public, the environment, and facility workers. Many are also established to comply with other requirements of DOE orders.

Together, these activities and programs represent an assessment of the interfacing of all factors that provide assurance of safe facility operations. However, to enhance and convey the **validity** of this assurance, some of these activities/programs may need to be discussed in sufficient detail to convince the reader that facility management is both appropriate and effective in controlling identified facility hazards. Such programs may include the following:

1. Radioactive and Hazardous Material Waste Management;
2. Radiation Protection;
3. Procedures and Training;

sufficient detail to establish that facility operations are safe.

Reference existing documentation whenever possible.

4. Human Factors; and
5. Operational Safety/Conduct of Operations;

Existing documentation supporting such programs should be referenced when possible. Then, the presentation of information should consist of brief abstracts of the referenced documentation. These abstracts should be supported by enough salient facts to ensure adequate understanding of the program and its relation to ensuring facility safety.

Also, where the same or similar topic discussions are requested in more than one place in the SA, referencing the once-provided material is appropriate, rather than repeating it in full. New material should be provided only as needed.

2.2 COVER PAGE

Treatment of the SA cover page can best be understood in terms of cover page contents and cover page style.

2.2.1 Cover Page Contents

On the following page, Figure 2.1 shows an example of a cover page for an SA. This example shows the elements that should be included on an SA cover page.

The SA cover page should contain specific information.

The SA cover page should include the following:

- Title of the facility or operation (e.g., Lunar Based Particle Beam Accelerator Test Facility);
- The particular type of safety documentation (e.g., Safety Assessment);
- Responsible organization (e.g., Sandia National Laboratories, Albuquerque, NM);
- Date of issue that includes the month and year (e.g., January 1947).

2.2.2 Cover Page Style

Cover page style should meet the following criteria:

- Type font used on the cover page should be sans serif.
- Type font size for the title should be 16-point.
- Type font size for other information on the title page should be less than 16-point.
- Information contained on the cover page should be well-balanced and fall within the page border limits of 1-1/2-inch left and right margins and 1-inch top and bottom margins.

The cover page should adhere to specific style criteria.

LUNAR BASED PARTICLE BEAM ACCELERATOR TEST FACILITY SAFETY ASSESSMENT

Sandia National Laboratories
Albuquerque, New Mexico

January 1947

This figure shows all the elements of information required for cover pages of SAs.

Figure 2.1. Example of Cover Page for an SA.*The cover page contains all the required identifying elements.*

The Table of Contents should adhere to specific style guidelines.

2.3 TABLE OF CONTENTS

On the following page, Figure 2.2 shows an example of a Table of Contents for an SA. This figure illustrates the style prescribed for a Table of Contents for a SA.

The Table of Contents for an SA should adhere to the following style criteria:

- The title heading should be in all bold capital letters and in 14-point or larger sans-serif type, such as 14- or 16-point Arial (e.g., **TABLE OF CONTENTS**).
- The remainder of the Table of Contents should be presented in less than 14-point serif type (e.g., 12-point New Times Roman).
- The Section and Page column headings should begin with an initial capital letter, and the headings should be in bold and underlined (i.e., **Section** **Page**).
- Sections of the SA designated in the Table of Contents should be numbered using the decimal system, with successive decimal points indicating levels of subordination.
- A two-digit-level section (i.e., X.0 and X.X) titles should be in capital letters in a serif font (e.g., New Times Roman).
- A three- and four-digit level subsection heading should have only the first letter of the first word, first letter of all main words, and the first letter of the last word of the heading capitalized.
- Spacing between a two-digit X.0 lead section heading and its two-digit X.X major section headings should be single spacing.
- Spacing between a series of two-digit X.X major section headings should be single spacing.
- Spacing between a two-digit X.X major heading and a three-digit X.X.X subsection or a series of three-digit X.X.X subheadings should be single spacing.

TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
1.0 INTRODUCTION	1-1
2.0 SUMMARY/CONCLUSION	
2.1 Facility Overview	2-1
2.1.1 Facility Description	2-1
2.1.2 Major Operations	2-4
2.2 Accident Assessment Summary	2-6
2.2.1 Hazards Identification	2-6
2.2.2 Risk Summary	2-8
3.0 SITE DESCRIPTION AND ASSESSMENT	3-1
3.1 Description of Site and Boundaries	3-1
3.2 Weather and Climate	3-3
3.3 Air Quality	3-4
3.4 Geology	3-5
3.5 Water Resources	3-8
3.6 Flora and Fauna	3-10
3.7 Demography	3-12
4.0 DESCRIPTION OF FACILITY	4-1
4.1 Facility Location	4-1
4.2 Facility Design Criteria	4-4
4.3 Facility Construction	4-5
4.3.1 Codes and Standards	4-6
4.3.2 Construction Materials	4-8
4.4 Comparison to Criteria	4-10
5.0 DESCRIPTION OF OPERATIONS	5-1
5.1 Facility Mission	5-1
5.2 Significant Operations	5-2
5.3 Hazardous Materials	5-7

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Figure 2.2. Example of a Table of Contents Page for an SA. *The example illustrates the style criteria specified for SAs at Sandia National Laboratories.*

A Table of Contents for an SA should follow specific style criteria illustrated in this example.

- Spacing between a three-digit X.X.X subheading and the next two-digit X.0 lead section heading should be double spacing.
- Page numbers assigned to the Table of Contents should be centered at the bottom of the page and be in small Roman numerals (ii, iii, iv, etc.).

2.4 LIST OF TABLES

On the following page, Figure 2.3 shows an example of a List of Tables for an SA. This figure illustrates the prescribed style for an SA List of Tables.

A List of Tables for an SA should adhere to the following style criteria:

- The List of Tables heading should be in all bold capital letters and in 14-point or larger sans-serif type, such as 14-point Arial (e.g., **LIST OF TABLES**).
- The remainder of the List of Tables should be presented in less than 14-point serif type (e.g., 12-point New Times Roman).
- The information in the List of Tables should be presented in three columns: Table No., Title, and Page.
- The table column headings should begin with an initial capital letter, and the headings should be in bold and underlined (i.e., **Table No.** **Title** **Page**).
- Table numbers should be identified using decimal numbers, and they should be numbered separately within each chapter (e.g., the third table in chapter 3.0 of an SA would be Table 3.3).
- Table titles should have only the first letter of the first word, first letter of all main words, and the first letter of the last word capitalized (e.g., Table 3.3 Meteorological Data: Albuquerque, NM Average Temperature).
- Spacing between a series of table titles for a specific chapter should be single spacing, and two spaces should be inserted between the tables of one chapter series and those of another chapter series.
- The page number should be centered at the bottom of the page and should be in small Roman numerals (iii, iv, etc.).

