

STATUS OF EPA'S POLLUTION CONTROL
GUIDANCE DOCUMENT FOR OIL SHALE

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ABSTRACT

An Oil Shale Pollution Control Guidance Document is being prepared by the EPA Oil Shale Work Group under direction provided by the Alternate Fuels Group and the Industrial Environmental Research Laboratory, Cincinnati. This document employs a unique multimedia approach to present extensive information on the design, performance and cost of environmental control technology options applicable to a commercial oil shale industry. Major portions of the document have been drafted and are undergoing internal review and revision within EPA. Following internal review and revision, the document will be made available for public review and submission of written comments. A public forum will also be scheduled during the public review period.

INTRODUCTION

The production of liquid fuel from shale to displace fuels from imported petroleum is an important component in the overall U.S. energy policy. It is anticipated that development of synthetic fuels will accelerate rapidly during the next few years. The Environmental Protection Agency (EPA) is responsible for ensuring that the designs of first generation synthetic fuel plants provide for adequate protection of the environment. At present, however, the EPA has not completed the research necessary to support promulgation of new regulations applicable to this industry under the air, water, solid waste, and toxic substances programs of the Agency. To serve the need for protection of the environment during the period

preceding such promulgation and to help avoid costly delays in the commercialization of a synfuel process due to uncertainties concerning environmental technologies, the EPA is developing a set of Pollution Control Guidance Documents (PCGD's).

This paper discusses the following subjects relevant to the Oil Shale Pollution Control Guidance Document: authority, purpose, preparation, processes covered, format and content, schedule, and public participation. It must be emphasized that development of EPA's PCGD for oil shale is a very dynamic process and some changes in format, content and schedule are to be expected as the effort progresses.

Authority

EPA's authority to issue PCGD's is based on the Agency's broad authority, under many of the statutes that it is charged with administering, to publish information and recommendations regarding pollution control. Examples of enabling legislation include Section 103 of the Clean Air Act, 42 U.S.C. §7403 (Supp. 1977), "establish a national research and development program for the prevention of air pollution" and

"collect and make available, through publications and other means, the results of and other information, including appropriate recommendations in connection therewith, pertaining to such research and other activities. . . ."

Section 104 of the Act, 42 U.S.C. §7404, "give special emphasis to research and development into

new and improved methods . . . for the prevention and control of air pollution resulting from the combustion of fuels." Section 104 of the Federal Water Pollution Control Act, 33 U.S.C. §1254, "collect and make available, through publication and other appropriate means, the results of (its research) and other information (relating to the prevention, reduction, and elimination of pollution), including appropriate recommendations . . ."); Sections 8001 (a) and 8003 of the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. §§6981(a) and 6983 (directing the Administrator to conduct research and coordinate and disseminate information on solid and hazardous waste management); Section 1442 of Title XIV of the Public Health Service Act (the Safe Drinking Water Act), 42 U.S.C. §300j-1(b)(1) ("collect and make available information pertaining to research . . . with respect to providing a dependably safe supply of drinking water together with appropriate recommendations . . ."); and Section 10 of the Toxic Substances Control Act, 15 U.S.C. §2609 (directing the Administrator to conduct research necessary to carry out the Act's purposes). More specifically related to the environmental problems of fuel production, Section 111 of the Non-Nuclear Energy Research and Development Act, 42 U.S.C. §5910, in combination with Executive Order No. 12040, directs EPA to evaluate the "adequacy of attention to environmental protection and the environmental consequences of the application of energy technologies."

Purpose

The primary purpose of the PCGD is to provide guidance to both system developers and permitting authorities on control approaches which are available at a reasonable cost for the technologies under consideration. The PCGD is an informational document only. It provides the public with the EPA's best current assessment of the environmental problems posed by the different oil shale technologies and the effectiveness and cost of available control technologies. This information should (a) assist system developers in their efforts to design their facilities to incorporate the best available control technology at the outset; (b) aid permit reviewers in their decision-making by delineating both the likely pollutants and their concentrations as well as the available control options; and

(c) provide the public with the Agency's best current assessment of the environmental problems associated with the commercial production of oil shale-derived synthetic fuels.

