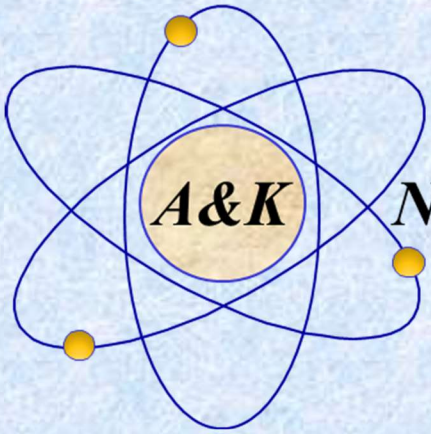
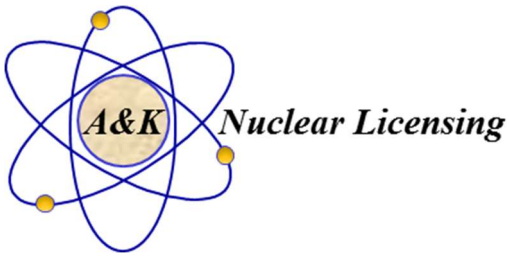


Nuclear Licensing

A&KRpt-2002
Revision 1
March 2021

Proto-Typical
Safety Analysis Report
Writers Guide

Kurt T. Schaefer



A&KRpt-2002
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Proto-Typical Safety Analysis Report
Writers Guide

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Table 4.4-1 Report Divisions

List of Abbreviations and Acronyms

Abbreviations or Acronyms	Definition
DCD	Design Control Document
FSAR	Final Safety Analysis Report
LAN	Local area network
LWR	Light water reactor
NRC	Nuclear Regulatory Commission
PSAR	Preliminary Safety Analysis Report
RG	Regulatory Guide
SAR	Safety Analysis Report
SMR	Small modular reactor
SRP	Standard Review Plan
SSC	System, structure or component
UFSAR	Updated Final Safety Analysis Report
USAR	Updated Safety Analysis Report

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1. INTRODUCTION

The following provides a noncompany-specific writers guide for use in highly regulated industries, i.e., nuclear industry. It is written such that it can be readily modified to be company-specific. This document is a compilation of information from numerous technical reports, publications, safety analysis reports, publication guidelines, writing guidelines and writing courses read, used, written and taken by the other author during the past 45 years in the nuclear power industry.

1.1 Purpose

The purpose of this guide is to provide a 90+ percent starting point document for generating a company-specific publication (writer's) guide. This guide provides guidelines and methods for preparing and producing various types of safety analysis reports (SARs), and technical reports that may be submitted to a regulatory agency. These methods include standard publication techniques and guidelines for proper grammar, syntax, abbreviations and word usage.

A plant license request submittal usually includes a SAR in the form of a Preliminary Safety Analysis Report (PSAR), Final Safety Analysis Report (FSAR) or a Design Control Document (DCD). Topic specific SARs are also submitted to a regulatory agencies to justify changes to a plants' current licensing bases, and to provide supplemental information to that in a PSAR, FSAR or DCD.

In some countries a SAR is labeled a "Safety Case."

1.2 Scope

The scope of this document includes guidelines for the general content and layout of SARs to be submitted for review and approval to a regulatory agency.

Guidelines are applicable to topic specific SARs, PSARs, FSARs, DCDs, and Safety Cases.

Appendix A provides principles of writing and grammar that should be implemented in the preparation of publications.

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2. PSAR/FSAR/DCD STRUCTURE AND CONTENTS

The structure and contents (i.e., the "Standard Format") for a PSAR/FSAR/DCD SAR were initially provided by U.S. Regulatory Guide (RG) 1.70 (last revised in 1978). However, the level of detail and the number of topics to be in a SAR has been significantly increased by the NRC's use of a Standard Review Plant (SRP), published in NRC NUREG-0800. Since the SRP's publication in 1981, numerous topics have been revised and the number of topics have been added.

Regardless, of how outdated the RG 1.70 Standard Format has become, its Introduction section is applicable and should be followed, when writing a modern PSAR/FSAR/DCD SAR.

2.1 Two-Step Plant Licensing Process

10 CFR 50.34 requires that each application for a construction permit for a nuclear reactor facility include a PSAR, and that each application for a license to operate such a facility include a FSAR.

The design information provided in a PSAR should reflect the most advanced state of design at the time of submission, within publication time constraints. If certain information is not yet available at the time of submission of a PSAR, then the PSAR should provide the criteria and bases being used to develop the required information, and any concepts and alternatives under consideration. In general, the PSAR should describe the preliminary design of the plant in sufficient detail to enable a definitive evaluation by the regulatory staff as to whether the plant can be constructed and operated without undue risk to the health and safety of the public.

Changes from the criteria, design, bases, and analysis results in the PSAR, as well as any new criteria, designs, bases and analysis results, should be identified within the FSAR submittal package. The reasons for and safety significance of each change should be discussed in the package. The FSAR should describe in detail the final design of the plant as constructed.

2.2 One Step Plant Licensing Process

From Appendix A of 10 CFR 52, a design control document (DCD) contains two documents, specified as Tier 1 and Tier 2.

The structure and format of Tier 2 is equivalent to a FSAR. Therefore, a DCD Tier 2 should have as much as reasonably possible final design information.

Tier 1 is that portion of the design related information contained in Tier 2 that is approved and certified by Appendix A of 10 CFR 52. The design descriptions, interface requirements, and site parameters are derived from Tier 2 information. Therefore, all Tier 1 information must be based on (i.e., taken from) Tier 2 information.

2.3 Proprietary Information in Detailed Engineering Reports and Drawings

A PSAR, FSAR or DCD is public document, thus should not contain proprietary information. Proprietary information should be provided separately, e.g., a topical report or drawing package.

It is common for two forms, a proprietary version and a non-proprietary version, of a topical report be submitted at the same time.

The Standard Format requests piping and instrument drawings, plant layout design drawings, process flow diagrams, functional control diagrams, test result diagrams, and other engineering

drawings. These types of detailed engineering drawing and diagrams are proprietary, thus should not be in a SAR. Both General Electric ESBWR and Westinghouse AP1000 DCDs contain simplified versions of proprietary engineering drawings.

A simplified drawing should contain only the information that shows or demonstrates the passive and active safety functions of a system, structure or component (SSC) as described in the SAR text, which refers to that drawing. For example, if a safety system has branch lines that are isolated when the system is performing a safety function, then the simplified drawing should include the safety to non-safety interface (e.g., closed valves) but not show the rest of the branch lines beyond those interfaces.

The results of testing, used to establish design parameters and acceptance, can be proprietary, thus (if requested) should be submitted separately form the non-proprietary SAR. However, the SAR may contain the final acceptance criteria and conclusions.

The establishment, qualification and design development analysis for calculational methods may also be proprietary, thus (if requested) should be submitted separately form the non-proprietary SAR. However, the SAR may contain their final acceptance criteria and calculation results.

Note, SAR safety analysis results required to demonstrate compliance with a regulation cannot be classified as proprietary.

2.4 Duplicate Information

Information should not be duplicated. Specific information should only be provided in the primary SAR location specifically provided to contain that information. Other SAR locations should reference the primary SAR location for the specific information.

RG 1.70 states; "*Duplication of information should be avoided. Similar or identical information may be requested in various sections of the Standard Format because it is relevant to more than one portion of the plant; however, this information should be presented in the principal section and appropriately referenced in the other applicable sections of the SAR. For example, where piping and instrumentation diagrams for the same system are requested in more than one section of the Standard Format, duplicate diagrams need not be submitted provided all the information requested in all sections is included on the diagrams and is appropriately identified and referenced.*"

2.5 Superfluous Information

A SAR should not contain superfluous information. If information is not requested by RG 1.70, the SRP or a regulatory transmittal, then that information should not be in the SAR.

SAR tables should only contain the information discussed in the SAR text. SSC design and analysis values that are not directly related to performing, ensuring or demonstrating a safety function do not need to be in a SAR. SAR tables are usually derived from internal design and analysis reports and records, which may have significantly more information than is needed in a SAR. This additional information would be superfluous in a SAR.

The Standard Format or a SRP may request design and analysis information on SSCs, functions and analyses that are not important to safety (e.g., do not describe, demonstrate nor ensure a safety function). With respect to this information a SAR's level of detail should be minimized. For

example, if a system has both safety and non-safety functions, (a) the safety functions should be described in sufficient detail to demonstrate regulatory compliance, and (b) the non-safety functions should only be listed and denoted as non-safety.

2.6 Addressing SRP Revisions and Acceptance Criteria

Each NUREG-0800 SRP section has its own revision. For an operating plant, the SRP revisions in affect at the time the plant's operating licensing was granted are applicable. Therefore, when justifying a change in a license amendment submittal to the NRC, the applicable SRP acceptance criteria should be addressed in the submittal's SAR.

For a generic (i.e., DCD based) or site-specific nuclear (PSAR/FSAR based) plant being licensed for the first time, the SRP revisions in affect within six months of the licensing submittal date are applicable to that plant.

In each DCD/PSAR/FSAR section, the corresponding SRP section's acceptance criteria should be addressed. Each SRP's "Review Procedure" provides guidance on what topics and level of detail the NRC diems acceptable in a SAR. Therefore, the Review Procedure should be evaluated to determine how best to address the acceptance criteria.

2.6.1 Addressing Non-applicable SRP Acceptance Criteria

RG 1.70 and the SRP were specifically written for conventional light water reactor (LWR) construction and operating license submittals. Particularly, LWRs with active safety-related systems. However, some LWRs (e.g., the ESBWR and AP1000) have some passive safety-related systems, and do not have nor need emergency diesel generator systems. In addition, newly and being designed small modular reactors (SMRs) have passive safety-related systems and are significantly different than conventional LWRs. Therefore, some SRP acceptance criteria are not directly applicable plants with passive safety systems and SMRs.

If a SRP acceptance criterion is not applicable, the DCD/PSAR/FSAR should (a) explain why the criterion is not applicable, and (b) describe how the plant complies with criterion's underling regulation(s), i.e., the basis for the criterion.

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3. PUBLICATION TITLES

It is standard practice to identify all publications and documents by title and/or identifying number to ensure identification and to be readily retrievable.

A SAR such as a FSAR typically would be titled "_____ Nuclear Power Plant Final Safety Analysis Report."

All printed publications shall be assigned a title appropriate to the contents. Titles of publications may include a subtitle or other descriptive matter; however, the most concise, descriptive title is preferred. Generic titles (i.e., "Topical Report", "Instruction", "Specification", etc.) should not be used alone, but shall be augmented by a phrase describing the content (e.g., "Topical Report – Safety Pump Generic Design Criteria").

The title of a publication shall be displayed on the title page and on the cover, if used. The title shall be displayed to achieve maximum recognition, regardless of the format of the cover or title page.

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4. GENERAL CONTENT AND LAYOUT

This section provides guidelines that should be applied to assure that the content of a publication meets acceptable standards of quality and discusses the general content requirements for publications. Detailed guidance for the authors of reports is provided in this section, as well as recommendations and requirements for specific publications such as engineering-controlled documents, instruction manuals, and procedural documents.

Section 5 provides specific SAR generation and updating guidance.

Appendix A provides a writing guide for use in generating the content of publications.

4.1 Readability

The level of quality in any publication or document begins with the level of readability and understanding of its content. Other things being equal, a well-written publication or document creates a positive impression with the reader/audience; in contrast, a poorly written publication or document creates a negative impression. When text is not precise or of professional quality, misunderstandings or confusion can result.

This section provides some basic concepts for effective writing. These can be applied to any form of publication or document.

The primary purpose of good writing is to precisely communicate information in its most direct form. The following basic rules are provided as a starting point:

- All parts of a sentence must be clearly related.
- Keep sentences short, precise, and fewer than 21 words (15 is better).
- There must be two (2) spaces after the end of each sentence.
- Correctly use verb tenses to indicate the proper time and sequence of events.
- In complicated construction, avoid using a singular pronoun with a plural antecedent, or using a singular subject with a plural verb.
- Hasty, sloppy writing carries with it the inherent risk of the omission of words necessary for grammatical or logical completeness.
- Unnecessary words obscure the meaning and waste the reader's time. For clarity, emphasis, and conviction, avoid circumlocutions and pointless repetitions.
- Do not “pile up” adjectives and nouns used as adjectives; the result is impaired readability.
- Assure all sentences within a paragraph are clearly related to the main topic of the paragraph.
- Avoid large paragraphs by making each paragraph related to a single topic and less than 125 words.
- Technical writing should be in active present tense as much as possible.

4.2 Use of Abbreviations, Acronyms and Company Initials

The following contains recommendations and requirements for the general content of publications and documents. Recommendations for the use of abbreviations and acronyms are included, as are requirements for the use of trademark names and references to the *Company* and its components.

4.2.1 Abbreviations and Acronyms

An abbreviation or acronym does not communicate information to the reader unless it is familiar to the reader. The use of abbreviations and acronyms should be adapted to the understanding of the reader. If in doubt, do not use the abbreviation or acronym. It is of particular importance in the writing of documents and publications for foreign readers that abbreviations and acronyms be used sparingly. Each first usage of an abbreviation or acronym in a document should be preceded by its spelled out version, e.g., “coolant injection pump (CIP).”

If available, the *Company* dictionary of abbreviations, acronyms and definitions should be consulted for abbreviations and acronyms.

4.2.1.1 Abbreviations

In non-technical reports, it is good practice to spell out simple units of measurement (e.g., foot, feet, inch, inches, seconds, minutes) in the text of publications instead of using abbreviations.

In technical reports, abbreviations of units may be used, but only if previously defined.

Abbreviations of units of measurement are acceptable in equations, but only if previously defined or defined within the same section/subsection of the document.

Abbreviations may be used freely on graphs, diagrams, or tables (where space is limited), if the meaning of each abbreviation is clear and has been defined.

It is acceptable to use abbreviations that are so well known that they are commonly accepted as part of everyday vocabulary, e.g., ac and dc with regard to electric power.