LIST OF TABLES

<u>Table No.</u>	<u>Title</u>	<u>Page</u>
2.1	Accident Risk Summary	2-9
3.1	Meteorological Data: Albuquerque, NM Normal, Means, and Extremes	3-14
3.2	Meteorological Data: Albuquerque, NM Precipitation, 1956-1985	3-15
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4.1	Comparison to Criteria.	4-11
5.1	Hazardous Materials	5-8
5.2	Containment Barriers	5-12
5.3	Confinement Barriers	5-15
5.4	Cleanup Systems	5-18
6.1	Accident Selection List	6-3
6.2	Accident Analysis Results	6-15
6.3	Risk Assessment Results	6-18

A List of Tables for an SA should follow specific style criteria illustrated in this example.

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Figure 2.3. Example of a List of Tables for an SA. *The example illustrates the style criteria specified for SAs at Sandia National Laboratories.*

2.5 LIST OF FIGURES

On the following page, Figure 2.4 shows an example of a List of Figures for an SA. This figure illustrates the prescribed style for an SA List of Figures.

A List of Figures for an SA should adhere to the following style criteria:

- The List of Figures heading should be in all bold capital letters and in 14-point or larger sans-serif type, such as 14-point Arial (e.g., **LIST OF FIGURES**).
- The remainder of the List of Figures should be presented in less than 14-point serif type (e.g., 12-point New Times Roman).
- The information in the List of Figures should be presented in three columns: Figure No., Title, and Page.
- The column headings should begin with an initial capital letter, and the headings should be in bold and underlined (i.e., **Figure No.** **Title** **Page**).
- Figure numbers should be identified using decimal numbers, and they should be numbered separately for each chapter (e.g., the third figure in Chapter 3.0 of an SA would be Figure 3.3).
- Figure titles should have only the first letter of the first word, first letter of all main words, and the first letter of the last word capitalized (e.g., Figure 3.3 Curve Showing Meteorological Data: Albuquerque, NM Average Temperature).
- Spacing between a series of figure titles for a specific chapter should be single spacing, and two spaces should be inserted between the figures of one chapter series and those of another chapter series.
- The page number should be centered at the bottom of the page and be in small Roman numerals (viii, ix, etc.).

A List of Figures for an SA must contain not only specific information but should adhere to specific style guidelines.

LIST OF FIGURES

<u>Figure No.</u>	<u>Title</u>	<u>Page</u>
2.1	Lunar Based Particle Beam Accelerator Test Facility	2-2
3.1	Test Facility Location and Distances to Other Facilities	3-2
3.2	Test Facility Layout.....	3-7
3.3	Meteorological Data: Albuquerque Daily Data for Year 1989	3-8
3.4	Tectonic Map of the Middle Rio Grande Depression	3-8
3.5	Map of West-Central New Mexico Showing Earthquake Locations	3-13
3.6	Seismic Risk Map of the United States	3-14
4.1	Particle Beam Accelerator Configuration	4-3
4.2	Cutaway View of Accelerator	4-3
4.3	Vacuum Test Chamber	4-4
4.4	Vibration Test Chamber	4-8
4.5	High Temperature Test Chamber	4-9
4.6	Test Facility Layout	4-11
4.7	Utility Services	4-13
5.1	Test Control Console	5-5
6.1	Fire Event Tree	6-10
6.2	Fire Compartment Temperature History	6-12
6.3	Explosion Event Tree	6-19

A List of Figures for an SA should adhere to specific style criteria illustrated in this example.

Figure 2.4. Example of a List of Figures for an SA. *The example illustrates the style criteria specified for SAs at Sandia National Laboratories.*

*Avoid redundancy in the SA —provide either a **List of Acronyms** or a **Glossary of Technical Terms**, but not both.*

General points of style for presenting a List of Acronyms.

2.6 LIST OF ACRONYMS

Preparers and writers of SAs should include a list of all acronyms used in the SA only if a *Glossary of Technical Terms* is not to be provided. Otherwise, the acronyms should be included in the glossary.

For example, see the *Glossary of Technical Terms* on introductory page xvii of this Volume 2 style guide. This glossary contains the acronyms and definitions of the acronyms as well as definitions of other terms used in this style guide. Consequently, a List of Acronyms for Volume 2 is not provided in order to avoid redundancy.

A formal List of Acronyms provided in an SA should adhere to the following style criteria:

- The List of Acronyms heading should be in all bold capital letters and in 14-point or larger sans-serif type, such as 14-point Arial (e.g., LIST OF ACRONYMS).
- The remainder of the list should be presented in less than 14-point serif type (e.g., 12-point New Times Roman).
- The list should be presented in two columns with the acronym placed in the first column and the words defining the acronym placed in the second column.
- The words for which the acronym is an abbreviation should have the first letter of the first word, first letter of all main words, and the first letter of the last word capitalized.
- The page number should be centered at the bottom of the page and should be in small Roman numerals (vii, ix, etc.).

NOTE: See Chapter 1, Section 1.6.4 for general guidelines and examples of how to use acronyms in SAs.

2.7 SA Chapter Contents

2.7.1 Introduction (Chapter 1)

AL Order 5481.1B, Chapter 1, paragraph 4.d “Table of Contents for SA’s”, defines Chapter 1 of an SA as the Introduction which is to include: “Basic information on the site/facility to obtain an understanding of the

protection afforded the public, environment, and worker health and safety without studying subsequent chapters.”

Some of the items which need to be discussed in Chapter 1 include:

- 1.1 The background of the facility and the process which the facility supports.
- 1.2 A discussion of the location of the facility.
- 1.3 The responsible organization.
- 1.4 The function of the facility, to include a discussion of the site structure and buildings that are part of the site.
- 1.5 The safety aspects of materials and operations at the site to include the hazardous materials, the hazardous operations as defined in Chapter 5, the waste products, their on-site storage, and the worker hazards involved with these materials.
- 1.6 A discussion of the overall facility safety.

See Figure 2.5 for examples of these sections.

Introduction

Background

For over four decades, Sandia National Laboratories (SNL) has constructed and operated test facilities as one of the technical activities conducted to achieve their primary mission of ensuring that the nation's nuclear weapons systems meet the highest standards of safety and reliability. These facilities have been specifically designed for the validation of analytical modeling and the functional verification of weapons systems. They are also used, on an as-available basis, by the DOE, other government agencies, and their contractors to support other research and development activities in the national interest. A number of these facilities are remotely located in an area within Kirtland Air Force Base (KAFB), referred to as the Coyote Canyon Test Complex (CCTC), for conducting energetic tests of weapon systems containing hazardous materials.