The Agency intends this PCGD to provide guidance only. To this end, both the guidance and the associated costs of environmental control are presented in terms of the media to which wastes are discharged, rather than in terms of regulatory requirements which in several instances have multi-media applications. This document has no legal effect and includes nothing that is mandatory in nature except when addressing existing regulations. In publishing this document, the Agency is in no way establishing a binding norm for permit officials to follow and does not intend that it be used in lieu of site-specific analyses. This PCGD leaves permitting authorities free to exercise their informed discretion, within the confines of applicable law, in choosing control strategies to be implemented at each oil shale facility. Permitting officials should use this document merely as an aid in evaluating the environmental problems associated with each particular facility and the adequacy of proposed environmental control system designs. The EPA does not intend the recommendations contained in this PCGD to be applied in a mechanical automatic manner, nor does the Agency intend the conclusions reached herein to be viewed as finally determinative of the issues to which this document is addressed, or to be adopted as regulations or law. Rather, it is the intent of the guidance documents to promote good faith efforts in the design, operation, and maintenance of environmental controls capable of meeting the recommended targets specified therein. If, for specific streams or constituents, a developer feels that these targets cannot or should not be met, that developer should provide data supporting his case. Since all possible options for achieving the specified targets have not necessarily been examined in the PCGD, and since innovation in pollution control is to be encouraged, permit reviewers should be aware that control schemes other than those covered are available. The major purposes of the oil shale PCGD are illustrated in Figure 1.

Approach

Responsibility for preparing the PCGD for oil shale rests with the EPA Oil Shale Work Group which is a subgroup of the Agency-wide Alternate Fuels Group. (A discussion of the formation and role of the Alternate Fuels Group was included in a paper presented at the 13th Oil Shale Symposium and is not repeated here.) Support to the Agency in preparing the Oil Shale PCGD is being provided by Denver Research Institute and its subcontractors, Water Purification Associates and Stone and Webster Engineering Corporation, under the direct supervision of EPA's Energy Pollution Control Division, Industrial Environmental Research Laboratory, Cincinnati, Ohio. A diagram showing the relation of these organizations is presented in Figure 2.

Because no commercial oil shale facilities exist in the U.S., the analyses of pollution control alternatives undertaken during development of the Oil Shale Pollution Control Guidance Documents are based on engineering analyses of hypothetical model plants. Until actual commercial facilities are in operation and source testing data is generated, pollution control guidance is based on the best data available from recent pilot plant operations, supplemented with calculated compositions of waste streams associated with the model plants. Although there are obvious uncertainties associated with using a model plant approach, it is felt that the model plants do accurately reflect the major technical features which will be encountered in a commercial oil shale industry.

The model plants discussed in the oil shale PCGD are listed in Figure 3. Although many oil shale processes or facilities have been proposed in addition to the six listed in Figure 3, it is believed that detailed study of these six will allow discussion of most major environmental concerns and pollution control alternatives. All six retorting processes are either being or have seriously been considered for construction. Pollution control alternatives for each process/development are approached in a detailed site-specific manner leading to preparation of six case studies which collectively constitute the Oil Shale PCGD.

By using various data sources, material and energy balances for several plant configurations are developed for each case study (model plant) to

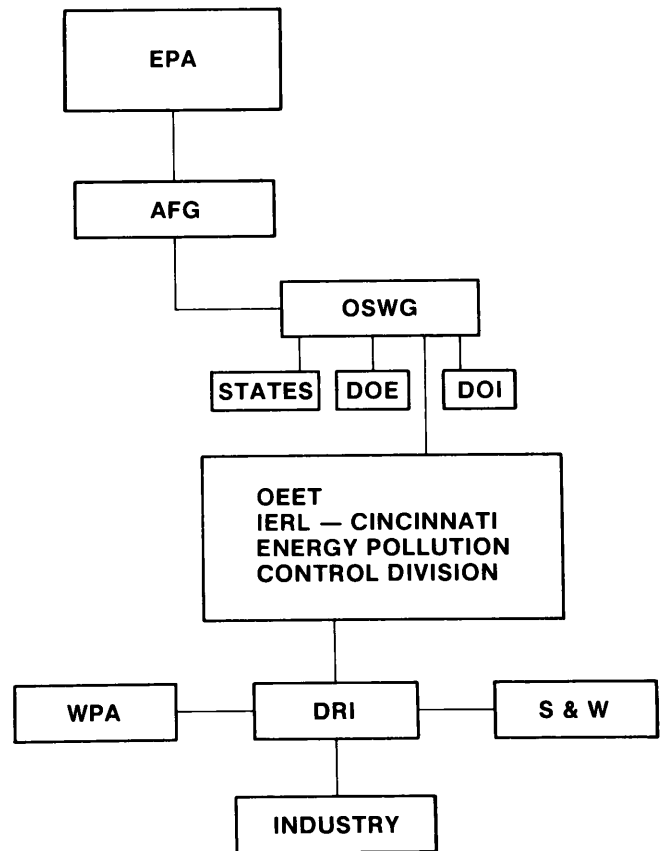
The oil shale PCGD is intended to:

