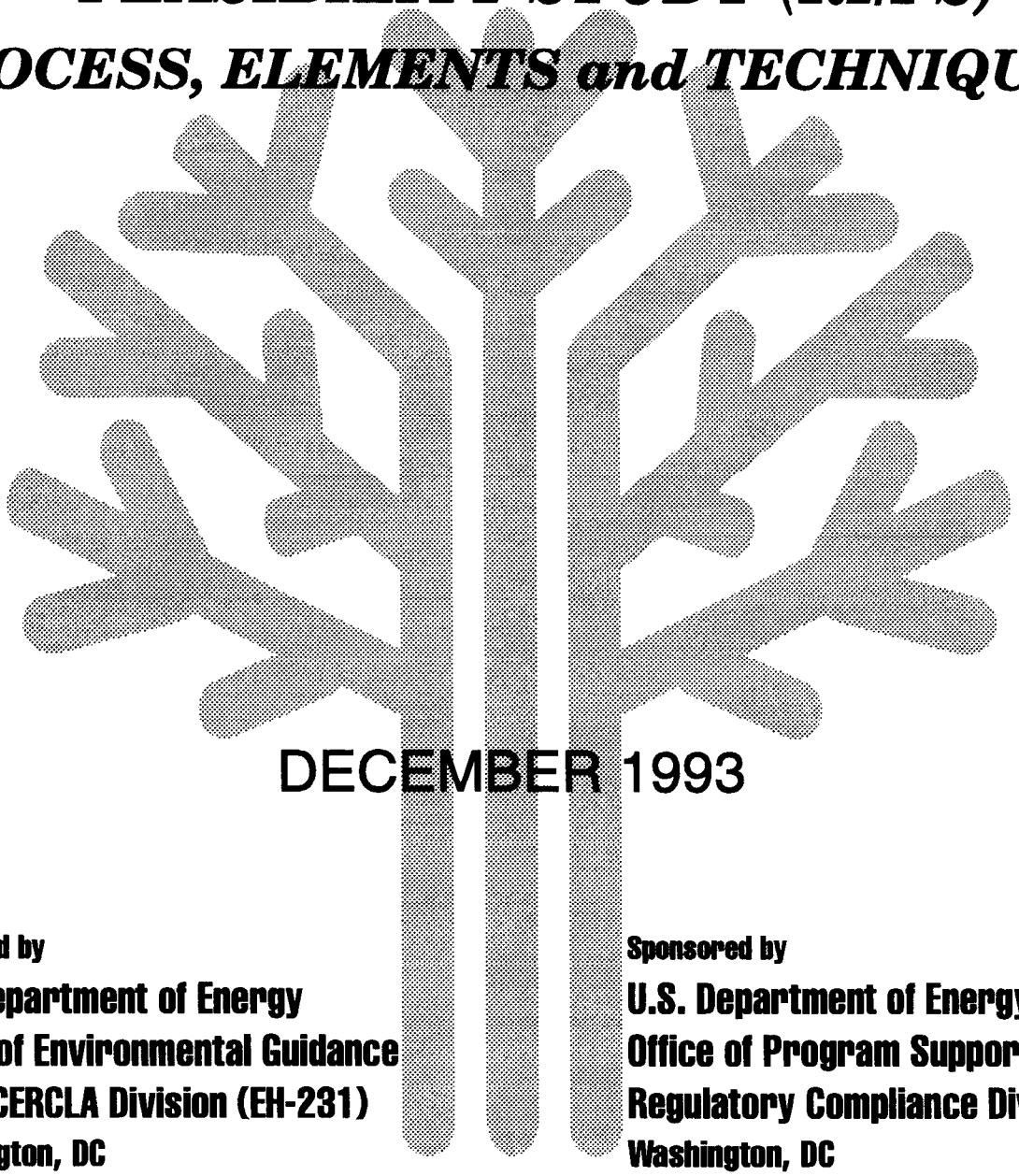
REMEDIAL INVESTIGATION/ FEASIBILITY STUDY (RI/FS)