In the late 1940's, weapons development activities required some method to stimulate high-speed impacts of weapon shapes, substructures and components in order to verify design integrity, performance and fusing function. In addition, some method was needed to subject weapon parachute systems to higher aerodynamics load than could be achieved with drop tests from aircraft. A rocket-powered sled track offered solutions for both of these testing requirements.

Sandia's first sled track was constructed in Technical Area m in 1951. It was approximately 2066 feet in length. It was supplemented in 1966 with a second sled track, approximately 5000 feet in length, located about one-quarter mile west. In 1985 a 5000 foot extension was added to the new track producing the current length of 10,000 feet. Operations at the original track were phased out in mid-1970. The site is closed.

Location of the Sled Track

The Sled Track Facility is located at Sandia National Laboratories, New Mexico (SNL). SNL is located on Kirtland Air Force Base (KAFB) approximately 6-1/2 miles east of downtown Albuquerque, New Mexico, 5 miles south of Central Avenue and 6 miles south of U.S. Interstate 40 (Figures 3.1 and 3.2) in the foothills of the Manzano Mountains. SNL is surrounded by KAFB and has co-use agreements on some portions of the Air Force property. The Sled Track is located on the Department of Energy (DOE) portion of 24,500 acres which are owned by the DOE and the U.S. Air Force. An additional 22,500-acre area to the east of KAFB has been withdrawn from the public domain for the exclusive use of KAFB and the DOE. Areas to the west and south are bounded by land belonging to the State of New Mexico and the Isleta Pueblo.

The Sled Track is located in Technical Area (TA) m (Figure 3.3). The site is located in the northwest corner of TA m and is approximately 17,000 feet south of TA I. The nearest on-base residential housing (Zia Park Housing) is located at a distance of greater than 18,000 feet northwest of the site. The nearest off-base residential housing in the city of Albuquerque is located at a distance of greater than 24,000 feet northeast of the site. The site is about 5,000 feet from the nearest boundary of KAFB.

Responsible Organization

The Sled Track is operated by Sandia National Laboratories for the Department of Energy under fixed fee contract with Martin Marietta Inc. Within SNL, the Sled Track is operated by the Development Test Center, Organization 2700, which is part of the Contract Development Support Division, 2000.

Function of the Sled Track

Weapons systems development and reliability testing at the Sled Track requires test velocities from about 100 feet per second up to 6000 feet per second (MACH 6).

The types of tests conducted at the Sled Track include:

- Collision Impact-tests by accelerating the test article to impact a fixed barrier
- Reverse ballistic impact tests in which the target is accelerated into the test article
- Parachute deployment tests using ejector sleds or free flight boosters
- Dynamic weapon firing tests
- Full function weapon deployment tests
- Sensor and telemetry system verification
- Hypersonic rocket sled development

In the above tests, the rocket sleds with attached test articles or targets are propelled from the northern end of the track at a point calculated to provide the terminal velocity required for specific test. At the precalculated point along the track or at the south end of the track, the test articles or targets are impacted, or the test articles are ejected into a free-flight trajectory. After test article ejection or impact the rocket sled is impacted against an earthen berm located at the track to terminate the sled's run and to contain fragmentation. For other tests, a water braking system functions as a mechanism for controlling sleds to a non-destructive stop. For free-flight trajectory tests, the test articles impact downrange at predetermined ranges or targets.

Figure 2.5 *Examples of some of the sections which should be covered in Chapter 1 of the SA.*

2.7.2 Summary/Conclusion (Chapter 2)

The summary should present sufficient information to provide a management overview of the facility, its operation, the significant hazards involved, and the results of the accident risk assessment. This should include a brief description of the risk assessment methodology used, a discussion of the scope of accident sequences analyzed, a discussion of significant assumptions used in the analysis, and a summary of the risk assessment results. An example of a risk assessment summary, using the nomenclature of DOE/AL Supplemental Order 5481.1B, is shown in Table 2.1.

Table 2.1 Example Risk Assessment Summary

QUALITATIVE RISK SUMMARY FROM THE MAXIMUM CREDIBLE EVENTS AFFECTING THE CNSAC FACILITY				
EVENT	PUBLIC	ONSITE WORKERS	LOCAL WORKERS	FACILITY
I. OPERATIONAL ACCIDENTS				
1. Fire (MCF)	IV-C	II-C	III-C	II-C
2. Explosion (MCE)	IV-C	I-C	I-C	III-C
3. Explosion (MCS)	IV-B	III-B	IV-B	IV-B
4. Inadvertent Exposure (MCIE)	IV-C	IV-C	IV-C	IV-C
II. NATURAL PHENOMENA				
1. Earthquake (DBE)	IV-B	IV-B	IV-B	IV-B
2. Wind (DBW)	IV-A	IV-A	IV-A	IV-A
3. Flood (DBFL)	IV-B	IV-B	IV-B	IV-B
III. EXTERNAL EVENTS				
1. Airplane Crash	IV-C	III-C	I-C	I-C
2. Nearby Facility	IV-C	II-C	III-C	IV-C

A conclusion discussion should address the acceptability of the accident analysis results. This should include brief discussions of applied risk acceptance criteria, any risk control measures to be implemented to achieve acceptable residual risk levels, and an implementation schedule for such measures. A conclusion of the need for a more detailed Safety Analysis Report (SAR) should be made based on the results of the risk analysis.

2.7.3 Site Description and Assessment (Chapter 3)

Sandia Report, SAND94-0920, printed April 1994, is available through the Risk Management and NEPA Dept., Organization 7258. This document contains much of the information necessary to prepare this chapter to include weather/climate, air quality, geology, water resources, flora/fauna, and demography of the area around SNL, New Mexico. If

the facility is in another area, then this SAND Report should be used as a reference for the development of this same information for that area.

2.7.4 Description of Facility (Chapter 4)

The contents of this chapter should focus on the design of structures, components, and systems to support the mitigative and preventive features used to control facility hazards. Those features that are credited in the safety analysis as preventative/mitigative measures should be discussed in a level of detail sufficient to provide a thorough understanding of the facility's engineered safety features. This degree of understanding should be conveyed to individuals who may have little or no knowledge of the facility design or operational characteristics. The type of mitigative/preventive components identified should be commensurate with the quantity, form, and location of hazardous material at risk in the facility.

Any potential energy sources and initiating events which could effect the hazardous material and lead to a release of material or other occurrence should be remediated by one or more facility specific mitigative/preventive features. Typical energetic events that would warrant a degree of protection from the consequences of material release include: (1) internally initiated events (e.g., explosions, fires); (2) process initiated events (e.g., spills or improper material transfers); (3) externally initiated events (e.g., floods, missile impact); and (4) inherent energies within the process (e.g., chemical reactivity, pressure, thermal, and kinetic sources).