4.2.1.2 Acronyms

Acronyms may be used:

- When the phrase is used repeatedly.
- If the acronym is better understood than the phrase for which it stands.
- If use of the acronym will make the sentence read "more smoothly."
- In tabular and illustrative material to conserve space.

The definite article, *"The",* must precede acronyms used in place of full names and titles in those cases where such use would normally occur.

Examples:

Use -

"It is the policy of *the* Nuclear Regulatory Commission...,"

"It is the policy of *the* NRC....,"

Not -

"It is the policy of Nuclear Regulatory Commission..."

"It is the policy of NRC...," *or*

Acronyms should not be used:

- If the sentence (or table or figure) is ambiguous when the acronym is used (e.g., FW should not be used to mean both feedwater and fresh water),

- If such use results in an over-proliferation of acronyms,
- If the term is used only a few times in the entire document,
- To begin a sentence, or
- In a heading.

4.2.2 References to the *Company* Initials

Only if a *Company* has a management-approved "company initials" acronym should initials be used to identify the *Company*.

4.2.2.2 References to *Company* Components

References to *Company* organizational components in *Company* publications shall be in accordance with the current and accurate component titles as given in the applicable *Company* organization directory. Assure that such titles used in publications and documents are complete and accurate as of the date of the document or publication.

Acronyms may be used for *Company* components to avoid excessive repetition of component names. In all such cases, the full name of the organizational component must appear at least once prior to the use of the acronym and the guidelines contained in Section 4.2.1 should be applied.

4.3 Report Structure

The following paragraphs contain general discussions and guidelines for the content, format, and preparation of technical reports (e.g., a SAR). This report uses the formats and styles described within this section.

4.3.1 Divisions of a Report

Reports differ from one another in the number and levels of divisions that must be used to logically provide the contents of each section in each report.

4.3.2 Styles and Formats

The following provides a prototypical format for technical documents. Samples of the basic page setup for headers, footers and the body of text, as well as the various levels of headers, body copy, indented matter, etc., are included.

4.3.2.1 Page Formats

Text pages shall be oriented in Portrait.

Tables and Figures may be oriented in either Portrait or Landscape; however, Portrait is preferred.

Table and Figure pages may be as large as 11 inches x 17 inches.

Normally, pages should have 1.0 inch top, bottom, left, and right margins, with headers and footers 0.5 inch from the top and bottom. However, for Landscape tables and figures, the right and left margins may be as little as 0.75 inch.

4.3.2.2 Headers and Footers

Headers and footers are normally centered at 0.5 inch from the edge of the page. The 12 point Times New Roman font is used for one-line headers and footers. Headers and footers consisting of two or more lines use the 10 or 11 point Times New Roman font. The header style in this report is titled "*Header*." The footer style in the report is titled "*Footer*."

4.3.2.3 Text, Sentences and Paragraph Style

Text, sentences and paragraphs for the "*Standard Text"* style are described below.

- The text should be in the 12 point Times New Roman font.
- For legibility, sentences are **always** followed by two (2) spaces.
- Blank lines should **not** be used for paragraph separation.
- Paragraphs should normally use the "Justified" alignment, have no (0) spacing before and 6 points spacing after, be single spaced but set with "At Least 14 points."
- Generic tabs should be set at 0.375 inch increments (0.375, 0.75, 1.125, etc.). However, tab spacing may be adjusted as needed for clarity or emphases.
- "*Widow/Orphan control*" should be active.

Note: Using of only one space between sentences and left justification make a paragraph harder to read and understand.

4.3.2.4 Headings

Except for major chapter and appendix headings (e.g., 1.0, 2.0, Appendix A, Appendix B), which are centered, all headings are left aligned. Levels of section/subsection headings should have 12 point spacing before and 6 point spacing after, and "*Keep with next*" should be active.

Each chapter should start on a new page, and its heading should have 12 point spacing before and 12 point spacing after. Chapter headings (style "*Heading 1*") use the bold, 12 point **Arial** font, with all capital letters.

All section and subsection numbers should start at the left margin.

Second level section (e.g., 2.1, 2.2, 2.3) headings (style "*Heading* 2") use the bold, 12 point **Arial** font, with only the first letter of each word (except small words such as "and," "or," "to" and "of") capitalized. The section title text should start at 0.5 inch from the left-hand margin, by setting a *Tab* and *Hanging* indent at 0.5 inch.

Third, fourth, etc. level section (e.g., 2.1.2, 2.2.1.2, 2.3.2.3.3) headings (styles "*Heading* 3," "*Heading* 4," "*Heading* _,") use the bold, 12 point **Times New Roman** font, with only the first letter of each word (except small words such as "and," "or," "to" and "of") capitalized.

A third level section/subsection (e.g., 2.1.3) title text should start at 0.625 inch from the left-hand margin, by setting a *Tab* and *Hanging* indent at 0.625 inch.

A fourth level subsection (e.g., 2.1.3.2) title text should start at 0.75 inch from the left-hand margin by setting a *Tab* and *Hanging* indent at 0.75 inch.

Fifth, sixth and follow-on subsections should have their title texts start at 0.125 further increment from the left-hand margin, by setting their *Tab* and *Hanging* indents accordingly.

4.3.2.4.1 Appendix Headings Fonts and Line Spacing

Appendices are ordered by capital letters, e.g., A, B, C. If an appendix is associated with a chapter or section, precede the A, B, etc. by the chapter or section number, e.g., #A, #B. Therefore, the first section of Appendix A to Chapter 3 would be numbered "3A.1," and the second section of Appendix B to Section 4.2 would be numbered "4.2B.2."

4.3.2.5 Bullet Listings

- A first level bullet list (style "*Bullet 1st Level List*") is indented 0.25 inch from the left-hand margin, uses a 0.25 inch *Hanging* indent and the "Justified" alignment, and each item within the list is preceded by a bullet. The first letter of the first word of each line item is usually capitalized, and each line item ends with a period. The line items are separated by 6 points of spacing. Note, if the items listed only consists of a few words each, for example, units of measure (e.g., days, pounds, inches, etc.), components (e.g., pumps), or plant systems (e.g., Diesel Generator System), a period is not used at the end of the item. If the list is an extension of a sentence, then semicolons ";" are used after each line item, except for the last line item, which should end with a period.
    - A second level bullet list (style "*Bullet 2nd Level List*") is indented 0.5 inch from the left-hand margin, uses a 0.25 inch *Hanging* indent and the "Justified" alignment, and is preceded by an open bullet. All other rules used in a first level list apply.
        - A third level bullet list (style "*Bullet 3rd Level List*") is indented 0.75 inch from the left-hand margin, uses the "*Left*" alignment, and is preceded by a square. All other rules used in a first level list apply.

4.3.2.6 Numbered Listings

1. If a list comprises a step-by-step procedure or process, is referenced in other parts of the document, or would be better understood if numbered, then each item in the list is preceded by a number followed by a period, as shown here. A first level numbered list (style "*Numbered 1st Level List*") is indented 0.25 inch from the left-hand margin, uses a 0.25 inch *Hanging* indent and the "Justified" alignment, and each item within the list is preceded by a bullet. The first letter of the first word of each line item is usually capitalized, and each line item ends with a period. The line items are separated by 3 to 6 points of spacing. Note, if the items listed only consist of a few words each, for example, units of measure (e.g., days, pounds, inches, etc.), reactor components (e.g., pumps), or plant systems (e.g., Diesel Generator system), a period is not used at the end of the item. If the list is an extension of a sentence, then semicolons ";" are used after each line item, except for the last line item, which should end with a period.
    a. A second level numbered list (style "*Numbered 2nd Level List*") is indented 0.5 inch from the left-hand margin, uses a 0.25 inch *Hanging* indent and the "Justified" alignment, and is preceded by a letter, as shown here. All other rules used in a first level list apply.

i. A third level numbered list (style "*Numbered 3rd Level List*") is indented 1.0 inch from the left-hand margin, uses the "*Left*" alignment, and is preceded by lower case roman numerals (i., ii., iii., iv., etc.). All other rules used in a first level list apply.

ii. (This line shows how additional line items will appear.)

4.3.2.7 Tables and Figures

4.3.2.7.1 Numbering

Both tables and figures use the same numbering sequence. Normally, a table/figure is associated with a Chapter # or a section #.#, is numbered in a "#-#" or "#.#-#" format, and is numbered in the order that it is first addressed in that section. For example, the 2nd table discussed in Section 5.4 would be numbered "Table 5.4-2."

For very long sections, in which clarity would be gained if tables/figures were associated with a #.#.# subsection, the tables/figures are associated with the #.#.# subsection number, are numbered in a "#.#.#-#" format, and are numbered in the order that it is first addressed in that subsection. For example, the 3rd figure discussed in Subsection 15.4.2 would be numbered "Figure 15.4.2-3."

Note: Between Table or Figure or Section and its number, it is useful to use a nonbreaking space by clicking "Ctrl+ Shift+spacebar" at the same time.

Do **not** re-order or number tables and figures, when making revisions. Usually, if a table or figure is being added, then it gets the next higher number available for that section.

If table or figure #.#-# is being replaced with 2 or more tables or figures, then replace #.#-# with #.#-#a, #.#-#b, etc.

If table or figure #.#-# is being supplemented with 2 or more tables or figures, then keep #.#-# and add #.#-#a, #.#-#b, etc.

4.3.2.7.2 Titles

Both table and figure titles

- Should be centered,
- Should use12 point (non-bold) Arial for the table identification and Arial Bold font for the title, and
- May be either in Portrait or Landscape page layout.

A table title should appear above the table. Table titles are normally to be provided on two lines (using style "*Table Title*"), separated by a space and a soft return (shift enter function), using with 0 point before and 6 points after spacing, with "Table" and its number un-bolded, as shown below.

Table 1.2-1
Pressure Analysis Results

Figure titles should use the "*Figure Title*" style, where the title is provided on one line with a period and two (2) spaces after the number, using single line spacing with 6 points before and 0 points after, with "Figure" and its number un-bolded, as shown below. SAR figure titles are

usually located below the actual figure. However, a graphics box may continue to be used for figure titles.

Figure 1.2-1. **Pressure Analysis Curves**

Some reports use graphics boxes for figure identification. A graphics box is usually located in the lower right corner of the page, and looks something like the following:

Figure 15.1.1-3

Reactor Coolant System Pressure Resulting Form a Turbine Generator Trip

Rev. _ "Date"

Provide at least one page in the chapter/section file for each table and figure that is greater in size than half a page, even if some of the tables or figures are supplied separately in a different file format (e.g., pdf). On the table/figure pages, include the table/figure number and title using the "*Table Title*" / "*Figure Title*" styles. This way a List of Tables and a List of Figures can be easily generated using one of the MS Word Insert functions.

A small table or figure may be inserted between text paragraphs, following the first paragraph that references to the table/figure.

4.3.2.7.3 Table Entry Formats

Table entries may use 12 to 10 point Times New Roman fonts or 8 point Arial font, however, 12 and 10 points are preferred.

Table entries should use single line spacing with

- 2 points before and 2 points after paragraph spacing for 12-11 point fonts (e.g., styles "*Table Left 12 Pt Times*" and "*Table Center 12 Pt Times*");
- 1 point before and 2 points after paragraph spacing for 10 point font (e.g., styles "*Table Left 10 Pt Times*" and "*Table Center 10 Pt Times*"); and
- 1 point before and 1 point after paragraph spacing for 8 point font (e.g., styles "*Table Left 8 Pt Arial*" and "*Table Center 8 Pt Arial*").

In some cases, line spacing and/or font size may need to be modified for a table to fit a page properly. However, try not to introduce a new MS Word style.

4.3.2.8 Footnotes and Endnotes

Footnotes and endnotes are not usually used in an FSAR, but may be used in other types of documents. Use the MSWord *REFERENCES > Footnotes* functions to insert footnotes and endnotes.

4.3.2.9 References

4.3.2.9.1 Use and Level of Detail

References should **not** be embedded within text nor a table. Within text and tables, references should only be referred to by number, and the full identifying details of the references should be in a *References* list section.

For example, do not write -

> "Trans Ware Enterprises Inc. Report ENT-FLU-002-R-001, Revision 0, "JAF Reactor Pressure Vessel Fluence Evaluation at End of Cycle 17 and 54 EFPY," dated October 2007 was prepared to support License Renewal. This fluence evaluation was then the input to Structural Integrity Associations, Inc. Calculation Fitz-10Q-302, Revision 0, "Revised P-T Curves," dated February, 2008."

Instead, just add the two references to the Reference section and write something like -

> "The pressure temperature (P-T) limits curves (see Reference 8) are based (in-part) on the fluence calculation results from Reference 9."

Each reference shall always be ordered as follows:

1. Reference number,
2. Author, which is the proper company name and **not the person** that works for the company,
3. Document type, if specified,
4. Title in quotation marks,
5. Document number, if specified;
6. Document classification, e.g., Class __ (Non-proprietary) and Class __ (Proprietary), if specified,
7. Revision number, if specified,
8. Date published, and
9. Page number(s), if needed for readily finding specific information.

If a report is written by a *Company*'s employee, then the author of a report should be the company name (as shown on the cover of each report), and **not** the employee who generated the report.

If a reference contains proprietary information that is to be submitted to a regulatory agency, then the reference must include the non-proprietary version. However, not all information within a report is proprietary, and the non-proprietary information may be put in the regulatory submittal. Proprietary reports should have the proprietary information clearly denoted/indicated in some manner.

A "*References*" list section should only include references specifically addressed within the section's text and tables. Regulatory documents and other documents readily available publicly do not require entries in the "*References*" list section. However, a regulatory agency request for information may force an unnecessary reference to be added to the "*References*" list section.

In submittals to a regulatory agency, **do not** include any reference that is not intended to be or allowed to be sent to that agency.

Note: The MSWord "*Insert Comment*" function can be used to document references and calculation numbers that are not intended to go to the regulatory agency. These types of references are commonly referred to as "annotations."