PROCESS, ELEMENTS and TECHNIQUES



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Acronyms

AEC	Atomic Energy Commission
ARARs	applicable or relevant and appropriate requirements
ATSDR	Agency for Toxic Substances and Disease Registry
AWQC	Ambient Water Quality Criteria
BAF	bioaccumulation factor
BCF	bioconcentration factor
BOD	biological oxygen demand
BRE	baseline risk evaluation
Btu	British thermal unit
CAA	Clean Air Act
CAMU	Corrective Action Management Unit
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
CLP	Contract Laboratory Program
COD	chemical oxygen demand
CPM	counts per minute
CRP	Community Relations Plan
CSL	Close Support Laboratory
CWA	Clean Water Act
D&D	decontamination and decommissioning
DNAPL	dense non-aqueous phase liquid
DOE	Department of Energy
DPM	disintegrations per minute
DQO	data quality objective

EA	Environmental Assessment
EIS	Environmental Impact Statement
EMSL/EPIC	Environmental Monitoring Support Laboratory/Environmental Photographic Information Center
EPA	Environmental Protection Agency
ER	Environmental Restoration (DOE Program)
ERMC	Environmental Restoration Management Contract
ERPM	Environmental Restoration Project Manager
ESA	Endangered Species Act
ESD	Explanation of Significant Differences
EU	exposure unit
FIT/TAT	Field Investigation Team/Technical Assistance Team
FONSI	Finding of No Significant Impact
FSL	Field Support Laboratory
FSP	Field Sampling Plan
FUSRAP	Formerly Utilized Sites Remedial Action Program
GM	Geiger-Mueller
gpm	gallons per minute
GRA	general response action
HEAST	Health Effects Assessment Summary Tables
HI	hazard index
HLW	high-level waste
HQ	hazard quotient
HRS	Hazard Ranking System
HSP	Health and Safety Plan
IDW	investigation-derived waste
IE	ion exchange

IRIS	Integrated Risk Information System
LDR	land disposal restriction
LFI	limited field investigation
LLW	low-level waste
LNAPL	light non-aqueous phase liquid
MCE	maximum credible earthquake
MCL	Maximum Contaminant Level
MDA	minimum detectable activity
MEK	methylethyl ketone
M&O	management and operating (contractor)
MP	multiport
MS/MSD	matrix spike/matrix spike duplicate
NAPL	non-aqueous phase liquid
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRC	Nuclear Regulatory Commission
O&M	Operations and Maintenance
ORNL	Oak Ridge National Laboratory
OSC	On-Scene Coordinator
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
OU	operable unit
PA	Preliminary Assessment
PAH	polycyclic aromatic hydrocarbon
PARCC	precision, accuracy, representativeness, completeness, and comparability

PCB	polychlorinated biphenyl
PER	preliminary engineering report
PMF	probable maximum flood
ppm	parts per million
PRG	preliminary remediation goal
QAMS	Quality Assurance Management Staff (EPA)
QAPP	Quality Assurance Project Plan
QA/QC	quality assurance/quality control
RA	Remedial Action
RAGS	Risk Assessment Guidance for Superfund
RAO	remedial action objective
RAS	Routine Analytical Services
RCRA	Resource Conservation and Recovery Act
RD&D	research, development, and demonstration
RD/RA	Remedial Design/Remedial Action
RfD	reference dose
RFP	request for proposal
RI/FS	Remedial Investigation/Feasibility Study
RME	reasonable maximum exposure
ROD	record of decision
RPM	Remedial Project Manager
RU	remediation unit
SAFER	Streamlined Approach For Environmental Restoration
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SCSR	Site Characterization Summary Report
SF	slope factor

SI	Site Inspection
SMOA	Superfund Memorandum of Agreement
SOP	Standard Operating Procedure
TBC	to be considered
TCE	trichloroethene
TCLP	Toxicity Characteristic Leaching Procedure
TIC	Tentatively Identified Compounds
TOC	total organic carbon
TRU	transuranic
TDS	total dissolved solids
TSCA	Toxic Substances Control Act
TSD	treatment, storage, and disposal
TSDF	treatment, storage, or disposal facility
TSS	total suspended solids
UMTRAP	Uranium Mill Tailings Remedial Action Program
USGS	U.S. Geological Survey
VGAC	vapor-phase granular activated carbon
VOC	volatile organic compound
WSSRAP	Weldon Spring Site Remedial Action Project

