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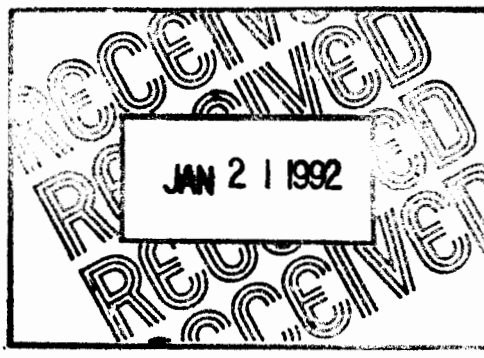
FROM: Michael Goodis

DATE: December 30, 1991

To follow-up the December 10-11, 1991, NAS meeting, we are again distributing the "Strategy for the Waste Isolation Pilot Plant Test Phase" document to you for your information.

If you have any questions, please contact me at (301) 903-7208.

Michael L. Goodis
WIPP Project Division
Office of Waste Operations
Environmental Restoration
and Waste Management



Department of Energy
Washington, DC 20585

OCT 21 1991

Distribution:

Enclosed for your information is the Strategy for the Waste Isolation Pilot Plant (WIPP) Test Phase. It defines the activities and associated performance assessment that will be conducted to determine compliance with Environmental Protection Agency disposal regulations. Using information from the Test Phase, a disposal decision will be made regarding the suitability of WIPP to be a permanent disposal facility for defense transuranic (TRU) wastes.

The purpose of this document is to provide the WIPP Project participants, decisionmakers, and interested parties with an understanding of the logic, objectives, and interfaces of the activities to be conducted during the Test Phase. It was presented for review to the National Academy of Sciences WIPP Panel and the Secretary's Blue Ribbon Panel earlier this year. This document represents the first in a series of top-level strategy documents to be developed for WIPP and will become the planning base for all WIPP Project management. This effort is consistent with Department of Energy (DOE) strategic plan initiatives and, in particular, with the Office of Environmental Restoration and Waste Management Five-Year Plan road-mapping initiative.

The document does not discuss all the activities which are necessary to support operations of WIPP as a disposal facility. For example, this document does not address the operational safety of WIPP or DOE's strategy for complying with other requirements. Rather, this document focused on the performance assessment program and its relationship with the test program. Work is underway to develop the strategy for all activities necessary to begin the operational phase of WIPP, if a decision is made to dispose of TRU wastes at WIPP. This more comprehensive strategy, which will also address uncertainties and alternative program logic, will be developed during fiscal year 1992 and will expand the planning horizon to include the disposal phase and the decommissioning phase for WIPP.

The Test Phase Strategy is formulated based on a number of assumptions that appear valid in today's regulatory, technical, and institutional climate. For example, the Test Phase strategy assumed initiation of dry-bin tests in September 1991 and does not reflect the impact of the law suit filed by the State of New Mexico or potential legislative land withdrawal proposals. As assumptions change, the strategy will be reexamined to determine whether it will continue to meet the goals of the program.

Sincerely,

Mark W. Frei

Mark W. Frei, Chairman
Headquarters WIPP Task Force
Office of Environmental Restoration
and Waste Management

Enclosure

DOE/EM/48063-2

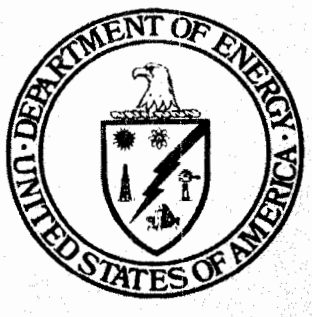
WIPP

Strategy for the Waste Isolation Pilot Plant Test Phase

Environmental Restoration And Waste Management

DOE/EM/48063-2

Department of Energy
Office of
Waste Operations



EXECUTIVE SUMMARY

1. INTRODUCTION

The U.S. Department of Energy (DOE) has developed a strategy for the Test Phase of the Waste Isolation Pilot Plant (WIPP), a demonstration facility for the disposal of transuranic (TRU) radioactive wastes from defense activities. Authorized and funded by the Congress, the WIPP has been constructed in New Mexico and, if disposal is determined to be safe, will be used for the permanent disposal of TRU wastes. The strategy summarized here is limited to the scientific activities of the Test Phase; the institutional, management, and other activities that will be needed to support a disposal decision will be included in a comprehensive long-term strategy document to be prepared in fiscal year 1992.