- provide guidance on reasonable control technologies
- assist developers and permitting authorities
- provide current assessment of environmental problems
- delineate likely pollutants and concentrations
- promote good faith efforts to develop BACT

The oil shale PCGD is not intended to:

- be regarded or adopted as regulation
- have any legal effect
- establish a binding norm or discourage innovation
- be used in lieu of site specific analyses
- be finally determinative of issues addressed

Figure 1. Purpose of the Oil Shale PCGD



ORGANIZATION STRUCTURE FOR PREPARING THE OIL SHALE PCGD

Figure 2. Organizational Structure for Preparing the Oil Shale PCGD

SIX OIL SHALE CASE STUDIES

<u>PROCESS</u>	<u>LOCATION</u>	<u>PROCESS TYPE</u>
PARAHO DIRECT MODE	TRACTS Ua, Ub	ABOVEGROUND
TOSCO II	PARACHUTE CREEK (COLONY)	ABOVEGROUND
OCCIDENTAL	TRACT C-b	MODIFIED IN SITU AND LURGI ABOVEGROUND
RIO BLANCO	TRACT C-a	OPEN PIT AND LURGI ABOVEGROUND
UNION B	PARACHUTE CREEK (LONG RIDGE)	ABOVEGROUND
SUPERIOR	BLM PROPOSED LAND EXCHANGE	ABOVEGROUND OIL AND MULTIMINERAL RECOVERY

Figure 3. Case Studies (Model Plants) in the Oil Shale PCGD

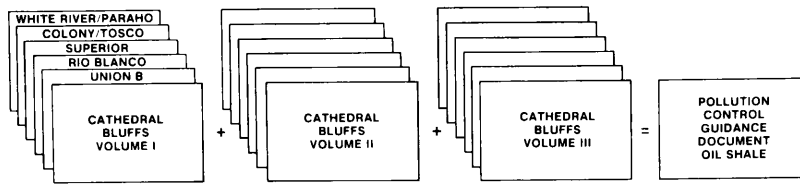
allow estimation of total stream and constituent flow rates in an integrated facility. These flow rates are then used in estimating the size, performance and cost of pollution controls. Control process options are examined on a stream-by-stream basis and "secondary" wastes streams resulting from pollution control activities are also defined. Controls for these streams are evaluated as well. For each stream, all known technology alternatives are given at least preliminary consideration, and the most promising approaches are analyzed in depth. In general, at least two approaches to control are fully analyzed for major plant streams.

The Oil Shale PCGD is based on six case studies which provide a broad spectrum of retorting and pollution control technologies. A tremendous effort has been placed on obtaining the best data base possible on the retorting technologies from the developers who will be using these technologies. Principal sources of data include the process and facility developers themselves, assessments by EPA and others on operation of pilot plants, the Federal Prototype Oil Shale Leasing Program administered by the Area Oil Shale Supervisor's Office, Department of Interior and the U.S. Department of Energy, particularly the Laramie Energy Technology Center.

Contents of the Oil Shale PCGD

EPA has decided on a three volume format for the Oil Shale PCGD. Since six case studies are planned, a three volume format leads to a total of eighteen volumes in the Oil Shale PCGD effort. These plans are tentative and some consolidation may be possible. For example, it is planned to investigate the possibility of employing a generic approach for combining the six Volume I documents. Figure 4 indicates the component volumes that are planned to eventually constitute the Oil Shale PCGD.