Introduction

Purpose

This manual provides detailed guidance on Remedial Investigation/Feasibility Studies (RI/FSs) conducted pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) at Department of Energy (DOE) facilities. The purpose of the RI/FS, to assess the risk posed by a hazardous waste site and to determine the best way to reduce that risk, and its structure (site characterization, risk assessment, screening and detailed analysis of alternatives, etc.) is defined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) and further explained in the Environmental Protection Agency's (EPA's) *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (Interim Final) EPA 540/G-89/004, OSWER Directive 9355.3-01, October 1988. Though issued in 1988, the EPA guidance remains an excellent source of information on the conduct and structure of an RI/FS. However, since that time, EPA has developed numerous supplemental directives, fact sheets, memoranda, and other types of guidance that further explain and define, at a more detailed level, the various aspects of an RI/FS. Additionally, the NCP requirements and EPA's RI/FS guidance were developed to respond to sites where EPA or private parties were conducting the cleanup; neither the NCP nor the guidance address the considerations that are unique to Federal facilities.

This document makes use of supplemental RI/FS-related guidance that EPA has developed since its initial document was issued in 1988, incorporates practical lessons learned in more than 12 years of experience in CERCLA hazardous site remediation, and drawing on those lessons, introduces the Streamlined Approach For Environmental Restoration (SAFER), developed by DOE as a way to proceed quickly and efficiently through the RI/FS process **at DOE facilities**. Thus as its title implies, this guidance is intended to describe in detail the process and component **elements** of an RI/FS, as well as **techniques** to manage the RI/FS effectively. To help accomplish this, the document also makes copious use of examples, many taken from actual RI/FSs being conducted at DOE sites.

Additionally, as stated above, the ultimate goal of the RI/FS process is the selection of remedy that will reduce the risk posed by a contaminated site. Although not formally a part of the actual RI/FS process and, therefore, not included in EPA's 1988 guidance, remedy selection has its own procedural aspects and documentation requirements. Therefore, this document provides detailed information on the remedy selection process and accompanying documentation, including the Proposed Plan and the Record of Decision (ROD). Again, examples are provided.

Finally, the RI/FS process tends to focus on long-term goals and remedial actions. However, options exist for using short-term actions that may be used to quickly reduce actual or potential risk during the RI/FS process. These actions may be taken under the NCP's removal or remedial authorities, and they are an integral part of the SAFER process. This document points out where, when, and how those various actions may be taken during the conduct of an RI/FS.

Audience

This guidance document is primarily intended for DOE personnel with line-management responsibility for environmental restoration efforts conducted pursuant to CERCLA at DOE facilities. It describes, in detail, the steps in the RI/FS process, explains how each should be conducted and what should be accomplished, and defines what should be included in the RI and FS reports and in the remedy selection documentation. A well-conceived and -implemented RI/FS should follow the format of and contain the elements described in this document.

The document also may be used by DOE contractors responsible for the technical development of an RI/FS, and by those technical staff, whether DOE employees or contractors, who review RI/FS documents for technical and regulatory adequacy.

The Streamlined Approach For Environmental Restoration (SAFER) was mentioned earlier. One of the fundamental precepts of the SAFER process is that stakeholders, defined as DOE, DOE's Federal and State regulators, and the public must be intimately involved in the conceptualization and development of an RI/FS and in the many decision points along the way toward its completion. In this regard, this document should also be of interest to the stakeholders participating in RI/FS at DOE facilities. Because this guidance lays out the general steps and methods that should be used in any DOE RI/FS, it can serve as a map to the process and as a guide to where the stakeholders can expect opportunities to participate in the evaluations and decisions that are critical to the process.