For those systems that do not play a safety role to prevent or mitigate the consequences of an accident, the descriptive information should be brief.

Facility systems that can be classified as standard industrial hazards (SIHs), i.e., materials or operations controlled by OSHA regulations or one or more national consensus standards, should also be brief.

The specific elements that should be considered in an acceptable facility description are summarized below:

Note: Ensure that the following subjects have been discussed in sufficient detail to enable the reviewer to evaluate whether or not all hazards have been adequately identified and assessed.

Basic Description - The intent of this section is to provide a broad understanding of the facility structure and layout. Specific care should be taken to relate this information to the hazard and accident analysis,

providing sufficient details to fully support the analysis. Using maps or drawings, identify the locations of major components of the facility and other nearby structures, as appropriate. The drawings should, as a minimum, illustrate basic floor plans, equipment layouts, and dimensions significant to analytical activities, e.g., physical and administrative boundaries of the facility. In addition, the function of the identified areas and the major components or equipment located in the area should be described. Particular emphasis should be placed on those systems that have a direct role in mitigating or preventing the release of hazardous material. After the essential information has been collected, it should be fully consistent with the "as-built" condition of the facility.

Safety Protections Systems - Systems that are credited in the accident analysis portion of the SA should be discussed. The level of detail should focus on the basis for selecting the system, including its functional reliability as a mitigator or preventor of potential consequences. The realm of safety related systems to be addressed can range from passive confinement structures to active mechanical systems. Examples of confinement structures, systems, and components could include process vessels, glove boxes, ventilation system, facility walls, tote boxes, etc.

System Interfaces - Any auxiliary support systems that interface with the safety protection systems should be described. Consideration should be given to those related systems that may impact the operability and reliability of the safety protection systems.

Applicable Codes and Standards - A summary comparison of the facility design characteristics and related safety protection systems with pertinent codes and standards, including design criteria contained in applicable DOE orders should be provided.

Figure 2.6 provides examples of these sections.

Description of Facility

This chapter describes the Microelectronics Development Laboratory's (MDL's) size, type of construction features and a detailed comparison to the design criteria of DOE 6430.1A.

General Description of Facility Features

The MDL consists of the heavy lab, central plant deionized (DI) water plant, nitrogen plant, acid waste neutralization and several chemical storage tanks. In the basement level of the facility is the main utility tunnel connecting the central plant to both the heavy lab and the office/light lab. The utility tunnel carries all the mechanical and electrical utilities. A separate utility tunnel surrounds the heavy lab and carries all the mechanical and electrical utilities for the clean rooms.

Structural and Mechanical Criteria

The MDL was designed and constructed to meet the Uniform Building Code (UBC) requirements for Seismic Risk Zone 2 and American National Standards Institute (ANSI) A58.1 wind loads using a 100 year plan mean recurrence level, Exposure "C" (SNL 1985). In addition to the above structural design requirements, the hazardous gas bunker was designed in accordance with Department of the Army, Navy and Air Force Manual "Structures to Resist the Effects of Accidental Explosions," Army Manual TM-5-1300, Navfac Manual P-397, Air Force Manual 88-22 dated June 1969. The design for seismic loading used $I=1.0$ and the combined value $CS=0.14$. All roofs were designed with a minimum of 1/4 in. per foot slope to ensure no ponding occurs from rain or snow loads.

The heavy lab area and central plant were designed in accordance with the occupancy requirements of the "Draft Green Book" (predecessor to H-6, UBC 1985) since the official H-6 requirements had yet to be published. The gas bunker was designed in accordance with the occupancy requirements of UBC (1982) H-2.

Other applicable industrial and government standards were also used in design and construction. These industrial standards include codes, standards, specifications, publications, handbooks, guides, lists and manuals of organizations such as ANSI, UBC, the American Society for Testing Materials, the American Welding Society, the American Concrete Institute, the Steel Joist Institute, the American Water Works Association, the National Fire Protection Association (NFPA), the American Society of Heating, Refrigeration, and Air Conditioning Engineers, Factory Mutual, Underwriter's Laboratories (UL), the National Electric Code, and American Petroleum Institute (API).

Site Storm water design runoff meets the criteria for the 100-year frequency storm.

Safety systems designed into the facility include the following:

- Concrete walls constructed as secondary containment for the bulk acid, and bulk caustic tanks.
- Installation of neutralization systems to adjust the pH of all chemical wastes prior to exiting the facility. The entire neutralization area is 4 feet below the basement level to provide containment in case of leaks.
- A hazardous gas detection system which detects toxic and flammable gases.
- A hazardous gas bunker houses all pyrophoric gases.
- Automatic hazardous gas shutdown systems.
- Containment of spills in the clean rooms or chases via epoxy coated concrete masonry units (CMU) walls which drain into the acid drain system.

Figure 2.6 *Examples of some of the sections in Chapter 4 of the SA.*

2.7.5 Description of Operations (Chapter 5)

This chapter describes the individual facility processes from a perspective of process design, process technology, system operations and maintenance activities. Specific details also should be provided on basic process parameters, process equipment, and instrumentation and control systems as they apply to each independent discrete operation.

The specific elements that should be considered in an acceptable description of operations are summarized below:

Description of Operation of Facility and Process/Operations to be Conducted in the Facility - Provide an overview of the individual processes performed in the facility. Delineate the basic process steps of the facility, including inputs and outputs. Include a description of the operational considerations for each individual process, and major interfaces of the process flow with safety protection systems.

Typical and Maximum Quantities and Forms of Hazardous Materials Utilized, or Stored in the Facility - Provide process information on the quantity, form, and location of hazardous materials that will be handled or treated in the facility. Where appropriate, supply information on toxicity, reactivity data, thermal and chemical stability, and hazardous effects of inadvertent mixing of incompatible materials that could foreseeably occur.

Summary of Chemical and Mechanical Processes and Control/ Support Systems - The discussion should focus on process related equipment that acts to prevent unwanted releases of hazardous chemicals into locations which could cause catastrophic incidents (e.g., Include mechanical barriers, vacuum systems, detection systems, HVAC systems and other safety systems, as deemed appropriate). Defense in depth where it applies to the reliability, operability, and redundancy of process functions should also be explained. Where appropriate, flow diagrams should be used to show the major process equipment and interconnecting process flow lines. The diagrams should identify flow rates, stream composition, temperatures, and pressures when necessary for clarity. Codes and standards that were incorporated into the design and selection of primary equipment should be documented. In cases where a process technology departs from the applicable codes and standards, sufficient documentation should be provided to demonstrate that the design is suitable for the intended purpose.