Generally, Volume I will provide the major elements of guidance including projected discharge limits which are felt to be achievable with available control technologies. For major streams (defined by potential environmental impact and estimated control cost), an Agency preference may be provided, but is not meant to preclude alternative approaches. In addition, Volume I will summarize the existing regulations applicable to oil shale facilities; provide a summary of the plant complex including an inventory of streams and control technologies; discuss the most viable alternatives for control of emission, effluents, and wastes; and provide a summary of pollution



COMPONENT PARTS OF THE OIL SHALE PCGD

Figure 4. The Component Parts Making up the Oil Shale PCGD

control costs. Table 1 presents a tentative list of subjects to be included in a Volume I document. Figure 5 illustrates a possible approach for presenting environmental control guidance for primary streams. Figure 6 presents one approach for presenting environmental control guidance for streams of lesser importance. In general, Volume I will contain the important elements of Agency guidance on pollution control alternatives, but will not contain the detailed discussions and evaluations found in Volume II.

Volume II will contain a detailed discussion of the site-specific case study and will essentially serve as the major data base for the effort. Included will be a discussion of several possible plant configurations based upon alternative approaches to control major discharge streams, detailed process flow diagrams and flow rates, detailed inventory and composition of emissions, effluents and wastes, detailed discussion of pollution control alternatives and equipment; and a discussion of pollution control

SUMMARY OF SO₂ CONTROL GUIDANCE FOR COMBUSTION OF PLANT FUELS

Guidance Type	Option I	Option II
Achievable Numerical Limits	XXppmv in flue gas from gas combustion	5 removal efficiencies
	XKg SO ₂ /barrel of product oil for gas fuels	H ₂ S - to Xppm COS - X% removal CS ₂ - X% removal
	XKg SO ₂ /10 ⁶ Btu fuel in Lurgi lift pipe	RSH - X% removal XKg SO ₂ /barrel oil for gas fuels
		XKg SO ₂ /10 ⁶ Btu fuel in Lurgi lift pipe
Technology Basis	Boiler flue gas—limestone scrubbing or equivalent Lurgi shale burner—Lurgi design	Boiler flue gas—Stretford process gas treating Lurgi shale burner—Lurgi design
Total Cost	Fixed capital—XX million Annualized— X%*	Fixed capital—XX million Annualized— X%*
Regulatory Basis	Best Available Control Technology	

*Expressed as a percentage of the sale price (\$32) of oil product.

Figure 5. One Approach Being Considered for Presentation of Control Guidance for Primary Streams

CONTROL OPTIONS FOR GASEOUS STREAMS, FUGITIVE DUSTS AND EMISSIONS FOR CATHEDRAL BLUFFS CASE STUDY

Stream (Stream Number)	Pollutants	Control Guidance		Discussion
		Option I	Option II	
Naphtha-free Lurgi Retort Gas (24)	H ₂ S/SO ₂	<p><u>Guidance:</u> 50 ppmv SO₂ in the flue gas after combustion</p> <p><u>Technology Basis:</u> Flue Gas Desulfurization (FGD)</p> <p><u>Cost:</u> Included with MIS gas control costs (Stream 32)</p>	<p><u>Guidance:</u> 15 ppmv H₂S in the treated gas</p> <p><u>Technology Basis:</u> Sulfur recovery by Stretford</p> <p><u>Cost:</u> Included with MIS gas control costs (Stream 32)</p>	<p>The naphtha free retort gas is combined with the MIS retort gas and burned in a steam boiler. Both FGD control of SO₂ in the flue gas (Option I) and Stretford gas treating for H₂S reduction (Option II) are combined systems which treat both gases. A separate Stretford absorber will be used on the Lurgi gas but the balance of the Stretford plant will be a common facility.</p> <p>Option II will result in a slight additional decrease in the NH₃ Content of the retort gas.</p>

Figure 6. One Approach Being Considered for Presentation of Control Guidance for Secondary Streams