4.3.2.9.2 Reference List Format

A reference list uses the "*References List*" style, which

- Uses full "Justified" alignment,
- Uses the 12 point Times New Roman font,
- Is single spaced with 0 point before and 6 points after each entry,
- Indents at 0.25 inch from the left-hand margin with 0.375 *Hanging* indent, and
- May be simply numbered 1, 2, 3, etc. or modified to use section level (i.e., #-# or #.#-#) numbering. If section level numbering is used, then a larger *Hanging* indent value shall be needed.

4.3.2.9.3 Example Reference List

1. General Fixit Co., "G-3 Heat Transfer Analytical Model," GFCN-00531, Class C1 (Non-proprietary), Revision 0, July 1979.
2. General Fixit Co., Design Model Report, "Safety Structure Analysis Method (SAAM)," GFCE-13450-P, Class C3 (Proprietary), Revision 0, January 1997; and GFCN-13450, Class C1 (Non-proprietary), Revision 0, May 1997, pages 3.3-7 through 3.3-12.
3. General Fixit Co., "PIPE-G Methodology for High Pressure Piping," GFCE-12463-P-A (____ [government agency] accepted), Class C3 (Proprietary), Revision 1, November 2002; and GFCN-12463-A (_____ [government agency] accepted), Class C1 (Non-proprietary), Revision 1, December 2002.

4.3.2.10 Page Numbering

The preferred number system uses a lower case Roman numeral "i, ii, iii,..." format for the pages prior to the first section. For report sections, use either a simple 1, 2, 3, etc. format or a section "#.#-#" format.

4.3.2.11 Table of Contents, and Lists of Tables, Figures, and Forms

The level of detail in the *Table of Contents* goes down to at least the third level section number (i.e., #.#.#). Subsection levels beyond the fourth level section are usually not needed. The section/subsections listed in a Table of Contents should include their page numbers.

All tables shall be included in the *List of Tables*. This list does not need to include page numbers.

All figures shall be included in the *List of Figures*. This list does not need to include page numbers.

If applicable, all forms shall be included in the *List of Forms*. This list does not need to include page numbers.

4.4 Report Structure

Report structures vary depending on the purpose and amount of information in each report. Some of the possible divisions of a report are shown in Table 4.4-1. Each division is discussed in detail after the table.

Table 4.4-1
Report Divisions

Example A	Example B (Larger Report)	Very Large Safety Analysis Report [4]
Title Page	Title Page	Report Title Page
Copyright, Proprietary and Legal Notices [1]	Copyright, Proprietary and Legal Notices [1]	Chapter 1 Title Page
Preface [1]	Changes from Previous Revision [1]	Chapter 1 Contents: • Table of Contents • List of Tables • List of Figures • List of Abbreviations and Acronyms

Foreword [1]	Preface [1]	Chapter 1 Sections 1.#
		• Text
		  o Technical Information
		  o References
		• Tables
		• Figures

Contents: [1, 2] • Table of Contents • List of Tables • List of Figures • List of Abbreviations and Acronyms	Foreword [1]	Chapter 2 Title Page
Abstract [1]	Contents: [1, 2] • Table of Contents • List of Tables • List of Figures • List of Abbreviations and Acronyms	Chapter 2 Contents: • Table of Contents • List of Tables • List of Figures • List of Abbreviations and Acronyms

Table 4.4-1
Report Divisions

Example A	Example B (Larger Report)	Very Large Safety Analysis Report [4]

Acknowledgements [1, 3]	Abstract [1]	Chapter 2 Sections 2.#
		• Text
		  ○ Technical Information
		  ○ References
		• Tables
		• Figures

Main Portion of Report
• Introduction
• Technical Discussion [1]
  ○ Descriptions
  ○ Experimental, Test or Process Procedures
  ○ Analytical Methods
  ○ Evaluations/Analyses
• Results
• Recommendations [1]
• Summary [1]
• Conclusions
• References
	Acknowledgements [1, 3]	Additional Chapters and Sections, as needed.

Appendices [1]	Main Portion of Report
	• Summary
	• Conclusions
	• Introduction
	• Technical Discussion [1]
	  ○ Descriptions
	  ○ Experimental, Test or Process Procedures
	  ○ Analytical Methods
	  ○ Evaluations/Analyses
	• Results
	• Recommendations [1]
	• References
		Appendices [1]

Distribution List [1]	Appendices [1]	
	Distribution List [1]	

[1] As applicable/needed

[2] Smaller reports may not need a formal Contents section

[3] Normally on same page as the Abstract

[4] For submittal to a regulatory agency

4.4.1 Title Page

Reports for distribution outside the *Company* have a formal title page. A title should be as short as is consistent for clarity. Titles should not convey too little, nor suggest more than is contained in the substance of the work. Superfluous words, such as "A Study of', "An Investigation of', "A Final Report on", or "A Note on", should not appear in a title. As applicable to a specific report, a title page usually contains the following information.

1. *Company* logo (per *Company* signature requirements)
2. Report number
3. Revision number
4. Date
5. Document classification designation
6. Title
7. Author(s) (optional)
8. Contract number (if applicable)
9. Approvals, as required.

4.4.2 Copyright, Proprietary, and Legal Notices

PSARs, FSARs and DCDs are public documents, thus shall not contain proprietary information, and need not contain a copyright statement.

As required for technical reports, a proprietary notice, legal notice or disclaimer and/or a copyright are placed (following the title page) in each report, as required.

4.4.3 Changes from Previous Revision

Some reports (e.g., engineering, design and licensing reports) are expected to be revised. To assure a clear understanding of the changes between revisions, each change and a short explanation for that change may be inserted at the beginning of each follow-on revision.

4.4.4 Preface

Only in rare instances is it advisable to include a Preface in a report, and it gets *iii* page type number. A Preface might contain the following:

- Information on the circumstances in existence before the work was started on the project.
- An explanation of why the report was prepared.
- Some significant details of the history of the work.

A Preface is frequently prepared by someone other than the report author, such as a noted authority or the author's sponsor. The Preface should not be confused with the Introduction.

4.4.5 Foreword

A foreword is not required in all SARs, and it gets *iii* page type number. Certain documents may require an introductory explanation, and others may contain a prepared foreword by a government agency or commercial contractor.

4.4.6 Contents

The contents portion of a report (see above tabulation) provides indices (lists of Chapters, Sections, Tables and/or Figures numbers and their titles) that provide a brief idea of the subject matter and detail within the report. A complex Contents is not necessary unless the report is very long. The Contents usually consist of the first- and second-order headings and the respective page numbers. (Third-, fourth- and additional-order headings may be included, if needed for guiding a reader to a specific subject within a large report.) Lists of tables and figures should be included if there are three or more tables or figures. The contents pages have page *iii* type numbers.

4.4.7 Abstract

An Abstract is not a part of a report, but rather an adjunct intended to briefly convey the content of the report, and to draw attention to all new information and to the main conclusions. (Readers use the Abstract to decide whether the report is pertinent to their areas of interest.)

SARs do not contain an Abstract, but an Abstract may be added to smaller reports.

There are two general types of abstracts: indicative (descriptive) and informative. The indicative abstract is short and is solely written to help the reader decide whether to read the entire document. The informative abstract is a summary of the major arguments and contains the principal data and conclusions that make valuable contributions to knowledge or are likely to be of use to the specific class of readers for whom it was prepared.

The Abstract should contain:

- A statement of newly observed facts, conclusions of a test or evaluation and, if possible, the essential parts of any new theory, treatment, apparatus, or analytical technique.
- A reference to new items and observations even though they may be incidental to the report.
- The methods used in the evaluation or test. For new methods, include the basic principle, range of operation, and degree of accuracy.
- A reference to previously published documents if the report is one of a series.

The Abstract should not contain numbered tables, figures, equations, preliminaries, descriptive details, footnotes, or references.

4.4.8 Introduction

SARs usually contain an Introduction chapter, and a smaller report may contain an Introduction section.

An Introduction is a convenient place to describe the purpose of the report, summarize the content of the report, and orient a reader so that the main body of the report can be followed clearly and be understood. An Introduction should be brief and concise.

The minimum contents of an Introduction are (a) a statement of subject and objective, (b) a clarification of the situation or circumstances, which made the preparation of the report desirable, and (c) a brief explanation of the general methods used to reach the results or desired answers.

4.4.9 Technical Discussion

The Technical Discussion contains the essential information for solving the problems described in the introduction, and for arriving at the conclusions and/or recommendations. This is the detailed section of the report, and usually consists of several parts. Each of these parts is related, but the specific parts may be distinct as to treatment. The headings and subheadings for the body of the report depend on the material being presented.

For long reports, suitable divisions and subdivisions (e.g., sections and subsections) should be provided to lead the reader through a logical sequence of thought.

Each section/subsection should have a heading. The headings should be brief and descriptive of the material following. A heading at any level should be followed by at least a phrase of introductory discussion or explanation before the material within that division is introduced.

4.4.9.1 Descriptions

The materials, topics and processes tested, measured, evaluated or analyzed should be described in full. All significant details should be included and discussed.

4.4.9.1.1 Experimental, Test, or Process Procedures

Provide a concise description of the techniques, methods, steps, and apparatus used in the measurement, experiment, test, or process. The materials described in the preceding section should be mentioned and identified with the procedure used in treating them. If the equipment, tests or process steps used are not standard, they should be described so that the work can be duplicated by others, and the accuracy and precision can be judged.

4.4.9.1.2 Analytical Methods

Provide general evaluation or analysis methods and related process steps used to obtain the documented results. These should be described in sufficient detail as to allow a knowledgeable reader to be able to judge the technical applicability and accuracy of the analysis models and steps used.

4.4.9.1.3 Evaluations/Analyses

Provide the detailed evaluation/analysis (a) test/experiment results inputs, (b) design inputs, and (c) assumptions used with the analytical methods and related process steps to obtain the documented results. These should be described is sufficient detail as to allow a knowledgeable reader to concur that the analytical methods were correctly used, thus the evaluation/analysis results should be technically acceptable.

4.4.9.2 Results

The test, experiment, evaluation or analysis results should be presented in full detail in an engineering report, while on the essential results are provided in a SAR. However, results presented in the previous report sections may be referenced, and summarized in the Results section.

Results known to be invalidated by experimental or other errors may be discarded. However, if the error affects the results in part, it is acceptable to use the result and mention the existence of the error (without apology). If no conclusive result was obtained, then it should be so stated.

It may be desirable to expand the results by discussing them in more detail. This is the part of the report that connects the factual data with the conclusions. The reader should be led through the reasoning necessary to reach the conclusions and to agree that they are sound. Simple, straightforward statements are more easily understood.

4.4.9.3 Recommendations

If there are valid recommendations, clearly state each recommendation such that there can be only one interpretation. If there is no valid recommendation, then do not include a recommendations topic in the report.

SARs do not contain recommendations.

4.4.9.4 Summary

For smaller reports (i.e., non-SARs), a summary may be provided later in the report. However, in a large report, such that the general reader is not likely to read the entire report, the summary usually appears at the front of the report following the abstract (or in place of the abstract) and should contain

- introductory thoughts, the problem or question, and the importance of the work,
- what was done and how, and
- the results.

The summary should not contain numbered tables, illustrations, equations, references or footnotes.

4.4.9.5 Conclusions

Report readers may be more interested in the conclusions from the analysis or the results interpreted from a test or experiment than in how the work was done. Conclusions must be complete, concise and definite.

Conclusions drawn from the findings should be presented in the same order as the findings on which they are based. Clearly distinguish between the factual trends and the inferences drawn from them. Try to answer questions the reader might ask. Document each specific conclusion.

If a report is only written for record keeping or to just provide results or information, then a conclusion may not be needed.

4.4.9.6 References

References are numbered consecutively throughout a report or by section, and are listed in numerical order at the end of the report or at the end of the section, if numbered by section. The reference number should appear directly after mention is made of the previously published idea or result. A detailed discussion of references and samples of a recommended style are given in subsection 4.3.2.9. Note: do not place a reference number in a heading or title of a table or figure.

4.4.10 Appendices

Appendices are used to present supplementary information that (a) is necessary for completeness but would detract from the orderly and logical presentation of the work if inserted into the main body of the report, and (b) may be omitted by the general reader but would be valuable for the specialist.

Appendices are self-contained units of a report. Each appendix should have (a) a separate number/letter (usually identified by a capital letter) and title, (b) figures, tables, equations, and references numbered to match the appendix number, and (c) a separate reference listing (if applicable).

4.4.11 Distribution List

SARs do not have a distribution list.

4.5 Other Editorial and Report Production Guidelines

The following provides the guidelines on various other editorial topics.

4.5.1 Numerals

The following are general rules for the use of numerals (1, 2, 3…) in text:

1. Avoid placing numbers in text. Where practical, numbers should only be provided in tables and figures, and the text refers to the locations of the specific values. Having all or most numbers in tables and figures allows large technical reports to be more easily revised.
2. Use numerals whenever a number is followed by a standard unit of measurement, such as gram, meter, milliliter, hour or curie, or its abbreviation.
3. Use words one through nine and numerals for larger numbers (e.g., nine animals, 14 parts). However, in a sentence containing some numbers under 10 and other numbers over 10, use numerals for all. Treat ordinal numbers in the same manner (third, 33rd).
4. In very large numbers, substitute a word for part of the number (write 1.2 million, instead of 1,200,000), or add appropriate prefixes, such as mega or kilo, to the basic unit of measurement. Powers of 10 may also be used.
5. Always use numerals for dates, page numbers, and numerical designations, percentages, and expressions of time.
6. Do not begin a sentence with a numeral.

4.5.2 Information Duplications

Except as needed in Summary and/or Conclusions sections, information should not be duplicated. Specific information should only be provided in the primary report location specifically provided to contain that information. Other report locations should refer to the primary report location for the specific information. This approach allows for making faster and more accurate report revisions.

4.5.3 Footnotes

Footnotes should be designated by symbols and not by superscript numerals. The use of asterisks, daggers, and combinations of both is suggested. Footnotes appear on the bottom of the page on which they are mentioned.

Where a footnote is necessary in a table, superscript lower case letters shall be used and the footnote appears at the bottom of the table. A table is considered to be a separate entity, as is an illustration, and is treated the same way. If the table contains a reference, the reference may be placed underneath the table as well as in the reference list at the end of the report body.