Control Room and Associated Monitoring and Control Systems - Describe the organization and layout of the control room or control areas. Discuss the role of operator actions that may be required to successfully respond to an offnormal condition. Include a description of those operator initiated actions that are credited in the accident analysis for bringing the facility to a safe and stable configuration. Also provide a discussion of the source and availability of information that's presented to the operators to verify that active preventive/mitigative systems are performing in their designated functions.

Hazardous Materials Receipt, Storage, Handling, and Transfer Procedures - Present sufficient information to demonstrate the applicable requirements for control of personnel exposures to hazardous materials.

Include in the discussion a brief overview of the procedures for handling and storage of hazardous materials. Provisions for monitoring the workplace and instrumentation used for detecting hazardous material inside the facility should also be emphasized.

Methods for Maintaining Safe Control During Normal and Abnormal Operations - Describe the system distribution philosophy for controlling the facility processes in a manner that ensures that operations are performed without compromising the integrity of facility structures, or reducing the analyzed safety envelope. Describe the automatic and manual control mechanisms in place to ensure continued safe operations and initiating a safe shutdown under accident or abnormal conditions. Information concerning the process technologies should also be presented such as: maximum process inventories; safe upper and lower limits for process parameters; and the consequences of deviations from the process parameters. Include a discussion of the Operational Safety Requirements (OSRs) and how they are integrated into the process control philosophy.

Instrumentation and Control Operations for Safety Related Processes - Provide a clear description of the Instrumentation and Controls (I&C) that are relied upon for successful operation of safety related functions. The manner in which the instrumentation senses the accident or abnormal condition and actuates the appropriate engineered safety features should be discussed. Provisions for the alarm system that indicates abnormal facility status should also be described as well as any interlocks that are provided for operational safety.

Operational Reliability and Maintenance - Describe the approach used to ensure operational reliability for those systems that provide preventive or mitigative functions during the onset and evolution of off normal events. Demonstrate how the systems are retained in a reliable state of readiness on demand under the circumstances that they may be called upon to operate. Incorporate the methods for surveillance, inspection, and overall maintenance commitments as a means for ensuring continued and reliable system operability.

Figure 2.7 provides examples of these sections.

Descriptions of Operations

This chapter describes the major mission related operations conducted within the Microelectronics Development Laboratory (MDL), the activities conducted in support of those operations, the safety systems utilized, and the major utilities. The major pieces of equipment used in support of each operation are also described. This chapter also describes the types and average inventories of chemicals and gases used at the MDL.

The MDL at Sandia National Laboratories is a world class facility with over 30,000 ft. of clean room space, a fully operational state-of-the-art equipment set for processing semiconductor wafers up to 150 mm in diameter, and a diverse, professional staff that focuses its work on a diverse array of microtechnologies. These include advanced packaging and interconnection development, microsensor research, advanced non-volatile memory research and development, micromachining, equipment improvement, and advanced materials and process development for the semiconductor industry. Since moving to the MDL in 1988, the mission has been to provide microtechnology development and engineering capabilities to support programs in the national interest.

MDL Mission-Related Operations

This section describes the microelectronics-related research and development operations conducted at the MDL, and the major pieces of equipment found in each lab area. Figure 5-1 indicates where the various operations are located in the MDL clean room area.

VTR Furnaces-Oxidations

In most microtechnologies, it is often necessary to use high temperature furnaces to grow oxides or to activate and diffuse dopants in the semiconductor. In the MDL's oxidation and diffusion area, the equipment set includes ten Silicon Valley Group Vertical Thermal Reactors (VTRs) controlled by an Apple Macintosh-based central computer system. Each VTR can accommodate up to 125 wafers. Film thicknesses vary less than 3% across an entire load. Particle generation is minimized through the use of robotic wafer handling and HEPA-filtered loading stations.

The process can be broken down into three basic areas: (1) Pyrolytic steam oxidations: primarily for the growth of thicker isolation oxide layers; (2) dry oxidations with and without chlorine (Trichloroethane is used as the chlorine source): primarily for thin high quality layers, such as gate oxides (MDL can also perform in-situ anneals in inert or N_2/H_2 atmospheres to tailor the oxide's electrical characteristics), and (3) low-temperature sintering and annealing of metallization or dielectric layers.

Silicon Valley Group Vertical Thermal Reactor Furnace

Diffusion/Oxidation furnaces (or reactors) are used to thermally diffuse dopant atoms into the silicon or to thermally oxidize the surface of the silicon. These furnaces are lined with ultrapure quartz tubes, and operate between 350°C. The silicon wafers are placed into a quartz boat which is then placed on the furnace loading stage. The boat is inserted into the furnace by an automated mechanical system to prevent accidents to the operators and to obtain absolutely repeatable furnace cycles. Process gases are controllably injected into the furnace tube by a gas system that is controlled by a local computer that also monitors and controls the temperature and operates the boat loading system. Gases used in the furnace are primarily nitrogen and oxygen; however, hydrogen is also used in conjunction with oxygen in a pyrogenic reaction to create a "wet" oxidation atmosphere.

Computer/mechanical controlled systems inhibit hydrogen flow unless oxygen flow and pyrogenic initiation conditions exist. Hydrogen chloride is another gas that is often used in the furnace tube operations. The hydrogen chloride is diluted with nitrogen by the furnace gas system and is utilized in oxidation processes to immobilize contaminants that may degrade the electrical characteristics of the oxide.

Figure 2.7 *Example of some of the sections which should be covered in Chapter 5 of the SA.*

2.7.6 Accident Assessment (Chapter 6)

The accident assessment should begin with the identification and characterization of hazards associated with the facility. This information should be readily available from the facility Preliminary Hazards Assessment document(s). Standard industrial hazards that are regulated by OSHA should not be included in this discussion.

The scope of accident sequences analyzed should be discussed, including the approach used to select sequences for analysis. For example, Table 2.2 illustrates a deterministic approach that identifies groups of accident scenarios to be analyzed. The range of representative accident sequences encompasses internal (or operational) events, natural phenomena events,

and external events. The deterministic approach is particularly well suited for evaluating the safety of facilities that do not have the potential to significantly impact the health and safety of the off-site public.

For some accident groups only the most bounding (or dominant) scenario of the group may need to be evaluated if the same set of mitigating structures, systems, and components (SSCs) is relied upon for all accident scenarios within the group (e.g., internal fires). However, in other cases each independent mechanism within the accident group may need to be addressed. For example, a chemical explosion, a steam explosion, a detonation of explosives, and a high pressure gas explosion will likely involve different sets of mitigating SSCs and the entire accident group will, therefore, not be bounded by a single scenario.