Table 1

TENTATIVE LIST OF SUBJECTS TO BE INCLUDED IN A VOLUME I CASE STUDY DOCUMENT

- 1.0 INTRODUCTION
 - PURPOSE OF DOCUMENT
 - DESCRIPTION OF THE APPROACH
 - A REVIEW OF THE DATA SOURCES
- 2.0 ENVIRONMENTAL CONTROL GUIDANCE FOR PRIMARY STREAMS
 - INTRODUCTION
 - DISCUSSION OF PRIMARY CONTROL AREAS
- 3.0 EXISTING REGULATIONS APPLICABLE TO OIL SHALE FACILITIES
 - AIR POLLUTION REGULATIONS
 - WATER POLLUTION REGULATIONS
 - REGULATIONS AFFECTING THE DISPOSAL OF SOLID WASTES, SLUDGES, AND BRINES.
 - REQUIREMENTS FOR TOXIC SUBSTANCES CONTROL
- 4.0 DESCRIPTION OF THE OIL SHALE PLANT COMPLEX
 - OVERVIEW OF THE COMPLETE PLANT COMPLEX
 - DISCUSSION OF UNIT PROCESS OPERATIONS
 - INVENTORY OF CONTROL ALTERNATIVES
- 5.0 ENVIRONMENTAL CONTROL GUIDANCE
 - ATMOSPHERIC EMISSIONS, WASTEWATER MANAGEMENT AND SOLID WASTE MANAGEMENT REQUIREMENTS UNDER THE TOXIC SUBSTANCES CONTROL ACT
- 6.0 ANALYSIS OF CONTROL COSTS
 - INTRODUCTION
 - COSTS FOR THE BASE CASE
 - SENSITIVITY ANALYSIS
- 7.0 REFERENCES

costs. Table 2 presents a tentative list of subjects to be included in a Volume II document.

Inherent in EPA's approach to evaluation of pollution control alternatives for oil shale, is the realization that one cannot treat streams as isolated subjects, but rather one must consider multi-media tradeoffs and be aware that selection of a particular control approach for one stream may also impact the composition and control alternatives for other streams in the plant. Therefore, several different possible plant configurations are evaluated in each case study. The three configurations being considered in the Cathedral Bluffs Case Study are indicated in Table 3. Although space does not

Table 2

TENTATIVE LIST OF SUBJECTS TO BE INCLUDED IN A VOLUME II CASE STUDY DOCUMENT

- 1.0 INTRODUCTION
 - PURPOSE
 - APPROACH
 - DATA SOURCES
 - STATE OF TECHNOLOGY DEVELOPMENT
 - MAJOR ASSUMPTIONS
 - UNIQUE FEATURES OF CASE STUDY
- 2.0 SUMMARY OF CASE STUDY FEATURES
 - PROCESS OVERVIEW
 - OVERALL DIMENSIONS
 - CONTROL FIGURATIONS
- 3.0 PROCESS FLOW DIAGRAMS AND FLOW RATES
 - INTRODUCTION
 - STRUCTURE OF DIAGRAMS
 - DIAGRAMS OF FLOWS AND RATES
- 4.0 INVENTORY AND COMPOSITION OF EMISSIONS, EFFLUENTS, AND WASTES
 - INVENTORY OF STREAMS
 - DETAILED COMPOSITION OF STREAMS
- 5.0 POLLUTION CONTROL ALTERNATIVES/EQUIPMENT
 - CONTROL BY POLLUTANT
 - CONTROL BY STREAM
- 6.0 POLLUTION CONTROL COSTS
 - EQUITY FINANCING
 - UTILITY FINANCING

permit a discussion in this paper, the Volume II documents will contain detailed flow diagrams, stream compositions and flow rates before and after treatment, and information on equipment sizes and costs. The major factors and key assumptions considered in cost evaluation are listed in Table 4.

Volume III is intended as an appendix volume containing additional and backup information explaining how data and conclusions in Volumes I and II were derived. Exact content of Volume III will depend upon the final content of Volume II for each case study.

Schedule and Opportunity for Public Participation

At the present time, three Volume II documents and one Volume I document have been prepared and are undergoing internal review and revision within the Agency. The remaining documents are in various stages of initial preparation. Since the developers of the six processes described in the PCGD along with the Department of Energy and the Department of

Table 3
SUMMARY OF POLLUTION CONTROL ALTERNATIVES, CATHEDRAL BLUFFS CASE STUDY

Area of Control Configuration	Retorting Treatment	Retort Gas Treatment	Retort Water Treatment	Gas Condensate Treatment	Steam Power Generation	Solid Waste Management
A	•Baghouses	•MIS: Operate at gas pressure below atmos.	•Water Scrubbing	•Thermal Sludge Boilers	•FGD for SO ₂ Control	Lurgi: Surface Landfill MIS: Abandonment*
	•Water Sprays	•Lurgi: Baghouse for Flue Gas		•Phosam •Thermal Sludge Boilers		
B	•Baghouses	•MIS: Operate at gas pressure below atmos.	•Water Scrubbing	•Thermal Sludge Boilers	No Control Necessary	Lurgi: Surface Landfill MIS: Abandonment*
	•Water Sprays	•Lurgi: Baghouse for Flue Gas	•Stretford	•Phosam •Thermal Sludge Boilers		
C	•Baghouses	•MIS: Operate at gas pressure below atmos.	•Water Scrubbing	•Steam Stripping	•FGD for SO ₂ Control	Lurgi: Surface Landfill MIS: Abandonment*
	•Water Sprays	•Lurgi: Baghouse for Flue Gas		•Reverse Osmosis •RCC Evaporation Adsorption		

*Problems of MIS retort abandonment, and type and extent of control required are unknown at the present time.