Format

This document follows the basic structure of the EPA's 1988 RI/FS guidance. This was intentionally done so that DOE staff with line-management responsibility for environmental restoration under CERCLA will be aware of the long-established procedure that EPA uses in its CERCLA remediations, and with which it will expect Federal agencies to conduct their environmental restoration efforts. Thus, as in EPA's document, the first five modules of this guidance address: (1) Scoping, (2) Site Characterization, (3) Treatability Studies, (4) Development and Screening of Alternatives, and (5) Detailed Analysis of Alternatives. Additionally, this guidance presents three other modules related to the conduct of RI/FS at DOE facilities: (6) Remedy Selection and Documentation, (7) The Streamlined Approach For Environmental Restoration (SAFER), and (8) Streamlining Case Studies.

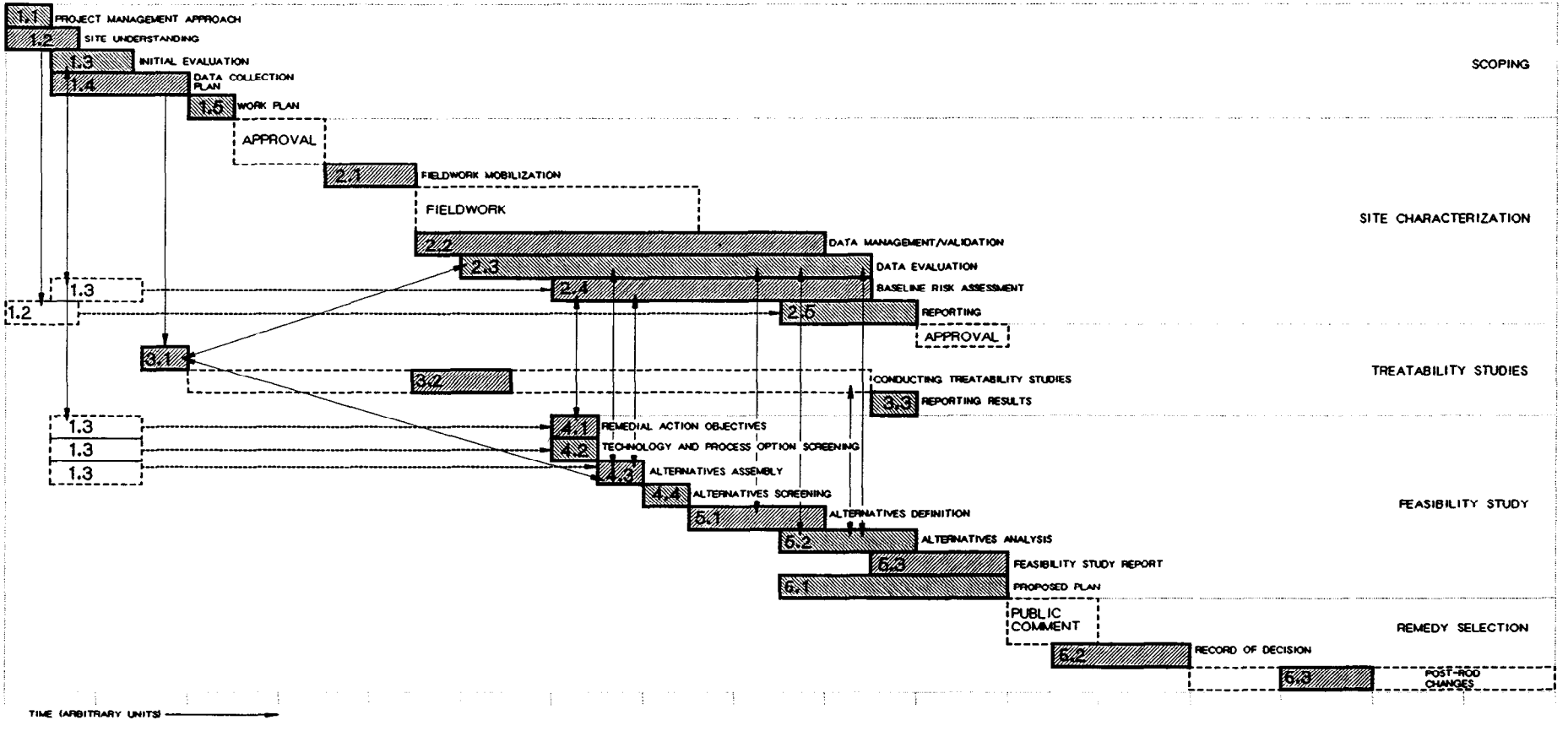
The RI/FS process is essentially an investigation and analysis effort. It provides a means to proceed from a position of limited information about a site to one of sufficient information such that an assessment of risk and selection of a method(s) to reduce that risk can be achieved. Intuitively, it may seem that this process would best be conducted in linear manner; that is, that one discrete part (site characterization) must be completed before another (development and screening of alternatives) can be started. Actually, a well-done RI/FS should have the RI and the FS conducted in an overlapping series of steps that establish the two studies as essentially concurrent and interactive. In fact, a major challenge to developing guidance for the RI/FS process is to overcome the physical appearance (a logically arranged sequence of modules) of the document that reinforces the perception that the RI/FS is a linear operation. Therefore, this guidance strives to show the interdependent and mutually supportive nature of the RI and the FS as the major aspects of CERCLA site investigation, assessment, and resolution. "Relative Timing of the Major Steps of the CERCLA Process," the figure on p. xv, shows this structure with arrows representing interdependencies among the modules in this guidance.