Development in phases. The TRU wastes will be radioactive for thousands of years, and some of them contain hazardous chemicals. To ensure safety, the DOE decided to develop the WIPP in phases. First, several sites were evaluated to select a preferred site, extensive surface-based testing was conducted at the site, a repository was designed, and preliminary safety analyses were conducted. Next, two shafts were constructed, an underground testing area was excavated, and studies were conducted to collect more data. Surface facilities were then built, and considerable underground excavation was completed. The WIPP is now in the Test Phase. The Test Phase consists of performance assessment, the test program, and the decision process. The Test Phase will end when a decision is made to begin disposal or to abandon the WIPP if regulatory compliance cannot be determined.

Key regulations governing the WIPP. The DOE has made a commitment that no waste will be permanently emplaced in the WIPP until compliance with the applicable regulations of the U.S. Environmental Protection Agency (EPA) has been determined. These regulations are the environmental standards for the management and disposal of TRU wastes (40 CFR Part 191) and the land-disposal requirements of the Resource Conservation and Recovery Act (RCRA) as amended.

The next steps in the WIPP project. Although extensive studies of the site and WIPP performance have not identified any attributes that would disqualify the WIPP as a repository, more information is needed to better characterize the WIPP and to reduce uncertainties in predictions of its long-term performance. The collection of data for the WIPP has been conducted through field tests at the site, studies performed in the WIPP underground excavations, and laboratory experiments. These activities have used and continue to use simulated waste. No tests with real TRU waste have been conducted to study the behavior of the waste or its interactions in the repository environment. During the Test Phase experiments with real TRU waste will be conducted. These experiments will be designed to permit the retrieval of all waste if the decision is made to abandon the WIPP.

The completion of performance assessment is now scheduled for the end of calendar year 1996, but could occur as early as 1993 if a revised Subpart B of 40 CFR Part 191 is promulgated in a timely manner and regulatory compliance can be determined with sufficient confidence. Similarly, the disposal decision is scheduled for the end of calendar year 1997, but may be made as early as 1995. Firm schedules cannot be given at present because it is not yet clear how much time will be needed for characterizing the wastes to be used in testing or how much data will be needed to determine compliance. Moreover, the time needed for collecting sufficient data from tests with the waste cannot be precisely estimated. These and other uncertainties will be evaluated and contingencies will be identified in the follow-on long-term strategy.

2. PERFORMANCE ASSESSMENT

Performance assessment will evaluate compliance with the EPA regulations. It is an iterative process of comparing performance goals with calculated performance predictions, using increasingly more-detailed site and design data. For these assessments, conceptual and numerical models are being developed.

Regulatory requirements. The EPA regulations in Subpart B of 40 CFR Part 191 limit cumulative releases of radioactive materials to the "accessible" environment for 10,000 years after WIPP closure, limit the annual radiation dose that can be delivered to members of the public, and specify groundwater-protection requirements for 1000 years after closure under undisturbed conditions. The EPA's RCRA-related regulations specify that land disposal of hazardous chemicals is to be permitted only if it can be predicted, to a reasonable degree of certainty, that these chemicals will not migrate from the disposal unit for as long as the wastes remain hazardous.

Approach to the determination of compliance. A formal process for evaluating compliance with the quantitative requirements of Subpart B of 40 CFR Part 191 has been established. It consists of identifying the processes and events that might affect long-term isolation, developing scenarios that describe how these processes and events could affect isolation, and estimating the cumulative releases of radionuclides caused by all significant processes and events.

The information needed for performance assessment will be provided by the test program. Critical parameters include the transport characteristics of the rock units overlying the repository, local radionuclide geochemistry in the waste rooms (mainly solubility in WIPP brine), gas generation and migration rates, the closure and compaction state of the drifts and shafts, and human-intrusion characteristics.

The approach to evaluating compliance with the RCRA-related regulations will be based on the evaluation performed earlier to obtain a no-migration variance from the EPA. Investigations during the Test Phase will provide more-specific estimates of hazardous-component source terms by examining waste compositions and further characterizing the waste.

Strategy for evaluating compliance. Performance assessment and the test program will be conducted in annual cycles. In each cycle, data from testing will be used to update scenarios and models, and the models will be exercised to define uncertainties and provide further guidance to the test program for data acquisition, the refinement of performance goals, and potential changes in the WIPP design. If at the end of any cycle the results of this process show, at a sufficient level of confidence, that compliance is achieved (or that compliance cannot be achieved), the DOE will begin the decision process. If the results show that the level of confidence is insufficient, the next annual cycle will start.

Engineered alternatives. In each cycle, if compliance cannot be demonstrated with existing waste forms, sensitivity studies will be used to determine guidance for testing. In addition to test modifications, engineering measures can be used to achieve a higher level of confidence. These measures include modifications of the waste forms and of the WIPP configuration.