4.5.4 Tables and Tabulations

Tables are used to present numerical data in concise form so that the reader can quickly understand the significance of, and the relationship between, various sets of numbers. Numbers tabulated in related sets are an efficient and understandable manner of presenting complex data. A SAR should only include values needed to meet regulatory requirements.

Every table must have a brief and descriptive title. Tables are numbered in Arabic numerals consecutively or by section in the order of their appearance. The table number and title are centered above the table. Each table must be specifically referenced in the text. The text reference should precede the table, and the table placed as close to the text reference as possible. (Note: it is acceptable to place tables at the back of each chapter or major section in long reports.) A full-page table may be placed immediately after the text page containing its reference, whereas a part-page table may be placed at the end of the paragraph containing its reference, or, if this is not practical, at the top of the succeeding page. Tables that continue beyond a single page shall be formatted such that the table title and column heading shall be identified at the top of each succeeding page.

A small table (tabulation), one that will not be referred to later, may sometimes be inserted in the middle of a paragraph without being assigned a number and title, so that it forms a part of the text. However, each table is normally assigned a number and title.

The title, subtitle, column headings, and footnotes of a table shall be sufficiently explicit to make a table self-explanatory (i.e., so complete in itself that the reader does not have to refer to the text to comprehend its contents). Similarly, the text of a report should, if possible, be so worded that the reader does not have to refer simultaneously to a table located on another page to make the text intelligible.

Units of measurement should be specified where applicable; usually the column or row heading is a convenient place to specify units. In a column of values of similar units, the decimal points should be aligned, and decimals less than one should have a zero preceding the decimal point. In columns of unlike units, particularly where the magnitudes differ greatly, the numerals may be centered in the column. The use of footnotes in tables is often convenient and may be preferable to a column of remarks/comments. In preparing column headings, abbreviations may be used if they are defined. If some of the quantities in a column are negative, a plus or minus sign should be prefixed to each value in the column. If the values in a column are all in the same units, it is better to express the unit in the column heading than to list it after the items in the body of the table. However, if miscellaneous units occur in a column, then each unit should be clearly indicated.

4.5.5 Illustrative Material

Illustrative material (i.e., figures) should be used whenever it will aid communication and support the text. Figures are useful in presenting details that are difficult to describe in words. The illustrative material used in technical reports is divided into two groups: half-tones (photographs) and line drawings.

Figures can be oriented in Portrait or Landscape, and can be on any page size up to an 11 inch by 17 inch.

The conventions for numbering and titling figures are provided within subsection 4.3.2.7.

When a figure consists of two or more parts, each part may have a descriptive subtitle, and the figure as a whole has a title. The Figure title is given in the List of Figures, but the subtitles of the parts need not be included in the List of Figures.

A figure should not be included in a report unless it is specifically referred to in the text. The text reference should precede the figure, and the figure placed as close to the text reference as possible. However, if the document does not lend itself to such format (e.g., fewer text pages than figures or a large report), the figures can either be placed at the end of the chapter/section or displayed in a separate Appendix (referenced within the main body of text). Part-page illustrations should be placed at the end of the paragraph containing its reference, or if this is not practical, at the top of the succeeding page. Part-page figures should have sufficient space both above and below to prevent confusion with text matter. Sizes of part-page figures must be determined before the text is composed.

4.5.5.1 Half-Tone Photographs

High quality black/white or color reproductions of photographs can be made from hardcopy or electronic sources. If the source document (photograph) exists only in hardcopy form, an electronic image of the document can be scanned into a digital copier. A photograph can be resized, if necessary, before making printed copies or inserting it into the document.

If the source document (photograph) exists in electronic form, it can be networked to a digital copier for reproduction.

4.5.5.2 Drawings

Drawings include schematic and wiring diagrams, piping and instrumentation diagrams, mechanical drawings, pictorial and perspective drawings, and graphs. Drawings should be resized, if needed, to fit on a page with sufficient room for the figure title line.

4.5.5.3 Graphs and Curves

According to established convention, independent variables are plotted horizontally and dependent variables are plotted vertically. Complete scale information must be given along the axes of each graph. Each scale label should give the name of the variable and the unit in which it is measured; for example, Frequency (MHz), or Current (A).

Curves should be heavier than the heaviest grid lines. Grid lines may be omitted entirely, and tick marks along the axes used to show scale divisions. Each tick mark that indicates a major division must be numbered, and the numbers placed outside the grid area.

Whenever more than one curve is shown in one figure, it must be possible to distinguish and identify each curve. Individual callouts or labels for each curve should be used if possible. If physical complications prevent the use of callouts, then the curves should be distinguished by either drawing them in differing lines and symbols (e.g., a solid line, a dashed line, and a dotted line) or assigning a different color to each curve. A key (legend) should be included on the figure to identify the symbols. When callouts are used on a figure, they should not cover any horizontal grid line. If callouts will intersect vertical grid lines, then these grid lines should not be drawn through the callouts.

Avoid placing numbered references in figures. If this is not possible, enclose the full reference in parentheses and place it after the figure title.

4.5.6 Referencing

In technical and scientific writing, exact and complete references to all works that are mentioned or quoted should be provided. This practice is fair to the original author, the writer, and the reader. However, references commonly known and readily publicly available (generic) documents (e.g., regulatory agency guidelines) do not require formal references.

Source references should be given whenever quotations, ideas, or results of other authors are used or mentioned. The name of the author (or when the name is omitted, the idea) is followed by a superscripted reference number. For example:

General Fixit Company[8] *measured ...*

Note: do not make reference to a classified document, or one that contains proprietary information.

Note: Try not to make references to classified documents, documents containing proprietary information, or other documents that your company is not allowed to provide to outside readers.

The reference numbers refer to a numbered list that is the last section of the body of the report or report chapter/section. The list is arranged numerically in order of appearance in the text.

When a translated foreign publication is used as a reference, the title of the translated work and its author should be followed by the words "transl. by" and the initials and last name of the translator. Other publication data should follow.

4.5.6.1 References to Company Design Records

No SAR may make reference to a *Company's* private/proprietary notebooks, design records or quality assurance program controlled records in which the original work can be found.

4.5.7 Presentation of Mathematical Expressions

Word processing math-type or equation editor applications may be used. Otherwise, numbered equations and unnumbered but complicated equations should be typed on separate lines (displayed equations), not run into the text material. Equations should be punctuated when necessary. Good usage is violated and ambiguity often arises when the equality sign is made to do the work of a main verb in a sentence. Note, however, that an equality sign can properly be the verb of a subordinate clause. For example, right

When Equation 7 is substituted in Equation 8, one obtains a = b.

Do not write:

When (7) is substituted in (8), a= b.

Similar misunderstanding results from beginning a main clause with a number or symbol after just ending the subordinate clause similarly, and vice versa.

If a = b, then c is infinite.

Do not write:

If a = b, c is infinite.

4.6 Topical Reports

Topical reports are prepared either (a) in response to question(s) raised by a regulatory agency regarding technical issues contained in a SAR previously submitted to the regulatory agency, or (b) in an application to a regulatory agency for licensing/permitting of a specific product, service or facility.

Two versions of each topical report are sometimes required: a proprietary version and a non-proprietary version. Both versions are assigned similar document numbers, with the proprietary version having a "-P" at the end of the document number. A typical convention is for both report versions to be identical, except the non-proprietary version has the proprietary information not showing (e.g., in white) with sidebars in the right-hand margins to indicate the locations where proprietary information has been removed (not showing). Another convention is to use brackets, [ ], to identify proprietary information in the proprietary version of a report, and that information to be "whited out" (with report spacing and brackets retained) in the non-proprietary version of the report.

Topical reports are provided to others outside the *Company* in hard copy (paper) or as pdf files. A pdf file is usually generated from a native word processing or spreadsheet (e.g., MS Word or Excel) file. The non-proprietary pdf file, which was converted from the native file, still contains the (hidden) proprietary information. This file must be re-printed as a pdf file, to create the final non-proprietary pdf file. The resulting final non-proprietary report pdf file will not contain any of the proprietary information.

5. SAFETY ANALYSIS REPORT GENERATION AND UPDATING

This is a desk top guide and not a formal procedure. The goal is to provide users with instructions on how to generate and update safety analysis reports (SARs) in a consistent and professional looking manner.

Because a SAR may be translated into another language in the future, no slang, regardless of how commonly it is used in the United States, should be used in the SAR.

This guide uses the structure, standard styles, formats, fonts and line spacing provided in Section 4.

5.1 Word Processor and File Formats

MS Word is assumed be to used for report generation. The final MS Word files are used to generate pdf files for the final (to be published/distributed) documents.

Try to only use the standardized formats and styles in Section 4. However, a writer may modify a style on a specific input basis. Avoid introducing any new style, and delete all non-standard styles that are not used.

5.2 Style and Composition

For style, there are two goals. The first goal is to write all SAR inputs in consistent and precise style, as if they are written by one technical writer, rather than including multiple writing styles from many separate contributors. The second goal is to write the report to be easy to maintain. (Note: the principles of writing and grammar are provided in Appendix A.)

Text should be in present active tense (i.e., make the subject do the action). Avoid the use of future and past tenses. For example:

- Do not write "*The containment pressure was analyzed for a LOCA and the calculated peak containment pressure result was 45.3 psia*." Write "*A LOCA results in an analyzed peak containment pressure of 45.3 psia*."
- Do not write "*The valve was designed to close within 3 seconds*." Write "*The valve closes within 3 seconds.*"

As much as possible, text should NOT contain numbers, and ideally, all numbers should be contained in tables and figures. When text must contain a number, the number should be some bounding value that is not likely to ever change. For example:

> Do not write "*the results of analysis indicate there was a peak pressure of 555 psi*," when you could write "*Table 3.9-1 provides the analyzed peak pressure*." This way, future numerical updates to the FSAR can be limited to revisions of the tables and figures.

Avoid the use of qualifying adjectives and adverbs, except if they are quantified, e.g., "*a small (< 3%) increase in pressure*." In this case, the "3%" value should not be subject to any future change.

Avoid using "*will*," because this denotes a licensing commitment that will be formally tracked to completion. "*Will*" should be used to state a future regulatory commitment. (This means that text is to be written to represent the plant as it currently exists.)

In licensing documents, the term "*shall*" specifies a requirement, "*should*" specifies a recommendation, and "*may*" specifies an option.

Avoid long sentences. Make sentences short and to the point. Try to keep each sentence less than 15 words, and never over 21 words. When a long sentence is truly needed, it can often be broken to use a list. Use numbered lists for sequential items, and use bulleted lists for lists in which there is no sequential order.

Avoid long paragraphs. Try to keep each paragraph less than 125 words.

Avoid using the word "*impact*" for the words "*affect*" and "*effect*." (To impact something is to "hit" it.) Remember that "*affect*" is a verb and "*effect*" is a noun.

Do not use the word "*since*" for the word "*because*." Use "*since*" in which the issue is time dependent.

No, *none* and *nothing* cannot be plural. Therefore, "there are no changes" is incorrect. State that "there is no change."

In numbering chapters, sections and subsections:

- A chapter has a number; e.g., write "*Chapter 5*".
- Sections have two levels, #.# and #.#.#; e.g., write "*Section 3.2*" and "*Section 3.3.3*". (Note: in the middle of a sentence, the word section is only capitalized if it is identifying a specific section, e.g., Section 4.2.)
- Subsections are all levels beyond #.#.#. Write "*subsection 3.2.5.2*" and "*subsection 3.2.5.2.1*," etc. (Note: in the middle of a sentence, the subsection is never capitalized.)

The following are general rules for the use of numbers and numerals (1, 2, 3…) within text:

1. Try to keep numbers down to three significant figures, and limit numbers to no more than four significant figures. For example; use "*14.6* "and not "14.62", "*145*" and not "145.1", and "*2334*" and not "2334.6". Remember, a SAR is a licensing report and not an engineering report.
2. **Avoid** placing numbers in text. Where practical, numbers should only be provided in tables and figures, and the text should refer to the locations of the specific values. Having all or most numbers in tables and figures allows large technical reports to be more easily revised.
3. Use numerals whenever a number is followed by a standard unit of measurement, such as gram, meter, milliliter, hour or curie, or its abbreviation.
4. Use words one through nine and numerals for larger numbers (e.g., nine animals, 14 parts). However, in a sentence containing some numbers under 10 and other numbers over 10, use numerals for all. (Example) Treat ordinal numbers in the same manner (third, 33rd).
5. Always use numerals for dates, page numbers, and numerical designations, percentages, and expressions of time.
6. Do not begin a sentence with a numeral.

See Section 4.5 for additional guidance.

5.3 Spelling and Wording Conventions

To be consistent with the Code of Federal Regulations (CFR), use the following spelling conventions.

- Use "*10 CFR ##*" and not "10CFR##"
- Use "*safety-related*" and not "safety related"
- Use "*nonsafety-related*" and not "non-safety-related" in US documents
- Except at the beginning of a sentence or in a title, safety-related and nonsafety-related are not capitalized.

The term "*important to safety*" is not defined in any regulation or in guidance, thus, should not be used, except as specified below. In most cases, the term "*safety-related*" should be used, e.g., "*structures, systems, and components important to safety*" should be changed to "*safety-related structures, systems, and components*." Only use the terms "*safety-related*" and "*nonsafety-related*" for denoting safety classification in US based documents.

"*Important to safety*" may be used, if (a) it is specifically defined in the SAR, or (b) it is a direct quote from an NRC document.

See Section A5.1 for frequently misused words.

5.4 Useful MS Word Functions

5.4.1 Cutting and Pasting

The chance that any other MS Word document has identical styles/formats as developed/required for the report is about zero, thus, do not copy from one document and paste into a report file (except if the source file has been checked to assure it only contains this Writers Guide styles!) If you do, then you will mistakenly insert ALL the non-Writers Guide styles/formats into the report file. The following shows the steps on how to use Paste Special in MS Word, so that all the styles/formats from the original document are stripped away before the information is pasted into the report file.