The format for presenting the discussions and information in this guidance was developed specifically for preparing DOE guidance documents. It is a way to present information on complex regulatory requirements in an accessible manner. Using flowcharts, step-by-step instructions, and detailed examples, the format distills statutory and regulatory requirements and guidance into essential concepts and logical steps necessary to meet the requirements.

This format reserves the left-hand page for graphics (e.g., flowcharts, icons). The graphic pages are used primarily to provide a quick reference to find information of interest. When a graphic is not appropriate for the left-hand page, the reader is informed that the page was "intentionally left blank." Right-hand pages are reserved for text. The graphic on the facing page provides detail on guidance organization.

Information is arranged in modules, each representing a major aspect of the project. Completing the steps in a module culminates in producing a major report or other product required in the process. Modules are generally divided into submodules. Each submodule begins by graphically illustrating its main contents on

RELATIVE TIMING OF THE MAJOR STEPS OF THE CERCLA PROCESS



NOTE:
INTERACTIONS BETWEEN THE STEPS NOTED BY ARROWS ARE DISCUSSED IN THE "PUSH-PIN" NOTES AT THE FRONT OF EACH SUBMODULE.

GUIDANCE DOCUMENT MODULES

1. SCOPING
2. SITE CHARACTERIZATION
3. TREATABILITY STUDIES
4. DEVELOPMENT AND SCREENING OF ALTERNATIVES
5. DETAILED ANALYSIS OF ALTERNATIVES
6. REMEDY SELECTION AND DOCUMENTATION.

a left-hand page. The supporting text page on the right provides background information, organization of the module, and relevant references. Each submodule includes flowchart graphics on a left-hand page that illustrate the main elements of the submodule as steps in process flowcharts. Detailed information on each step is provided on the facing right-hand pages. The distilled information provided in the flowcharts and the steps is followed by technical notes on certain aspects of the process. Notes provide more detailed supporting guidance than is provided in the process steps. Notes include examples, outlines, checklists, and expanded technical discussions with marginal notes. The graphical format used in this document is shown in the figure on pp. xvii and xviii.

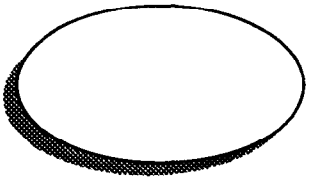
Cross-references are provided between modules where necessary to show the connections between steps. The references may be at any level (e.g, module to module, submodule to submodule, step to module, note to module). Cross-referencing is the primary means by which the parallel and interdependent nature of the RI and the FS is made clear in this document.