The accident groups of Table 2.2 may be qualitatively evaluated using a risk methodology such as that documented in SAND95-0320 (Qualitative Methods for Assessing Risk). This methodology also includes a means for assessing risk "acceptability" that has two important aspects. First, it can point to the need for quantitative analyses of certain accident scenarios to more precisely evaluate the associated risk. Secondly, risk acceptability criteria can be used to determine the degree to which additional risk management measures are warranted for a particular accident scenario. Where a quantitative risk assessment is called for the quantitative methods of ES&H Manual Supplement GN470083 (An Introduction to the Fundamentals of Safety Analysis) can be applied.

The results of the accident assessment should be displayed in tabular format in the safety document. An example of a qualitative risk assessment display, using the nomenclature of DOE/AL Supplemental Order 5481.1B, is shown in Table 2.3.

Finally, the results of the accident assessment should be used to develop the Operational Safety Requirements (OSRs) for the facility. The OSRs define the operating limits of facility, operation, or activity control parameters that assure acceptable risk to the offsite public, as well as the process safety management programs and processes that demonstrate adequate consideration for worker safety. This section should include a brief summary of the training, procedures generation, internal review and approval, change control, and any other management programs that minimize worker risk.

Table 2.2 Generic events for Non-nuclear Facility Accident Analysis Consideration

Internal Events	Natural Phenomena Events	External Events
Fires Hazardous material spills, releases, or exposures Radiation exposures Explosions Other	Earthquake Tornado/high winds Flood	Aircraft crash Nearby Facility events Other

Table 2.3 Example Display of Risk Assessment Results

QUALITATIVE RISK SUMMARY FROM THE MAXIMUM CREDIBLE EVENTS AFFECTING THE CNSAC FACILITY				
EVENT	SECTION	FREQUENCY CATEGORY	CONSEQUENCE SEVERITY	RISK
I. OPERATIONAL ACCIDENTS				
1. Fire	6.3.1.5.2	Extremely Unlikely (C)	Marginal (III)	III-C
2. Explosion (MCE)	6.3.2.5.2	Extremely Unlikely (C)	Catastrophic (I)	I-C
3. Spill (MCS)	6.3.3.5.2	Unlikely (B)	Negligible (IV)	IV-B
4. Inadvertent Exposure (MCIE)	6.3.4.5.2	Extremely Unlikely (C)	Negligible (IV)	IV-C
II. NATURAL PHENOMENA				
1. DBE	6.4.1	Unlikely (B)	Negligible (IV)	IV-B
2. DBW	6.4.2	Likely (A)	Negligible (IV)	IV-A
3. DBFL	6.4.3	Unlikely (B)	Negligible (IV)	IV-B
III. EXTERNAL EVENTS				
1. Airplane Crash	6.5.1	Extremely Unlikely (C)	Catastrophic (I)	I-C
2. Nearby Facility	6.5.2	Extremely Unlikely (C)	Marginal (III)	III-C

QUALITATIVE FACILITY RISK SUMMARY FROM THE MAXIMUM CREDIBLE EVENTS AFFECTING THE CNSAC FACILITY				
EVENT	SECTION	FREQUENCY CATEGORY	CONSEQUENCE SEVERITY	RISK
I. OPERATIONAL ACCIDENTS				
1. Fire	6.3.1.5.3	Extremely Unlikely (C)	Critical (II)	II-C
2. Explosion (MCE)	6.3.2.5.3	Extremely Unlikely (C)	Marginal (III)	III-C
3. Spill (MCS)	6.3.3.5.3	Unlikely (B)	Negligible (IV)	IV-B
4. Inadvertent Exposure (MCIE)	6.3.4.5.2	Extremely Unlikely (C)	Negligible (IV)	IV-C
II. NATURAL PHENOMENA				
1. DBE	6.4.1	Unlikely (B)	Negligible (IV)	IV-B
2. DBW	6.4.2	Likely (A)	Negligible (IV)	IV-A
3. DBFL	6.4.3	Unlikely (B)	Negligible (IV)	IV-B
III. EXTERNAL EVENTS				
1. Airplane Crash	6.5.1	Extremely Unlikely (C)	Catastrophic (I)	I-C
2. Nearby Facility	6.5.2	Extremely Unlikely (C)	Negligible (IV)	IV-C

2.7.7 Safety Related Documentation (Appendices - Chapter 7)

The safety analysis document must define the safety basis and controls (programmatic elements) needed to maintain the safety envelope. To this end, the preceding chapters should be presented in sufficient detail for the reviewer, or end user, to make informed decisions regarding the adequacy and completeness of the information presented. However, it is recognized that the overall quality and integrity of the material contained in the body of the report can often be augmented with the addition of one or more appendices. When properly applied, appendices provide the reader with deeper levels of analysis, data, and findings for the purpose of clarifying or expanding upon the statements located in the main report. Specific guidance for organization and selection of appendix-related materials are described below:

- If the desired information can be referenced in another controlled document (e.g., operating procedures, safety analysis reports) that is easily accessible to the majority of potential readers, then an appendix may not be necessary. A simple reference to the material of interest may preclude the need for an attached appendix. The practice of referencing other sources is particularly appropriate in cases where the actual text or data selected from the original document has not been significantly changed or modified.
- Consider the addition of an appendix if the facility or system being described in the safety assessment document is unique or "one of a kind." In these situations, the addition of an appendix describing specific attributes or design characteristics that are unique to the facility or system of interest would be beneficial.
- Methods used in the determination and assessment of potential accidents can typically be referenced to other documents that more fully describe the basic applicability and basis of the methods chosen. If a particular analytic method is unusual or not consistent with standard practice, then an appendix could be used to explain the methodology in greater detail. Detailed steps in the accident analysis that defend or support major conclusions should also be considered as an appendix.

It is important to note that the use of appendices should not be construed as filler. If the information does not directly add to the understanding of the material contained in the main report, then it should be either referenced to another document or deleted entirely. In addition, extensive appendices are not a substitute for material that is poorly organized. The contents should basically stand on their own with the aid of appendices providing added points of clarification or understanding.

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CHAPTER 3

PUBLICATION GUIDELINES FOR SNL SAFETY ASSESSMENT REPORTS

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CHAPTER 3: PUBLICATION GUIDELINES FOR SNL SAFETY ASSESSMENT REPORTS

Chapter 3 provides guidance to writers concerning publishing Sandia facility SAs.

3.1 INTRODUCTION

This chapter of the style guide presents the general guidelines for the publishing of Sandia facility SAs. The final ingredient that preparers and writers must consider in the SA preparation effort is to ensure that the SA issued meets the highest possible standards for publishing documents.