1. Make a place for pasting, highlight the text to be replaced, or point to a place in the report file where the information from the source file is to be pasted.
2. Highlight and Copy the information in the source file.
3. Go to location report file where the copied information is to be pasted, and click on "Edit".
4. Click on "Paste Special".
5. Click on "Unformatted Text".
6. Click on "OK".

At this point, all of the pasted information will be in the one style/format in effect at that location. If additional styles are needed, reformat those inputs using the styles that work best from the standard Writers Guide styles.

5.4.2 Pasting in a Figure

When pasting a figure into a file, it is usually best to use the "Edit" – "Paste Special" – "Picture" functions. This inserts the figure between the two lines where the cursor is located.

5.4.3 Inserting a Comment

The MSWord "Insert" "Comment" function may be used for inserting comments and annotations (e.g., the name/number of source document) into a SAR or any other document.

1. Highlight the SAR input to be annotated.
2. For piece of text, just highlight the applicable text.
3. For a figure, highlight the figure number & title.
4. For a table, (i) if the table is imported as a whole, then highlight the table number and title, or (ii) if the table is typed in, then highlight piece by piece, like text.
5. Click on "Insert".
6. Click on "Comment".
7. Type in the annotation/comment.

5.4.4 Use of Nonbreaking Spaces, Nonbreaking Hyphens and Keep-With-Next

Between each table, figure or reference and its number it is useful to use a nonbreaking space. Create a nonbreaking space by clicking "Ctrl + Shift + spacebar" at the same time. This keeps the table, figure or reference with its number on the same line.

Within the text, a nonbreaking hyphen can be used in scientific numbers (for example 3.41E-04) or in a table or figure number (for example Table 15.2-4) to keep these numbers on the same line. Crease a nonbreaking hyphen by clicking "Ctrl + Shift + -" at the same time. Be aware that a nonbreaking hyphen will not paste correctly when using the Edit, Paste Special, Unformatted Text, OK function.

To keep a title, heading or subheading connected to the next line (so that heading is not on a different page), highlight the title, heading or subheading line, click on "Format," click on "Paragraph," go to "Line and Page Breaks," and click on "Keep with next."

5.4.5 Revising SAR Text

To incorporate the SAR changes into a file:

- Obtain the current SAR file, and "Save" it under the next revision number;
- Turn "Track Changes" on, but only show "Track Changes" as right sidebars,
- Type in all the changes;
- Save the file.

Note: Although the eventual SAR update will only show right side bars to denote changes, the author may also use Track Changes to show deletions and additions. In these cases, it is recommended that ~~deletions be shown in red strike through~~ and additions in blue, because blue copies better on a black and white copier. However, the use of ~~deletions being shown in red strike through~~ and additions being shown in dark red underline is almost as good.

5.4.6 Updates to Safety Analysis Report Tables

Additional rows can be added using the Table, Insert, Rows Above or Rows Below function.

Additional columns can be added using the Table, Insert, Columns to the Left or Columns to the Right function.

If rows in the middle of a table are being deleted for Rev. #, then delete the entries and type in "[Deleted]," and for Rev. #+1, the rows may be completely deleted. However, if rows at the end of a table are being deleted, then just completely delete rows from the table.

5.5 Avoiding Common Pitfalls

5.5.1 Proprietary Reports, Data and Figures

Proprietary information shall not be put into the SAR, because a SAR is or can become a public document. However, technical reports often contain proprietary information.

Assure that the author of the proprietary report has (a) clearly denoted which specific information within a proprietary report is actually proprietary, and (b) provided a non-proprietary version of the report.

Do not reference a proprietary report, unless you also include the non-proprietary version within the reference.

A test's process, operating conditions, input variables and output data (results) can be proprietary information, thus should not be included in a non-proprietary SAR. If a test must be addressed in a SAR, then a non-proprietary summary description of the test with a conclusion explaining the acceptability of the results should be in the SAR.

Only if a figure is previously addressed in the SAR text or a table may the figure be included in the SAR. A figure should not contain any extraneous information, because extra details will make the figures more difficult to revise, and can detract from the purpose of the figure.

Regulatory guidance may request that detailed proprietary engineering and design drawings (e.g., piping & instrument diagrams, process diagrams, and electrical design diagrams) be included within a SAR. However, regulatory guidance documents are **not** requirements. Instead, non-proprietary simplified figures that demonstrate the safety function(s) of the system(s) or process(es), described in the SAR, are to be included in the SAR.

Note: Proprietary information, documents and drawings can be presented to regulators during closed meetings, or provided "for information only" if government controls are applied such that no proprietary information can be made public.

5.5.2 Other Tips and Things to Do and Check

Embed the fonts before converting the file to pdf. Under Tools, select Options, then select the settings below.

Assure change bars do not extend into areas of the text that are not changed. This can happen when adding or deleting a block of text.

Assure change bars do not extend into table entries. Either change the page layout to landscape or move the table away from the change bars.

Check References sections to assure the current references are being referenced.

5.5.2.1 Converting a File to pdf

Before converting a MS Word file to pdf, change settings in "Track Changes" to assure that additions and deletions are only shown with a revision bar down the right side of the page. Note: after creating the pdf, if you want to see the revision changes again, you need to change setting in "Track Changes" back to your original settings.

Assure the revision bars do not show on the cover page or in the headers or footers. This can be done by accepting any changes in those areas.

5.6 Generation of an Updated Final Safety Analysis Report

First, generate the "Original Licensing Basis" final safety analysis report (FSAR). This is the version of the FSAR as of the date that the original government approval was issued plus all the FSAR changes that have been submitted to and accepted by the regulatory agency prior to the date that the original approval was issued. The Original Licensing Basis FSAR should be published and provided to the regulatory authority for information only. The Original Licensing Basis FSAR shall be maintained unchanged to document plant's original licensing basis.

An updated FSAR (UFSAR/USAR) is generated from the Original Licensing Basis FSAR, and includes all SAR/USAR changes since the end date of the final changes that were used to generate the Original Licensing Basis SAR. Additional UFSAR updating guidance is provided in the following section.

5.7 Updating an Updated Final Safety Analysis Report

The following provides the guidelines and requirements specific to the nuclear power industry. However, they may be used for updating SARs from other government regulated industries.

5.7.1 Generic Guidance and Requirements

10 CFR 50.71(e) requires a FSAR be updated at least once per year or per fuel cycle. The level of detail of the FSAR updates (directly from 10 CFR 50.71(e)) is provided below.

> "Each person licensed to operate a nuclear power reactor pursuant to the provisions of § 50.21 or § 50.22 of this part shall update periodically, as provided in paragraphs (e)(3) and (4) of this section, the final safety analysis report (FSAR) originally submitted as part of the application for the operating license, to assure that the information included in the report contains the latest information developed. This submittal must contain all the changes necessary to reflect information and analyses submitted to the Commission by the licensee or prepared by the licensee pursuant to Commission requirement since the submission of the original FSAR, or as appropriate the last update to the FSAR under this section. The submittal must include the effects[1] of:
>
> - All changes made in the facility or procedures as described in the FSAR;
> - All safety analyses and evaluations performed by the licensee either in support of approved license amendments, or in support of conclusions that changes did not require a license amendment in accordance with § 50.59(c)(2) of this part; and
> - All analyses of new safety issues performed by or on behalf of the licensee at Commission request.

The updated information shall be appropriately located within the update to the FSAR.

[1] Effects of changes include appropriate revisions of descriptions in the FSAR such that the FSAR (as updated) is complete and accurate."

The NEI 98-03 guidelines for updating FSARs are endorsed without exception by the NRC in Regulatory Guide 1.181. NEI 98-03 states that the updated FSAR (UFSAR) is the original FSAR (defined in Section 5.6) as updated per the requirements of 10 CFR 50.71(e). The following subsections are primarily based on the NEI 98-03 guidelines.

5.7.1.1 General Requirements

A FSAR description is defined as the "text, tables diagrams, etc., that provide an understanding of the (10 CFR 50.2) design bases safety analyses and facility operation under conditions of normal operation, anticipated operational occurrences, accidents, external events, and natural phenomena for which the plant is designed to function."

A FSAR update should include (since the last 10 CFR 50.71(e) FSAR update) information concerning changes and new/revised requirements that meet any of the following FSAR Update Criteria:

- New or modified (§ 50.2) design bases;
- Summary of new or modified safety analyses models and/or results;
- FSAR descriptions sufficiently detailed to permit clear understanding of new or modified (10 CFR 50.2) design bases, safety analyses and facility operation; or
- An existing (§ 50.2) design basis, safety analysis/evaluation or description in the FSAR is either not accurate and/or not bounding.

In general, changes to existing FSAR descriptions and information related to amended or new regulatory requirements that do not meet any of the above FSAR Update Criteria, do not need to be included in an FSAR update.

5.7.1.2 Specific Changes to the Existing Facility or Procedures

Any change (approved via § 50.59 or § 50.90) including its supporting safety evaluation(s) to the existing facility or procedure(s) requires an UFSAR update if:

- The existing UFSAR information, including changes to the § 50.2 design bases, safety analyses, analysis methods or descriptions of SSCs or functions, is affected;
- A SSC, function or procedure described in the UFSAR is removed;
- A new (1) § 50.2 design basis, (2) § 50.2 design basis analysis method, (3) safety analysis or (4) safety analysis method results; or
- A new or revised regulation requires the UFSAR to be updated and/or supplemented (e.g., 10 CFR 54.21(d)).

5.7.1.3 New Regulatory Requirements and Safety Issues

New or revised regulations, NRC Generic Letters, NRC Bulletins and plant-specific NRC requests can affect the licensing basis of a plant. If the plant response to a new/revised regulation or safety

issue meets any of the (above) UFSAR Update Criteria, then a UFSAR update is required. However, if a NRC-requested change or evaluation does not meet any of the UFSAR Update Criteria, then an UFSAR update is not required.

5.7.1.4 Frequency and Format of UFSAR Updates

10 CFR 50.71(e)(4) requires UFSAR updates to be filed annually or six months after each refueling outage provided the time interval between successive updates does not exceed 24 months. Each update must reflect all changes up to a maximum of six months prior to the date of the filing.

10 CFR 50.71(e)(5) requires that each UFSAR page replaced include both a change indicator for the area changed (e.g., a vertical line in the margin adjacent to the portion actually changed), and a page change identification (date of change and/or change number.)

5.7.1.5 Temporary Modifications and Procedure Changes

Temporary changes normally do not require UFSAR updates, and are tracked separately from the UFSAR update program. Temporary changes in support of plant operations should be restored to the normal condition, consistent with the UFSAR, in a timely manner. However, if a temporary change:

- Is expected to be in place throughout the next periodic UFSAR update cycle (time between cutoff dates for new information to be added into the next UFSAR update), and
- Meets any of the UFSAR Update Criteria;

then a UFSAR update is required.

The UFSAR descriptions of temporary changes should clearly identify the temporary conditions.

5.7.2 Generating the Next Published Version of an UFSAR

Toward the end of a fuel cycle, it is expected that some or most of the changes, implemented prior to the next refueling outage, are already incorporated into a "living" UFSAR. However, there could be a number of changes that would be implemented during the outage, thus their associated UFSAR change packages cannot be input into the UFSAR until after the outage.

After the refueling outage, the UFSAR and the (not yet incorporated) UFSAR changes from the implemented change packages should be used to generate the next published UFSAR.

1. Each UFSAR chapter file should be updated as follows.
2. Use with the latest UFSAR chapter file as the starting point.
3. Turn off its write protection function.
4. In the affected #.# sections, change the revision date in the footer to agree with the month and year of the next published UFSAR.
5. Turn on Track Changes, make the technical and (if any) editorial changes, and assure that applicable changes are denoted by right hand sidebars.

   Note: A Drafting department may be authorized to generate revisions to some figures and tables.
6. Turn off Track Changes.

7. Have a second person check all UFSAR changes against the UFSAR change packages.
8. Update the UFSAR, as needed, starting from Step 6.
9. Update the Table of Contents, List of Tables and List of Figures (if needed).
10. Use the Accept Change function to accept formatting, style, punctuation and other minor editorial/grammatical changes.
11. Turn on the write protection function and resave the file on to the local area network (LAN).
12. Update the UFSAR change list of all technical and major grammatical changes since the last published revision of the UFSAR.
13. Generate pdf chapter level UFSAR files, such that they are acceptable to the NRC.

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Appendix A

Principles of Writing and Grammar

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This appendix defines those principles of writing and grammar that should be implemented in the preparation of *Company* publications to assure optimum professional quality. Included in this appendix are discussions of style and grammar, spelling and hyphenation, punctuation, compound words and derivatives, and word usage.

A.1 Style

It is customary in technical and business writing to use a style that is both formal and impersonal, and that conforms to technical writing usage in grammar, syntax, and punctuation. It should be emphasized that English need not be stilted (overly formal). This does not mean that every technical or business manuscript should be written so that any layman can understand it. However, the necessity for employing technical or business terminology does not make this type of writing a kind of esoteric form of communication. The fact that such writing deals with technical terms should not lead the writer to assume that unnecessary "big words" and rare, polysyllabic terms are the mark of a well-written document. In fact, the more involved and complex the data to be presented, the more slowly and carefully the writer must organize the material to keep the non-technical words and sentence structure simple.

When writing of documents and publications that may reach foreign reader-audiences, the writer must avoid the use of jargon and “shop talk”, because most readers are unfamiliar with such terms. In most cases, a term from the general English vocabulary shall express the idea as well and as economically as the term of jargon.

A.1.1 Preferred Sentence Tense and Number of Words

Try to write in the present active tense with as few words as possible.

> *The analysis results demonstrate ....* is better than *The analysis results are to be used to demonstrate*.
>
> *The vacuum pump delivers 200gpm* is better than *The vacuum pump is designed to deliver 200gpm.* If the pump is not designed with the capacity of delivering 200gpm, then it could not deliver 200gpm.

Where possible, make the noun provide the action, by avoiding passive verbs, e.g., is, are, be, were, etc. The use of “were” can incorrectly convey something that is no longer valid.

> *The test data were from the 1906 coil test.*

A person could write the above same sentence, regardless if the results are superseded or not. If something is valid, regardless of when it was generated, then use present tense.