NEPA/CERCLA Integration

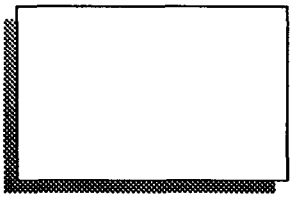
It is the Department's policy to incorporate National Environmental Policy Act (NEPA) values into its environmental restoration efforts conducted pursuant to CERCLA. To date, DOE Headquarters has provided guidance (EH-1 memorandum, November 15, 1991) on implementation of the DOE NEPA/CERCLA integration policy. Additionally, DOE's NEPA regulations (10 CFR 1021) include categorical exclusions for removal actions, and site characterization and monitoring, including those under CERCLA. These two documents should be referenced and used by DOE staff and contractors to ensure the incorporation of NEPA values in CERCLA environmental restoration efforts.

Document Graphics

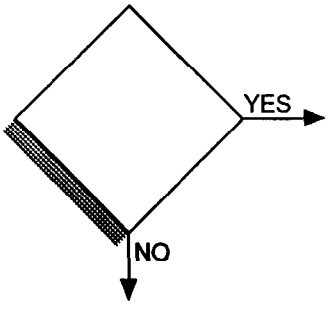
Graphics are central elements of this guidance document. The graphics are used to help guide users through the RI/FS process, provide key information, and illustrate supporting materials. Graphic concepts include flowcharts, icons, examples, and information boxes. Symbols used in this document observe the following conventions:



Ovals represent the beginning of a flowchart. *



Solid Line Rectangles indicate action that must be completed.

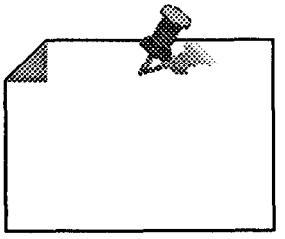


Diamonds represent decision points. Evaluate the question contained in the diamond and follow the appropriate path: YES or NO.

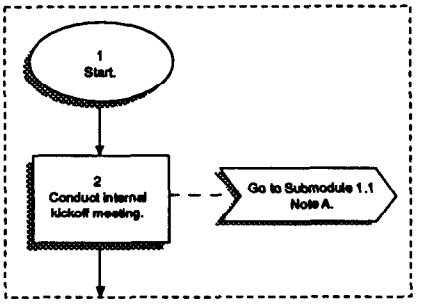
Thin Dashed Line Rectangles contain notes "continued on" or "continued from." Read the notes for guidance through flowcharts.

Solid Line Arrow Polygons represent "go to" statements. Information given in the arrow will provide detail on where to proceed.

* An oval also completes the final graphic of this document.



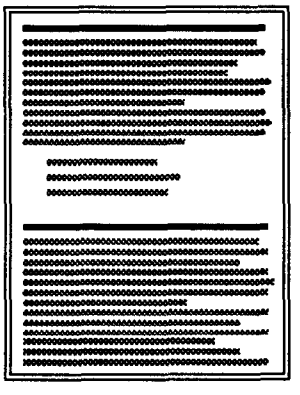
Note Pad Icons contain information that may be key text, a cross reference in the guidance, a key reference document, or other concepts that require special note. No action is associated with Note Pad Icons.



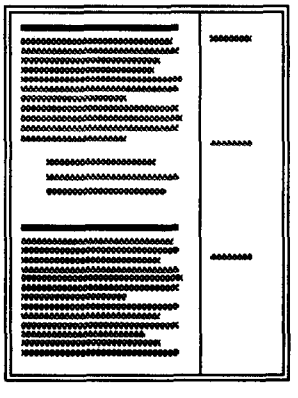
Compressed Icons provide a summary of steps on previous pages.

Document Notes

The format that is used to represent notes is shown here.



Notes With a Double Border are to distinguish them from regular text. Notes provide detailed information on specific topics.



Notes With a Double Border and a Right-Hand Margin supply the information detailed above, with the following additions:

- These illustrative examples are from actual reports.
- These notes can be edited, unedited, or excerpted.
- Marginal comments identify significant elements of the note.