NOTE: The official guide to be used for publishing SNL SAs is SAND89-0996, *Guide to Preparing and Processing SAND Reports*.

3.2 OBJECTIVES

The objectives of this chapter of the style guide are to:

1. Provide guidelines for publishing SAs, and
2. Ensure the final document meets the highest possible state-of-the-art quality expected for published SA documents.

3.3 SCOPE

The scope of the publishing guidelines encompasses:

- Paper stock;
- Report covers;
- Graphic illustrations;
- Section numbering and style;
- Page numbering;
- Grammar;
- Abbreviations, acronyms, and glossary terms;
- References;
- Draft copies; and
- Final copies.

3.4 PAPER STOCK

Use only white paper and print only with black ink for the final SA.

3.5 REPORT COVERS

For front and back covers, use 65-pound cover stock. Use only black ink for printing on the front cover.

3.6 GRAPHIC ILLUSTRATIONS

Use artwork to make the SA presentation more effective.

Artwork is very effective in supporting the text messages. Use drawings, maps, diagrams, sketches, and tables to support text when the artwork would make the text more effective.

Make certain the artwork being presented (figures, tables, etc.) meets the following criteria:

- Reproductions are in black on white for easy reproducibility;
- Title is at the bottom for figures, or at the top for tables;
- Figure/table number designators use decimals;
- Information presented is legible;
- Symbols used are defined;
- Dimensions used are to appropriate scale;
- References are appropriate; and
- Design and presentation of information can stand alone.

Ensure each piece of artwork meets these criteria.

Figure criteria.

Place the figure titles at the bottom of the figure. Number the figures sequentially (using decimal system) within each individual chapter. For example, the fifth figure to appear in chapter 3 would be Figure 3.5.

Table criteria.

Place table titles above the tables. Number the tables sequentially (using decimal system) within each individual chapter. For example the first table to appear in chapter 2 would be Table 2.1. Capitalize the first letter of the first word, all main words, and the first letter of the last word of the table title.

Reference artwork in the text.

Place the artwork within the section where it is first referenced. However, a figure/table/etc. simply referenced and left to its own is not effective. Do NOT simply reference the artwork. Artwork must be "connected" to the text to be effective.

Establish a connection between the text and the artwork.

Design each piece of artwork to **stand alone**, although it must be placed strategically to support the text, and the text message must be written to support the artwork. Thus, the SA writer must make certain to use the necessary language in the text and in the figure/table *captions* to "connect" each piece of artwork to the text message, and the text message to the artwork.

To establish a connection for the SA reviewer between the artwork presented and the text message:

- Write into the text a sentence or paragraph explaining what the referenced figure/table/etc. is about.
- Add an *italicized* informative caption after the title of the figure/table/etc.

NOTE: See the figures presented in this style guide for examples. Each contains a figure number, title, and explanatory caption.

3.7 SECTIONS/SUBSECTIONS NUMBERING AND STYLE

Use the decimal system to identify each section/subsection.

Number each section/subsection of the SA. Use the decimal system to indicate the levels of subordination.

Use ALL CAPITAL LETTERING for X.0 and X.X headings and subheadings. For the X.X.X subheadings, capitalize only the first letter of the first word, all main words, and the first letter of the last word.

NOTE: This style guide follows this principle.

3.8 FORMAT FOR SECTIONS

Formatting the SA sections requires use

Formatting for the SA involves several important points requiring computer software word processing functions:

*of word processing
computer software.*

- Use block formatting for the SA sections, subsections, etc.
- Use double spacing between paragraphs and single spacing within paragraphs.
- Use *serif* type for the body of the text in the document.
- Use sans-serif type for the cover page, individual title pages, and X.0 and X.X headings.
- Use appropriate font sizes for title page information.
- Use 14-point or larger font size for chapter title.
- Use 12-point font size for section headings and section text.

**NOTE: Also see Section 3.15 and 3.16
for additional requirements that require
computer software word processing
formatting.**

3.9 PAGE NUMBERING

Preliminary pages.

Number the Table of Contents, List of Tables, List of Figures, and glossary-type pages sequentially with small Roman numerals. Center the page numbers and position them 1/2 inch from the bottom of the page.

Body of report.

Also number all chapters and appendices individually, and place the page numbers 1/2 inch from the bottom center of the pages. For example, page 4 of chapter 3 would be numbered 3-4. Page 1 of Appendix B would be numbered B-1.

*Odd - and even-
numbered pages.*

Make the first page of each preliminary section (e.g., Table of Contents), chapter, and appendix of the SA an odd-numbered page. Any blank pages inserted to achieve this should be numbered at the bottom center of the page, and the words "Intentionally left blank" should appear centered on the even-numbered page.

Also, odd-numbered pages must be the front side of a page. Even-numbered pages must be the back side of a page.

For English grammar and style of presentation, see the Shipley Associates Style Guide.

Shipley Style Guide address.

Criteria depend on the subject and conventions.

3.10 GRAMMAR

An acceptable guide for English grammar is:

Freeman, Lawrence H. and Bacon, Terry R. *Shipley Associates Style Guide*. Revised ed., reprinted 1992. International Standard Book No. 0-933427-22-0. Shipley Associates.

The *Shipley Associates Style Guide* is a comprehensive style guide containing state-of-the-art information on all conceivable concerns that preparers and writers of SAs may have on use of English grammar and style of document presentation. This guide also lists other published standard guidebooks that may be consulted for instructions.

This style guide may be obtained from:

Shipley Associates
P.O. Box 480
Bountiful, UT 84011

Another acceptable guide is:

Gregg Reference Manual. William A. Sabin, Ed., McGraw-Hill Publishers.

3.11 ABBREVIATIONS, ACRONYMS, AND GLOSSARY TERMS

The criteria to be followed depend on the subject matter and accepted conventions. For example:

- Capitalize all proper nouns, except when professional conventions dictate otherwise.
- Follow U.S. Geological Survey (USGS) conventions for geological terms.
- Follow American Physics Society (APS) conventions for physics terms.
- Follow conventions of the various engineering societies for engineering terms.
- Spell out the term/acronym the first time it is used, then follow with the term/acronym in parentheses.

- Refer to the *Glossary of Technical Terms* in the preliminary pages of this SA style guide.

Two documents that preparers and writers of SAs may find useful for referencing in the SA are:

- SAND89-0217, *Acronyms, Initialisms, and Abbreviations*
- SAND92-0192, *Environment, Safety and Health Glossary*

3.12 MEASUREMENTS

Writers of SAs must make the necessary effort to ensure that the style of using measurements in the text and illustrations is correctly and consistently applied. Measurement style that is inconsistently applied throughout the SA will distract the reviewer. Inconsistent style may create the impression that other data and parts of the SA are inconsistent and perhaps not entirely correct.