> *The test data are from the 1906 coil test.*

A.2 Grammar

Grammatical writing is easier to read and comprehend than ungrammatical writing. Some of the more troublesome points of grammar are discussed in the following paragraphs. Again, no attempt is made in this appendix to be completely definitive or all-inclusive, because complete texts on English grammar are readily available.

A.2.1 Vague Pronoun

Every pronoun must stand for a word (or an idea) that has already been expressed, and what it stands for must be immediately evident. Worst of all is the pronoun in which the meaning cannot be deduced.

> *These observations do not, however, explain why e does not rise above E, and this shall be important to us.*

What shall be important?

Momentary confusion is a less serious fault, but should be avoided.

> *As the temperature falls, a compressive stress is exerted by the bezel on the glass because of its greater temperature coefficient.*

Does the bezel or the glass have the greater temperature coefficient?

Also, avoid allowing the same pronoun to stand, in close succession, for two different statements.

> *It became listless during the hot part of the day and revived when it got cooler.*

A.2.2 Order of Sentence Elements

An important factor in clear writing is the proper order for the elements of each sentence. At least temporary confusion results from misplaced phrases.

> *The sample to be analyzed first must be put into solution.*

This sentence seems to say that the first sample must be put into solution. What was actually meant was that before the sample can be analyzed it must be in solution.

In particular, try not to separate a verb too far from its subject to its object or complement.

> *No trouble with engines running 1000 hours where valves and air cleaners were concerned has developed.*

The subject, "No trouble," is widely separated from the verb, "has developed". The sentence should be reworded:

> *No valve or air-cleaner trouble has developed with engines running 1000 hours.*

A.2.3 Split Infinitive

Avoid the split infinitive when possible. However, it is sometimes necessary to split an infinitive to retain clarity and to avoid sounding stilted and artificial. For example:

> *Usage is expected to more than double by 1990.*

A.2.4 Tense

Most documents are written in the past tense, but there are legitimate reasons for using other tenses. Consider:

> *The balloon rose because helium was less dense than air.*

To avoid the implications that helium used to be, but no longer is, less dense than air, write:

The balloon rose because helium is less dense than air.

A.2.5 Parallelism

Parallel construction for parallel ideas shall make the meaning clearer because nonparallel construction hints to the reader that the subject has been changed.

If the meter under test is fast, the dial reading shall be less than 1.0; and more than 1.0 if it is slow.

The same sentence, with parallel construction, would be written:

If the meter under test is fast, the dial reading shall be less than 1.0, if it is slow, the dial reading shall be more than 1.0.

Faulty parallelism is particularly obvious and annoying in any kind of list or enumeration. Use either phrases or sentences, but not both, in a list of enumeration.

(1) Non-equilibrium conditions.

(2) Sampling.

(3) Excessive heat.

(4) Other elements may have interfered.

List item (4) could be changed to parallel construction by rewriting the item:

(4) Possible interference by other elements.

A.2.6 Nonparallel Construction

All elements in any one series must be of the same grammatical form. Any external operator that operates on more than one element of a series automatically operates on all elements of the series. Disregarding this rule produces a special form of nonparallel construction. Because such nonparallel construction appears to be a legitimate enumeration, but is not, it should be avoided.

Adapters are made in various sizes, shapes, weights, and with any number of leads.

The words *"in various"* obviously operate on sizes, shapes, and weights; therefore, they operate also on *"with any number of leads."* The result is

... in various with any number of leads.

This error can be eliminated by inserting another and that separates the construction into two parts, one of which is a true enumeration.

Adapters are made in various sizes, shapes and weights, and with any number of leads.

A.2.7 Number with Collectives

A noun that denotes a whole comprised of a number of similar parts is referred to as a collective. Common examples are: *pair, set, group, majority, series, data, 30 inches.*

A collective may take either a singular verb or a plural verb, depending upon its sense. When it refers to the entire group as a unit, the collective takes a singular verb. When it refers to the separate entities that make up the group, the collective takes a plural verb.

A.2.8 Apparently-Plural Words

Some examples should clarify the use of singular and plural verbs with plural-form nouns:

- *Two million dollars is a lot of money.*
- *Two million pennies were scattered on the floor.*
- *There is 16 inches of water in the forward hold; it must be pumped out.*
- *Ten grams of the isotope was collected.*

A.2.9 Apparently-Singular Words

The following are some examples of plural verbs used logically with collectives that are plural in sense, though singular in form.

- *The majority were in favor of increasing the tax rate.*
- *A pair of hawks took turns feeding the young birds.*
- *A number of fuel rods were damaged when the fuel bundle was dropped.*

A.2.10 Data

The word *data* is the plural form of datum. There is constant clamor about its taking the plural (or singular) verb. Either may be correct. When using the word data to mean a collection of separate items, the plural verb is appropriate. However, when "data" is used to mean a body of information, the singular verb is correct.

> Singular Meaning: *Data concerning limits and tolerances has (NOT have) been included in Section 6.*
>
> Plural Meaning: *When the data have (NOT has) been evaluated and arranged, the trend may be seen.*

A.2.11 Nouns Used as Adjectives

When several adjectives precede a noun, the reader is aware from the beginning that the adjectives shall ultimately modify a noun. When several attributive nouns (nouns used as adjectives) precede the noun they modify, their function may not be so readily apparent.

> *It is necessary to eliminate part of the triple superphosphate plant waste disposal cost.*

The compound adjective (attributive noun) construction would be clearer if it is hyphenated, but a clutter of hyphens would result. The sentence would be clear -but longer -if rewritten:

> *It is necessary to eliminate part of the cost of waste disposal at the triple superphosphate plant.*

Attributive nouns that include numerals and units of measure usually result in a clutter of hyphens when they are placed before the noun they modify. For example:

> *The 1-1/2-in.-diameter fuel rod failed.*
>
> *The operator looked through the 2-ft-wide by 2-ft-high by 2-ft-thick viewing window.*

These two samples could be clarified by rewriting.

> *The failed fuel rod diameter is 1-1/2 inches.*

The operator looks through the viewing window that is 2 feet wide, 2 feet high, and 2 feet thick.

A.2.12 Dangling Participles

A "participle" is a form of a verb that is used in a sentence to modify/describe an element of the sentence. A "dangling participle" is a participle phrase, often at the beginning of a sentence that appears from its position to modify an element of the sentence other than the element that it was intended to modify/describe. The dangling participle could confuse the reader; it also produces astonishing statements. Consider the following:

(1) *This mummy was discovered <u>while digging a cross-cut in a copper mine</u>.*
How can a dead person, the mummy, dig?

(2) *<u>Suffering intense pain</u>, police carry badly injured boy to ambulance.*
Was the police (officer) or the boy in pain?

When a writer intends to apply a phrase to a particular subject but fails to include that subject in the sentence, the phrase becomes attached, incorrectly, to the nearest available subject. The phrase then dangles and obscures the sense of the statement. Consider this example:

The scale height of the atmosphere was computed by successive approximations, trying to fit the new density to an extension of the model atmosphere.

What does this sentence mean? Who or what is trying?

An ambiguity may remain no matter how the sentence is re-written. Mere correction of a dangling participle cannot clarify a muddled thought. For example:

This conclusion receives support from the fact, if, after subtracting the background, the widths of the lines are used to determine a kinetic temperature, this temperature comes out to be about 150°K.

Who or what subtracts the background? Of what? From what? This whole structure is faulty. Although the author may know what is meant, the reader cannot make even a plausible guess.

A.2.13 Misplaced Phrases

Unlike the dangling participle, the misplaced or squinting word or phrase does not break an explicit rule. Like the dangling participle, the misplaced phrase causes trouble because it occupies the wrong place in the sentence. Squinting both backward and forward, the phrase gives two and sometimes more possible meanings to the sentence. For example,

A somewhat smaller value of e would suit the light curve fairly well, but not a larger one.

Does the "one" refer to a larger curve or a larger value? The reader should be spared from this confusion.

Occasionally, a sentence contains so many misplaced phrases and words, correct interpretation becomes impossible:

It is doubtful if anyone beside Dr. Curtis saw Halley's comet oftener than himself.

Who is himself? Who saw Halley's comet more frequently, Curtis or Halley? Did Curtis see the comet more frequently than he saw Halley? Did someone standing beside Curtis see the comet oftener than Curtis did? Or did Curtis see the comet oftener than he saw himself (Curtis)? The reader tires of trying to find the meaning and quickly loses interest.

The position of a key word or phrase can make a sentence true or false or simply funny:

> *It shall be necessary to approach the problem of how a star emits its energy from the other end.*

or

> *An intense restless man, Borch, normally walks to Company's headquarters office on Lexington Avenue, in a rust-colored, 46-story skyscraper.*

Remember that your reader is reading your work because of a desire to learn.

A.2 Spelling and Hyphenation

Spelling and hyphenation are frequently controversial points of style. Some words have two spellings; both are correct (e.g., buses, busses). In these instances, either is correct and the choice is a matter of personal preference, provided the spelling of the particular word is consistent throughout the document. New words have come into use, and new spellings have become common, especially in science and engineering, without the authority of entries in a standard dictionary to support them (e.g., radioisotope).

The tendency in technical spelling is to avoid the hyphen when it does not serve a useful purpose. Words that were formerly hyphenated have now become either one or two words (e.g., bypass, cross section). In general, words with prefixes, such as anti, re, semi, non, quasi, and un, are written without the hyphen unless the meaning is changed. These prefixes are hyphenated when preceding a proper noun.

It is correct to hyphenate adjectival combinations of words (beta-ray spectrum, not beta ray). The rule may be somewhat relaxed when there is no risk of ambiguity. With very few exceptions, however, prefixes such as hand- and self-, when used as adjectives, are always hyphenated.

A.3 Punctuation

A good writing style (proper words in proper places) may require less punctuation than a bad one. Punctuation must not be expected to do the work that proper word order might do better. No matter how you word and punctuate a sentence, you supposedly know what it means; however, you must consider whether your meaning shall be equally clear to others. If a sentence requires excessive punctuation, rewrite it or divide it into two or more sentences.

A.3.1 Period

Use a period:

1. After a declarative or explanatory sentence.
2. As a decimal point.
3. After certain abbreviations: W. B. Jones, Fig., p., pp. (page, pages), and most abbreviations of Latin words e.g., i.e., et al.).

Three periods, separated by spaces, are used to denote an ellipsis (omission) within a sentence, at the beginning or end of a sentence, or in two or more consecutive sentences. Four periods are used when an ellipsis ends a sentence.

He called... and left... When he returned the... he left. After the... came, ... left

A line of periods indicates the omission of one or more entire paragraphs. Quotation marks are not used in a line of periods in quoted matter, where a line of periods ends a complete quotation, no closing quote is necessary.

Do not use the period after

1. Capital letter abbreviations of names of countries (USSR, USA) government agencies (NRC, NSF, USDA, NIH), societies (AAAS, AIBS, CBE), international agencies (WHO, UNESCO), compass directions (NW), biochemical compounds (DNA), and most companies (KEPCO, G&W, CE, IBM.)
2. Contractions used as abbreviations (e.g., 22nd), symbols for chemical elements (C, H, O, Cl), and units of measurement (mg, ml mg) unless the unit spells a word (in.).
3. Titles, headings, and major subheadings, except run-in subheadings; legends for tables.
4. Single items in lists.

In special situations, place the period:

1. Inside the quotation marks when a sentence ends with a quoted phrase, even when the period is not part of the quotation.
2. Inside or outside parentheses or brackets, depending on whether the parenthetical matter is an independent sentence (the period goes inside) or is a subordinate part of the main sentence (the period goes outside).

A.3.2 Comma

The comma provides separation or a brief pause within a sentence, and is helpful in grouping words, phrases, and clauses for clarity and ease of reading. Do not separate a subject and its verb or a verb and its object, except for phrases between commas. Noun phrases can act as subjects and objects, and should not be set off with commas.

Use a comma:

1. To separate two independent clauses joined by a coordinating conjunction (and, but, either, neither, or nor). If the clauses contain internal punctuation, separate them with a semicolon.
2. To set off a dependent introductory clause, begin with a subordinating conjunction (if, although, because, when, where, while, because).
3. To separate words or phrases in apposition if necessary for clarity (e.g., J*ohn, a bashful child, was afraid of strangers*).
4. To separate the elements (clauses, words or phrases) in a series; use a comma before the "and" used to indicate the last element in a series, except (a) if the items of the series are similar, e.g., *the colors on the flag are red, white and blue,* and (b) if the series is followed by an "and" statement, e.g., *He bought a candy bar, a toy airplane and a sucker, and then went home.*

If one element already contains other internal punctuation, separate elements with a semicolon. (If a series is constructed grammatically, the parts shall be parallel. That is, each part can be read separately in the sentence without loss of sense.)

5. To separate nonrestrictive (non-defining) clauses or phrases from the rest of the sentence. Nonrestrictive clauses or phrases give extra information that is not essential to the meaning of the sentence. If uncertainty exists whether a phrase or clause is restrictive, read the sentence without it; if the meaning is materially altered, the element is restrictive.
6. To separate conjunctive adverbs {therefore, thus, then, still, however, accordingly, moreover, nevertheless, consequently) and transitional phrases (on the contrary, on the other hand, in fact, after all).
7. To set off a short quotation. If the quotation is long, use a colon.
8. To set off contrasted words, phrases, or other elements. "*It is..., not ... ,"; "the greater..., the less ...*"
9. (9) To separate words, phrases, and clauses used parenthetically or placed out of their natural position for emphasis or clarity. ("Keys provide, except in the most specialized works, a useful means...")
10. To separate adjacent sets of numbers: "In 1965, 100 experiments ..."
11. To group numbers in thousands: 1,000; 18,000; 1,000,000.

Do not use the comma:

1. If two independent clauses joined by a coordinating conjunction are short, and if no ambiguity results.
2. After a short introductory phrase begun with a preposition, if no ambiguity results.
3. Around short appositives. "The species Bornbyx mori ..." "The respiratory quotient RQ is..."
4. After equations and formulas set off from the text by centering on the page.