Table 4

MAJOR FACTORS AND KEY ASSUMPTIONS FOR
DETERMINATION OF POLLUTION CONTROL COSTS

Major Factors

- Investment and Start Up Profiles
- Contingency Allowance on Capital
- Extra Start Up Costs
- Severance Tax and Royalties
- Federal and State Income Tax (Including Investment Credit, Depletion Allowance and Appropriate Depreciation)
- Working Capital
- Overhead Type Charges

Key Assumptions

- Constant Dollars (Mid 1980)
- 12% DCF ROR (All Equity)
- 20% Investment Tax Credit
- 90% Capacity Utilization
- Site-Specific Evaluations

Raw Capital Cost Factors

- Major Equipment (Vendor Quotes)
- Excavation and Foundations
- Support Steel
- Duct Pipe Insulation
- Pumps
- Piping
- Electrical
- Instrumentation/Controls
- Painting
- Structural Enclosures

Operating Costs

- Maintenance
- Operating Labor
- Maintenance Labor
- Supervisory Labor
- Chemicals
- Electricity
- Steam
- By-product Credit

that will be required to prepare the documents for release to the public. Therefore, the Agency will publish a notice in the Federal Register advising the public of the availability of the documents for public review and containing details on the public forum. EPA wants to work with industry, state, and local governments to make sure that the documents are accurate and useful. Following the public review period, the Agency will make appropriate revisions to the documents prior to publishing.

In summary, it should be emphasized that the purpose of the Oil Shale Pollution Control Guidance Document is to provide guidance only and it should not be regarded as regulations. It is intended as an aid to both industry and the permitting authorities regarding pollution control approaches which appear most promising, but should not discourage alternative approaches if they can be shown to be equally effective. Although the documents are not available for public review at this time, a public review period is planned and public comment is encouraged prior to finalizing the documents.

the Interior provided much of the data for the PCGD effort, these organizations are reviewing the initial Volume II documents concurrently with EPA. Volume I documents are presently being restricted for review inside the Agency, but will in the future be released for public review and comment.

It is presently estimated that two months or more will be scheduled for the public review of the Oil Shale PCGD documents. During this public review period a public forum will be scheduled to encourage free exchange of ideas and comments on the documents. A tentative schedule for preparation and review is indicated in Figure 7. However, it is very difficult to estimate the amount of time

OIL SHALE POLLUTION CONTROL GUIDANCE DOCUMENT SCHEDULE*

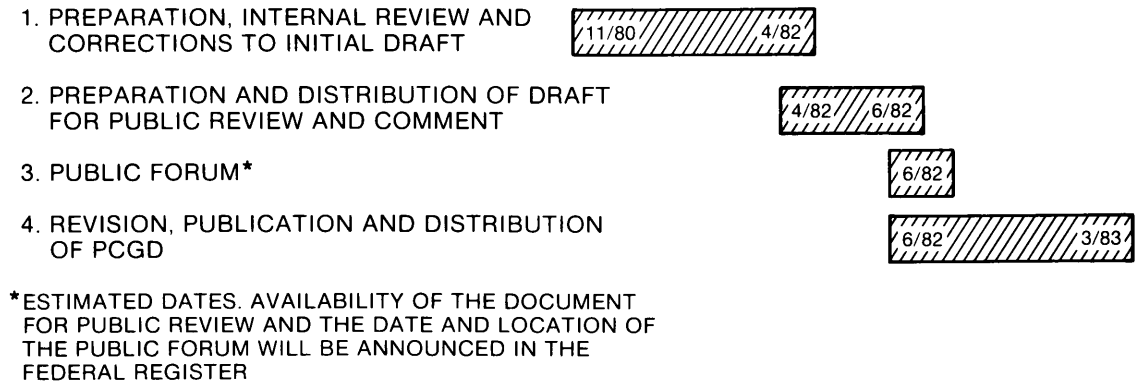


Figure 7. Estimated Schedule for the Oil Shale PCGD