See the Shipley Associates Style Guide for detailed instructions on correct use of measurements.

Consult the *Shipley Associates Style Guide* for a detailed presentation of use of measurements in reports. Generally, adhere to the following to ensure correct and consistent use of measurements style:

- Use metric units followed by English units in parentheses throughout text.
- Abbreviate when appropriate and use proper style for abbreviations.
- Be consistent in use of abbreviations (if abbreviations are used in one section use them in all sections).

NOTE: The *Shipley Associates Style Guide* referenced in Section 3.10 above contains detailed guidelines on the state-of-the-art style for using and abbreviating measurements.

3.13 REFERENCES

Place the references that support the SA chapter text in a list at the end of each SA chapter to which they belong.

3.14 DUPLICATION OF INFORMATION

Avoid duplication.

Avoid duplication of information whenever possible. Information required in multiple sections of an SA should be presented only in the most appropriate section of the document, then referenced appropriately in all other sections.

3.15 DRAFT COPIES

Submit 10 copies.

To facilitate the review process, drafts of the SAs must be printed double-sided and be line-numbered on the left side of the page. Page/text dimensions are the same for final copies (see Section 3.16 below). Submit 10 copies of all drafts for review to:

Sandia National Laboratories
Risk Management and NEPA Department
P.O. Box 5800, MS 1037
Albuquerque, NM 87185-1037

No logos in the document!

No contractor logos or information on which company prepared the document shall appear anywhere in the document, except for the cover page.

3.16 FINAL COPIES

Along with publication-quality copies of the SA, submit a 3-1/2-inch diskette prepared using the computer word processing software authorized by SNL.

Final documents must be printed double-sided with 1-1/2-inch-wide margins and a 1-inch top margin. The text should end 1 inch from the bottom of the page, while the page number should be centered 1/2 inch from the bottom of the page.

Final copies are to be issued in 3-ring binders. If the document is prepared by a contractor, two unbound original copies of the SA shall be provided to SNL for reproduction purposes.

In addition to hard-copy documents, the preparer must provide a diskette (3-1/2 inch) for the document in the computer word processing software specified by SNL.

NOTE: Because software may change in the future, be certain to consult the Risk Management and NEPA Department before selecting the computer software to be used for word processing for SAs.

No logos in the document!

No contractor logos or information on which company prepared the document shall appear anywhere in the document, except for the cover page.

Submit the above deliverables to:

Sandia National Laboratories
Risk Management and NEPA Department
P.O. Box 5800, MS 1037
Albuquerque, NM 87185-1037

CHAPTER 4

APPENDICES

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CHAPTER 4: APPENDICES

Chapter 4 provides guidance on how and when to use appendices that contain supporting information relevant to the SA, but that do not belong in the body of the SA text.

4.1 INTRODUCTION

Appendices for SAs should contain any additional information the preparers and writers deem relevant, but which would distract a reader if it were placed within the body of the text. Appendices are supporting parts of the document.

For example, reviewers may turn to data in an appendix if they want to delve deeper into how certain information in the SA was derived. However, if these data had been placed up front in the text, readers would have been delayed or detoured as they waded through the data. Too complex data may even send readers in unintended directions. Complex data, calculations, graphs, lists of terms and definitions, etc. are examples of information that should be placed in appendices.

4.2 OBJECTIVES

The objective for this chapter is to illustrate the kinds of information that should be included in appendices rather than in the text of a SA.

4.3 SCOPE

One appendix that a SA should contain is a *List of Acronyms*.

Two related SNL documents that may be referenced in the SA are:

- SAND89-0217, *Acronyms, Initialisms, and Abbreviations*
- SAND92-0192, *Environment, Safety and Health Glossary*

An alternative, if appropriate, to these longer lists would be a short list to be included in the preliminary part of the SA.

NOTE: In the preliminary pages of this style guide, a *Glossary of Technical Terms* is provided because the list is short.

Another appendix that SAs should contain is a *Reference List of Applicable DOE Orders and Other Guidance Documents that Provide Necessary Guidance*.

Distribution:

MS0149	J. C. Cummings, 4000	MS1392	R. A. Smith, 2719
MS0151	J. L. Davenport, 9002	MS1392	M. G. Zimmerman, 2719
MS0312	R. G. Lundgren, 9814	MS9005	C. Schafer, 5300
MS0327	L. L. Bonzon, 2654	MS9020	D. Charlesworth, 8631
MS0352	K. L. Higgins, 1001	MS9037	L. D. Humphreys, 8200
MS0461	E. Scott-Patterson, 5501	MS9041	D. W. Putz, 8609
MS0517	B. Campbell, Domme, 2011	MS9054	W. J. McLean, 8300
MS0522	R. J. Welberry, 2502	MS9054	J. M. Michael, 8300
MS0555	V. Gabbard, Jr., 2707	MS9401	T. L. Garner, 8700
MS0557	G. L. West, 2701	MS9901	D. L. Mohrman, 8600
MS0631	R. A. Vigil, 12300	MS9018	Central Technical Files, 8523-2
MS0651	C. J. Pigg, 7711	MS0899	Technical Library, 13414
MS0658	R. G. Hay, 9819	MS0619	Print Media, 12615
MS0720	C. D. Massey, 6626	MS0100	Document Processing, 7613-2
MS0724	S. H. Weissman, 6000		
MS0727	M. S. Y. Chu, 6622		
MS0728	D. H. Berry, 6602		
MS0728	R. L. Hunter, 6602		
MS0747	A. L. Camp, 6412		
MS0948	J. A. Hands, 7734		
MS1017	W. K. Sanderville, 3300		
MS1035	J. J. Baremore, 7200		
MS1037	A. O. Bendure, 7285		
MS1045	M. M. Carroll, 7732		
MS1045	A. M. Fine, 7733		
MS1054	J. E. Stiegler, 7700		
MS1054	W. D. Burnett, 7701		
MS1056	B. L. Doyle, 1111		
MS1067	G. Chavez, 7000		
MS1093	W. G. Rhodes, 7714		
MS1094	E. H. Forbes, 7712		
MS1095	D. J. Thompson, 7713		
MS1135	M. S. Garrett, 2761		
MS1152	E. L. Neau, 1243		
MS1153	M. T. Buttram, 1248		
MS1170	G. A. Zawadzkas, 9302		
MS1175	L. A. Miller, 6513		
MS1193	D. D. Bloomquist, 1236		
MS1194	D. H. McDaniel, 1273		
MS1304	S. Ward, 7511		
MS1310	E. D. Conway, 7571		
MS1315	T. E. Blejwas, 7500		
MS1335	F. W. Bingham, 6301		