Place the comma:

1. Inside the closing marks when a sentence continues beyond the end of the quoted phrase, even when the comma is not a part of the quotation.
2. After a period that follows an abbreviation if the sentence requires a comma. (Do not expect the period to do its own work and substitute for the comma.)
3. After Latin abbreviations.

A.3.3 Semicolon

The semicolon is a mark of coordination and should not be used with dependent clauses.

Use the semicolon:

1. To separate coordinate clauses not joined by a conjunction.
2. To separate coordinate elements or elements of a series if they contain internal punctuation.
3. To separate coordinate clauses joined by a conjunctive adverb (however, moreover, also, then). (Clauses introduced by subordinating conjunctions (because, whereas, inasmuch) are separated by commas.)

Place the semicolon outside the quotation mark.

A.3.4 Colon

Use a colon:

1. To introduce a long quotation (a comma is sufficient for a short one),
2. To introduce a list of enumeration not immediately preceded by a verb or preposition,
3. To emphasize a sequence in thought between two complete sentences when the emphasis obtained by a period or word, such as namely, is insufficient,
4. To separate a complete clause from a following illustrative clause or phrase
5. To separate parts of ratios,

Place the colon outside the quotation mark.

A.3.5 Question Mark

1. Use a question mark at the end of a direct question, even if the question is presented in declarative form (i.e., no direct answer is expected): "*Wasn't the pump operating?*"
2. Do not use a question mark after an indirect question: "He asked what our plans for tomorrow were."
3. Always place the question mark inside of the period.

A.3.6 Exclamation Point

The exclamation point is rarely justified in technical or commercial writing. Exceptions: in place of sic or a mark of affirmation in older taxonomic work, and as a factorial symbol in mathematics: (x-2)/6!

A.3.7 Dashes

Use the en dash (-) sparingly. In typing copy, indicate an em dash (--) by two un-spaced hyphens.

1. To indicate an abrupt break or shift in thought.
2. To isolate parenthetical matter (as parentheses are used, see subsection A.3.8).
3. Within the parentheses within brackets for a third level of interpolation. (*The house sparrow* (*common in bushes* -- avoid this cumbersome construction -- *as well as trees*) *is a bird*.)

Use an en dash (-) (half the length of an em dash, a single hyphen on typewriter) between numbers to indicate range (e.g., pages in a citation, 23:9-14; but from *pages 6 to 8,* not *from page 6-8).* Do not use a minus sign and an en dash together: *-4 to -5C*, not *-4 -5C*.

A.3.8 Parentheses

Use parentheses:

1. To set off comment or explanation that is structurally independent of the sentence.
2. To group mathematical expressions.

3. To label enumerations included within a paragraph. "The three steps were (1)..., (2)..., and (3)..." (but do not label the enumerations unless necessary).

Avoid use of double parentheses: (...(...)...), use brackets[...(...)...] or (...[...]...), but be consistent.

A.3.9 Brackets

Use brackets:

1. To set off words or other matter inserted in a quotation
2. To set off bibliographic details not shown in the original

A.3.10 Apostrophe

Use an apostrophe:

1. And s ('s) to form the possessive of a singular noun, but use the apostrophe alone to form the possessive of a plural noun ending in s.
2. To indicate omission of letters in a contraction; but contractions such as can't, don't, and won't are inappropriate in technical and commercial writing. No apostrophe is used in an abbreviation or symbol.
3. And s to form the plural of letters, numerals, and some words if ambiguity results from the omission of the apostrophe, *"He uses too many but's."* Do not, however, use the apostrophe to form acronym plurals, unless doing so prevents ambiguity.

Do not use an apostrophe in certain well-established geographic names (Pikes Peak) or in names of some organizations (Teachers Association), where the qualifying word has the force of an adjective rather than a possessive noun.

A.3.11 Quotation

Use double quotation marks in the text around:

1. All direct quotations.
2. Titles of articles, parts of books, and series titles.
3. New technical terms or familiar terms used in a new or unusual sense. Use single quotation marks around a word, title, or term within a quotation.

If a quotation extends over more than one paragraph, begin each paragraph with a quotation mark, but close the quotation only at the end of the last paragraph.

1. Place a comma or period inside the closing quotation mark, if it is part of the quotation.
2. Place the colon and semicolon outside the quotation marks.
3. Place the question mark and dashes inside the closing quotation mark when they belong to the quotation, outside if they do not.

A.3.12 Hyphen

Use a hyphen:

1. Between the numerator and denominator of a fraction when spelled out (one-third).
2. Between the parts of some compound words.

3. Between reference numbers to indicate a range. In running text, the word "to" is preferable; e.g., *8 to 10*, not *8-10*.
4. After prefixes, such as self- (self-explanatory), hand- (hand-operated), and half- (half-life).

Do not use the hyphen:

1. Between parts of a compound modifier if the modifier follows the noun modified (*the scientist was well known*).
2. Between words of a well-established open compound noun that is used to modify a substantive (*sodium chloride solution, or house sparrow population*).

A.3.13 Slant Line

Because the slant line (/) is a mathematical mark of division, it must be used with care.

In some publications, it is used instead of a colon to indicate ratio (3/4 or 3:4), but not in a ratio involving more than two elements. The ratio 1:3:4 is clear, 1/3/4 is mathematically ambiguous.

Do not use the slant line as shorthand for per if more than one is required (1.5 pCi/km^2/yr), because it is mathematically ambiguous. To abbreviate "The strontium fallout was 1.5 picocuries per square kilometer per year," use the form "The strontium fallout was 1.5 pCi/km^2 per year" or "The strontium fallout was 1.5 pCi/km^2-year."

Avoid such expressions as *and/or* and *signal/noise* ratio. The expression, "The cultures were subjected to light and/or dark" can be expressed by "The Cultures were subjected to light, or dark, or both." Use a hyphenated compound. signal-to-noise ratio, instead of signal/noise ratio.

A.3.14 Enumeration and Series

Series may range from three one-word elements to complex enumerations, each element of which may require a separate sentence or paragraph. If a complex series seems necessary, the elements may be kept in proper order by use of indicative words, such as then when, afterward, and finally. In a series, simple or complex, the elements should be constructed in parallel. For example, the sentence "*The mixture was heated, shaken, centrifuged, and the supernatant fluid frozen*" is not properly constructed, because the last element cannot be read as part of the series. If the first portion of a sentence contains a series of items, then the last portion must become a coordinate clause with a verb: "*The mixture was heated, shaken, centrifuged; the supernatant fluid was frozen*."

Punctuate all simple series with commas, e.g.

> *The mixture was heated, shaken, and centrifuged*, and
>
> *The mixture was heated to 40°C, shaken at 30 cps, and centrifuged at 18,000 x g.*

Punctuate more complex series (those in which the individual elements contain their own punctuation) with semicolons.

> *The mixture was heated at 40°C for 10 min to inactive which was shaken at 30 cps; and centrifuged at 18,000 x g*, and
>
> *The mixture was heated, shaken, and centrifuged; the pellet was discarded; and the supernatant fluid was quick-frozen and stored for 3 days at -10°C.*

A.4 Compound Word and Derivatives

A compound consists of two or more words joined together, with or without a hyphen. A compound word expresses an idea, different in meaning or function from the ideas expressed by the individual parts (black bird, possibly a crow; blackbird).

Two questions must be answered in determining whether a compound should be formed: (a) is compounding desirable? and (b) should a hyphen be used? Compound words are used commonly in technical writing without hyphens, but occasionally a hyphen is needed to avoid a confusing sequence of letters or a jumble of ideas (cell-like, freeze-dry, red-ear sunfish). A few examples of styling for compounds and derivatives are cited below.

1. Noun compounds are usually separate when the two elements are both accented (e.g., buffalo fish, oak wood, subject matter), solid when the term has a special meaning and when one of the elements has lost its accent (as northwest, pineapple, paperback, blackboard), and hyphenated when the elements are short and lower case (ox-bow) or the names of a technical unit of measurement (gram-centimeter, light-year).

2. Verb compounds in which the second element (noun or pronoun) is the direct object of the verb are usually solid (killjoy), unless confusing letters result and a hyphen is indicated (cure-all). Verb compound consisting of two verbs is hyphenated (has-been.)

3. An adjective compound is frequently hyphenated when placed before the word it modifies, but when the same combination is written after the word a hyphen is omitted: (*a well-known method*, *a method well known in physics*.)

   This rule does not apply when simple technical terms or well-established open compound nouns are used as adjectives:

   > *... a sodium chloride solution;... a solution of sodium chloride; house sparrow population, a population of house sparrows*

   When a numeral forms an element of a compound adjective, a hyphen is recommended:

   > *... two 2-liter flasks, two-thirds majority... a can of 10-ml pipettes*

   Compound adjectives with endings such as born, bred, fold, like, and proof are usually solid.

4. An adverb ending in “ly” is not hyphenated when it is the first element of a two-word modifier:

   ... a quickly completed reaction, ... a carefully preserved specimen,... naturally occurring substance.

5. Words in which prefixes, suffixes, or combining forms appear are derivatives rather than compounds. Derivatives are usually set solid. A few exceptions are (a) prefixes that may cause confusion because they end with a vowel and the base word begins with the same letter (anti-intellectualism, semi-independent); (b) prefixes before words that begin with a capital (pre-English; un-American; but, in geology, Precambrian); (c) prefixes that govern two or more words (ex-vice president, self-appointed leader); (d) prefixes that, if set solid with the base element, would form a word easily confused with another (recreation, re-creation; un-ionized, unionized); and (e) suffixes that when added to the base word would

form a succession of three identical consonants (bell-like, hull-less) or a word of several syllables (pleuropneumonia-like).

6. Certain scientific societies approve lists of common or vernacular names of animals and plants that are compound words. Adopt these names when they represent good usage.

A.5 Word Usage

A.5.l Problem Words

The following list contains words that are frequently misused. It is intended that the list be practical and illustrative, rather than comprehensive.

Problem Word(s)	Meaning(s)
absorb	*Absorb* means to assimilate or to incorporate.
adsorb	*Adsorb* means to condense and hold by adsorption.
adsorption	*Adsorption* means the adhesion in an extremely thin layer of molecules (as of gases, solutes, or liquids) to the surfaces of solid bodies or liquids with which they are in contact.
accuracy, precision	*Accuracy* refers to the discrepancy between the true value and the results obtained by measurement. *Precision* refers to the agreement among repeated measurements of the same quantity.
adjust, calibrate	Adjustments or changes (usually slight) may be made without even hinting at calibration. *Calibration* suggests the determination of exact gradations, as in a measuring device.
affect, effect	*Affect* (verb) means to influence. *Effect* (noun) means to produce or bring to a conclusion.
alternate, alternative	*Alternate* as a noun means that which alternates with something else, a substitute. As an adjective, it means occurring or succeeding by turns. As a verb, it means to occur or succeed by turns. *Alternative* as a noun means an opportunity for choice between two or more things, or a choice. As an adjective, it means offering a choice of two or several things.
apparent, obvious, evident	That which is *apparent* is open to view. That which is *obvious* is unavoidably clear, so as to need no explaining. That which is *evident* is demonstrable by facts or evidence.

Problem Word(s)	Meaning(s)
as, since, because	A subordinating conjunction, *as* conveys the idea of comparison, likeness, or illustration. *As* should never be used to mean *because*. *Since* denotes sequence in time or in logical connection. *Since* should not be used to mean *because*. *Because* refers to the direct cause of or reason for something.
beside, besides	*Beside* means next to. *Besides* means other than.
between among	Use *between* when referring to **two** things, *among* when referring to more than two things.
case	*Case* is used only when needed and when the reader is sure that no other word will express the meaning. There are, in fact, two words. The first means that which holds, e.g., container or receptacle, and there is no confusion in the meaning (as a case of soap.) The second word means that which befalls. Some of the common and correct meanings of case follow. A state of things requiring or decision — This is a *case* for the dean to decide. A statement of facts or reasons — He made a strong *case* for his idea. An instance of disease requiring medical attention. — A *case* of measles. A suit or action at law. — The lawyer presented his *case.*
certain	In the sense of "some," this term has little or no meaning without further definition.
compare, contrast	In most usage, *compare* means to point out similarities and differences, but *contrast* should be reserved for pointing out differences
compare with, compare to	Use *compare with* when pointing out either similarities or differences, or both, between two or more things. That is, when setting up a comparison. For example: "*Compared with* the development of steam power, the development of nuclear power has been very rapid." Use *compare to* when likening one thing to another. For example, "He *compared* radio *to* a magic messenger."
compliment complement	*Compliment* means praise. *Complement* means a number or amount.

Problem Word(s)	Meaning(s)
comprise compose consist	These words are not synonymous. *Comprise* means to include or to contain. For example: “The equipment *comprises* a hood, exhaust funnel, and a blower.” *Compose* means to put together, to make, or to fashion. For example: "The equipment is *composed of (not composes)* a hood, exhaust funnel, and a blower." *Consist* means to be made up of things. For example: “A sodium chloride solution *consists* of sodium ions, chloride ions, and solvent.”
contaminate contaminant	*Contaminate* is the verb form. *Contaminant* is the noun.
content contents	As nouns, *content* is used more as an abstract term (*the content of the course*) and in amounts (*the moisture content.*) *Contents* is more concrete (*the contents of the box.*)
continual continuous	*Continual* means over and over again at short intervals. *Continuous* means occurring without interruption.
degree	Use the degree symbol (°) only following a specific unit of temperature or angular measure (375°F or 45° angle). Do not add a space between either side of the degree sign. The word “degree” must be spelled out in all other applications.
delete omit	*Delete* means to take something out, to erase, or to remove. *Omit* means to leave out, to leave unmentioned, to fail to perform, or to make use of.
denotation connotation	*Denotation* means a direct specific means of a word. A *connotation* suggests a meaning of a word apart from which it explicitly names or describes.
differ from differ with	Use *differ from* or *different from* to express unlikeness. Use *differ* with to express disagreement.
discrete discreet	*Discrete* means individually distinct, consisting of distinct or unconnected elements. "*The matrix was composed of discrete particles*." *Discreet* means having or showing discernment or good judgment in conduct or especially in speech. "*He maintained a discreet silence*."
dissimilar	Write *dissimilar to* rather than *dissimilar from*: Metal is *dissimilar to* water.

Problem Word(s)	Meaning(s)
distinguish differentiate	*Distinguish* means to recognize (and point out) those aspects of something that mark its separate identity. *Differentiate* means to point out the difference between two things.
Due to	*Due to* is an adjective phrase and is used to modify nouns, not verbs. *Due to* is often used carelessly to mean caused by or because of. If these phrases can be substituted for due to, they should be used. Whenever the expression *due to* is used, however, the word due must be a predicate adjective. A predicate adjective follows a linking verb (e.g., a verb that has little or no meaning of its own). Forms of "be" are common linking verbs. Note; a sentence must never begin with the expression *due to*. Wrong: The cylinder leaked due to a broken gasket. Correct: The leak in the cylinder was due to a broken gasket. Correct The leak in the cylinder was caused by a broken gasket. Correct: The cylinder leaked because the gasket was broken.
electric electrical	Of the words electric and electrical, *electric* is the more concrete. It should be used mainly in describing anything in which an electric current is present (e.g., electric appliance, apparatus, motor circuit, device, energy, equipment, machine, power cable, and product.) *Electrical* is the more abstract term and should be used in the sense of "pertaining to electricity." For example: *electrical engineer, dealer, industry, operation, and store*. Use electric when referring to insulation.
eluent eluate elute elution	*Eluent* is the liquid used for extraction. *Eluate* is the solution resulting from *elution*. *Elution* is the process of extracting. *Elute* is the verb.
enable permit	To *enable* is to provide power or competency to be or to do something. To *permit* is to allow or to authorize.
assure ensure insure	*Assure* means to confirm or to give confidence in; e.g., a person. *Ensure* means to make certain; e.g., a fact. *Insure* means to indemnify against loss; e.g., life, property. People *assure*, things and processes *ensure*, and companies *insure*.

Problem Word(s)	Meaning(s)
experience	*Experience* implies direct *personal* knowledge through immediate observation; actual practice; or conscious subjection to an emotional or mental state or condition. It especially implies knowledge that comes as a result of one's normal way of life, one's particular environment, or one's character or training. Therefore, non-living things cannot experience anything.
farther further	Use *farther* when referring to distance. Use *further* when referring to something additional.
flammable inflammable	Both words have the same meaning. *Flammable*, is preferred. *Nonflammable* should be used to mean lack of support for combustion.
foreword forward	A *foreword* is a preface or introductory statement in a book or a report. *Forward* means to advance or to transmit.
full-scale	Change to *full-size* when referring to drawings or equipment. It is proper to use *full-scale* when "scale" refers to the indicating scale of an instrument.
if whether	Do not use to indicate only two alternatives - the stated one and its opposite: “The equipment will be checked to see *if* it meets the requirements." Change *if* to *whether*: "The equipment will be checked to see *whether* it meets the requirements."
homogeneous, homogenous	*Homogeneous* means composed of parts all of the same kind. *Homogenous* means corresponding to structure because of a common origin.
illusion allusion	*Illusion* means a deceptive appearance. *Allusion* is a reference to something written, to someone, or to something.
immanent imminent eminent	*Immanent* means that which remains or operates within the subject considered; inherent or intrinsic; often (as applied to a metal event) confined to consciousness, or to the mind; subjective as an immanent act. "A cognition is an *immanent* act of mind." *Imminent* means near at hand, impending (usually of misfortune), e.g., “an *imminent* danger”. "A storm is *imminent*." *Eminent* means to be prominent, to stand out, to be distinguished. "Einstein was an *eminent* scientist."
imply infer	To *imply* means to express an opinion or to present a fact indirectly without being blunt or outspoken. To *infer* means to draw a tentative conclusion and to suggest it as a hypothesis. In formal English; the speaker *implies*; the listener *infers*.

Problem Word(s)	Meaning(s)
in into	*In* refers to position. *Into* involves the element of progression. For example: "Sodium hydroxide is charged *into* the tank every half hour. *In* the tank, it reacts quickly."
initiate instigate	*Instigate* means to incite. *Initiate* means to begin or start.
lay lie	*Lie* means to recline, or to be at or come to rest. *Lay* means to place, put to rest, or cause to lie. The tendency in modem grammar is to use *lay* when speaking of inanimate objects and *lie* when speaking of living creatures. You *lie* down for a rest. You *lay* a book on the table.
less fewer	Do not use *less* with plurals. *Less* gasoline, *fewer* gallons.
may can might	*May* indicates permission, possibility, or where there is an element of doubt. *Can* indicates ability. *Might* indicates a more remote possibility than *may*.
microscopic macroscopic	*Microscopic* means invisible or indistinguishable without the use of a microscope. *Macroscopic* means that which is large enough to be observed by the unaided eye.
molal molar	A *molal* solution contains 1 mole per 1000 grams of solvent. A *molar* solution contains 1 mole or gram molecular weight of the solute in 1 liter of solution.
only	Make certain this word is placed where there can be no doubt as to what it modifies. Note the differences among the following: He saw *only* the motor. (That was all he saw). He *only* saw the motor. (He did nothing with it.) *Only* he saw the motor. (He was the only person who saw it.)
overall overalls over all	*Overall* (adjective) is accepted spelling. *Overalls* (noun) is a garment worn to protect one's clothing. *Over all* (prepositional phase) is used in the sense of everything considered (e.g., *over all*, the work was successful. The sun shines *over all* the people.)

Problem Word(s)	Meaning(s)
per	The word *per* should be used only in standard business expressions (e.g., percent, per diem, per annum, per hour). It should not be used synonymously with "in accordance with", "in keeping with", and similar expressions. Wrong: We shall ship the merchandise as per your instructions. Right: We shall ship the merchandise in accordance with your instructions.
portion proportion part	A *portion* is a *part* of a whole. A *proportion* is the relation of one *portion* to another, or to the whole, or of one thing to another. *Proportion* should be reserved to express a comparative relation between things or magnitudes.
precipitate precipitant	A *precipitate* is the product of precipitation, and can be used as a verb. A *precipitant* is the precipitating substance.
principal principle	*Principal* is an adjective except in the sense of the highest in rank or authority, a capital sum placed at interest, or due as a debt. *Principle* is always a noun and means the fundamental point, a source, or origin. In technical usage, *principal* means main, chief, most important. *Principle* means physical truth as an accepted mode of conduct. In technical writing, *principal* is an adjective; *principle* is a noun.
prior to before	The expression *prior to* is similar to the expression *due to*. That is, when the expression *prior to* is used correctly, *prior* must be a predicate adjective (predicate adjective is briefly defined in the discussion of *due to*). Also, the expression *prior to* should not be used as a prepositional construction to be substituted for the preposition before. Wrong: The letter came prior to the package. Correct: The letter came before the package. Correct: The arrival of the letter was prior to that of the package. (Correct because "prior" is a predicate adjective.) Note: As is true of *due to*, *prior to* can never begin a sentence. Correct: The change requires *prior* government approval *before* being implemented.
promotes	Should be used only in connection with something desired. Wrong: Exposure to the weather *promotes* corrosion (corrosion is undesired.) Correct: The rain *promotes* crop growth.

Problem Word(s)	Meaning(s)
Proved proven	*Proved* is always either a verb or part of a verb phrase. For example: "He has *proved* the answer by checking." *Proven* must always be used as an adjective. For example: It was a *proven* answer to the problem
quantity	Do not use *quantity* (amount) for *number*. For example: "A *number* of reports," not "A *quantity* of reports."
regardless of, irrespective of, irregardless	*Regardless of* is a preposition and means in spite of. *Irrespective* of means without regard or regardless of. *Irregardless* is **erroneous** and should never be used.
(so) as	Use after a negative to limit a comparison. For example, write: "This wire is not so heavy *as* that which we formerly manufactured." Do not write: "This wire is not *as* heavy *as* that which we formerly manufactured."
specie species	*Specie* is a collective noun without plural form and means money in coin. *Species* has the same form in the singular and in the plural and means kind or class.
that which	These words are, to a great extent, interchangeable. However, it is preferable to use *that* to introduce a restrictive clause, and *which* to introduce a nonrestrictive clause. The house *that* stands on the comer is painted black. The plant, *which* is not edible, has broad leaves.
toward towards	*Toward* is the preferred spelling.
use employ utilize	*Use* is the preferred term whenever the idea of serving as the means or instrument is uppermost. *Employ* is the preferred term whenever the idea of engaging or selecting, of keeping occupied or busy, or of turning to account is uppermost. For example: "A successful writer is one who *uses* words effectively and who knows what words to *employ* in a given context." One *utilizes* something when one finds a profitable *use* for it or how to *employ* it for a practical purpose. For example: "He tried to figure out how to *utiliz*e the small limbs cut from the tops of trees."
various varying	*Various* is an adjective meaning different, changeable, or inconstant. *Varying*, from the verb to vary, means modifying, altering in form, appearance, substance, or position.

A.5.2 Redundant Phrases

Redundancy is a term applied to duplication or repetition of meaning. Redundant phrases should not be used. The following list contains redundant phrases (in capital letters) most frequently found in writing.

a LARGE massive structure
adequate ENOUGH
all OF
ALONG with
AND etc.
atop OF
ascend UP
ASSEMBLE together
AT PRESENT, the machine is being repaired.
ATTACH together
being used AT PRESENT
bisect INTO TWO PARTS
blue IN COLOR
broad IN SCOPE
carbon COPY of
CLOSE proximity
consensus OF OPINION
contemporaneous IN AGE
continue ON
CURRENTLY used today
descend DOWN
each AND EVERY
enclosed HEREWITH
ENTIRELY completed
equally AS well
estimated at ABOUT 10%
few IN NUMBER
first AND FOREMOST
FIRST began to
FIRST priority
for A PERIOD OF 2 months
fuse TOGETHER
GOOD benefits
heat to A TEMPERATURE OF 500°C

heat to UP above
IMPORTANT essentials
inside OF
in the EARLY beginning
was done IN THE PAST
we are ACTIVELY engaged in
will be done IN THE FUTURE
within our NARROW limited perspective
lag BEHIND
lead AHEAD
large IN SIZE
LESS-COSTLY AND more economical
may POSSIBLY
MOST unique
mutual advantage OF BOTH
NECESSARY requisite
oval IN SHAPE
pair TOGETHER
PRESENTLY active programs
recoil BACK
repeat AGAIN
reverse BACK
SAME identical
SEEMING paradox
square IN SHAPE
STILL persists
STILL remains
SUCCESSFUL achievements
SURROUNDING circumstances
termed AS
the FINAL conclusion
the ULTIMATE outcome
the results are OVER AND above our expectations
the SUM total of
they are BOTH alike
this SAME program
throughout the ENTIRE experiment
TOGETHER with

total effects of ALL this
TRUE facts
TWO EQUAL halves
unite TOGETHER
universally BY ALL
2 p.m. IN THE AFTERNOON
8 a.m. IN THE MORNING

A.5.3 Superfluous Words and Phrases

The following expressions are not grammatically incorrect, but they are wordy. The shorter versions of these expressions should be used whenever possible.

Instead of	Use
a large number of	many, several
a very limited number	few
afford an opportunity	let, permit
along the lines of	like
are present in greater abundance	more abundant
as described by Smith in reference 12	as described [12]
as in the case	as is true
at an earlier date	previously
at the present time	now, at this time
because of the fact that	because
by means of	by
by the use of	with, by using
call attention to the fact	remind, notify
conducted treated experiments on	treated
created the possibility	made possible
did not have much confidence in	distrusted
did not pay any attention to	ignored
did not remember	forgot
due to the fact that	because
during that time	while
for the case of	for
for the purpose of	for
for the use of	for
found or known to be	are
from the commercial standpoint	commercially
from the standpoint	according to
give consideration to	consider
if conditions are such that	if

Instead of	Use
in a few cases	occasionally
in a hasty manner	hastily
in all cases	always
in any case	anyhow
in case	if
in compliance with your request	as you requested
in consequence of this fact	therefore
in each case	each time
in many cases	often, frequently, many
in most cases	usually
in order for	for
in order that	so
in order to	to
in other cases	sometimes
in some cases	sometimes, occasionally
in spite of the fact that	though, although
in terms of	in
in the amount of	for
in the case of	for
in the event that	if
in the near future	soon
in the neighborhood or vicinity of	nearly or about
in view of the fact that	since, because
in which case	when
information of a confidential nature	confidential information
is of the opinion	believes
it is often the case that	often, frequently
it is possible that the cause is	the cause may
it would thus appear that	apparently
made a statement saying	stated, said
make inquiry concerning	ask
must be borne in mind	must be remembered
not honest	dishonest
not important	trifling, unimportant
of great importance	important
of such hardness that	so hard that
on the basis of	from, by, or because
on the occasion of	when
on the order of	about

Instead of	**Use**
owing to the fact that	because
plants exhibited good growth	plants grew well
prior to, previous to	before
serves the function of being	is
subsequent to	after
such is the case	it is true
such that	so that
the experiment in question	this experiment
the problem is a difficult one	the problem is difficult
the question as to whether	whether
the test in question	this test
the treatment having been performed	after treatment
there is no doubt but that	no doubt, doubtless
this is a subject that	this subject
through the use of	with, by using
unaware of the fact	did not know
until such time as·	until
used for fuel purposes	used for fuel
with reference to	about
with regard to	about

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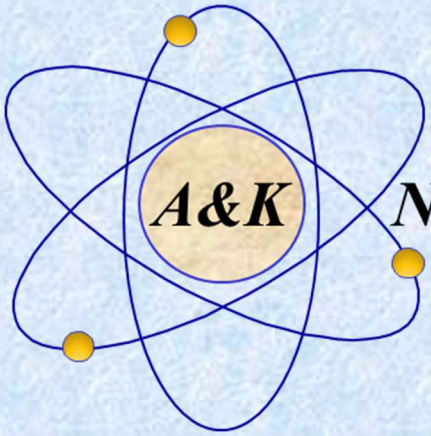

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