As a contingency for the baseline design of the WIPP, the DOE established the Engineered Alternatives Task Force to identify and select various modifications, analyze their relative effectiveness, and evaluate the feasibility of implementing the most promising alternatives. The task force identified a number of potential waste-form and facility modifications.

Early in the Test Phase the DOE will use existing TRU wastes, and in later cycles, the DOE will conduct tests with modified wastes. System studies will also be conducted to assess impacts on the rest of the TRU-waste-management system (i.e., system components other than the WIPP). The performance-assessment cycles will continue to refine tests and engineered modifications to determine whether they are warranted.

3. THE TEST PROGRAM

The test program is directed at (1) describing the natural barriers that can provide long-term isolation at the WIPP site, (2) characterizing the environment expected to prevail in the WIPP underground after waste emplacement, and (3) determining waste interactions with the underground environment. The main purpose is to support a credible and defensible prediction of WIPP performance over the next 10,000 years.

Describing the natural barriers

There are multiple natural barriers at the WIPP site that would contribute to safe isolation over the long term. The first barriers are the salt and anhydrite units of the Salado Formation (the host rock), which do not admit the flow of groundwater, the principal natural mechanism for transporting nongaseous waste constituents to the environment. Other barriers lie above the repository; they consist of multiple rock units, only a few of which admit the flow of groundwater. Some of these same barriers would act to contain or retard the movement of RCRA-regulated gases. The investigations of natural barriers will be focused on understanding the travel of waste constituents through or past the various barriers.

Extensive studies of geologic, hydrologic, and geochemical conditions have been performed since the start of site characterization in 1975. These studies are being extended to provide detailed data for performance assessments and to reduce or define uncertainties. They will include laboratory tests to determine the physical and chemical properties of the rocks and brine; studies in the field; and the development, verification, and validation of models.

Characterizing the repository environment

Tests and studies in this category will address two phenomena important to long-term performance: brine inflow and the tendency of salt to creep. Processes related to these phenomena can profoundly affect the progression of events and perhaps long-term performance. Because of uncertainties in the progression of these and other natural, events the DOE has begun a series of tests to characterize the WIPP underground environment. Another objective is to obtain data needed for developing two types of engineered barriers: backfill for the underground excavations and long-term seals for shafts, drifts, and boreholes.

Waste-interaction tests

Performance assessment requires information that can be obtained only from tests with waste, whether real or simulated. This includes data on gas generation, which can slow or reverse room closure and may drive hazardous chemicals beyond acceptable boundaries and data on waste leachability by, and solubility in, brine. Uncertainties in the existing information are too great for defensible performance assessments. The tests on waste interactions consist of early laboratory tests and follow-on, more-definitive tests with real waste.

The laboratory tests use simulated waste. They examine such phenomena as gas generation from the corrosion of metals, radiation effects, bacterial effects, the effects of waste compaction, and the efficacy of proposed backfill additives in removing gas or preventing its production. These tests are expected to provide guidance for the follow-on tests and to aid in the interpretation of the follow-on test results.

Bin tests. These tests will be conducted in the WIPP underground testing areas, using real contact-handled TRU waste. They are designed to provide gas-generation data for evaluating compliance with 40 CFR Part 191; these data will also be useful in evaluating compliance with the RCRA. Most of the waste will come from the Rocky Flats Plant or the Idaho National Engineering Laboratory.

The bin tests will be conducted in phases and will examine low-organic, high-organic, and sludge waste under conditions of wetness and oxygen availability that may occur in the long term; they will also examine the effects of modifying the wastes by adding "getters" for carbon dioxide or supercompacting the waste. Brine, salt, and backfill will be added to some bins to more closely simulate the postclosure environment. The first phase will be a limited set of experiments with the existing TRU waste to determine gas-generation rates under dry conditions and variabilities for each waste category. It will be followed by tests with some modified waste as soon as practicable. Further testing with modified waste forms will be conducted if needed.

Alcove tests. The results of the bin tests will indicate to what extent alcove tests are needed. These tests will use TRU waste packaged in disposal containers and will be conducted in specially prepared alcoves, or large rooms, under conditions similar to those expected in the WIPP. The alcoves will be used to verify predictions from the smaller-scale, more-selective laboratory and bin tests. A prerequisite to implementing alcove tests is assurance that an adequate alcove seal can be emplaced. The design of the seals will be tested before emplacing waste and conducting the alcove tests.

Tests of leachability and solubility. These tests will be conducted with real contact-handled TRU waste. They will provide information critical to performance assessment—the quantities of radionuclides that may be mobilized for transport to the environment and the rate of this mobilization in each scenario.

4. THE DECISION PROCESS

The decision process will involve all the activities necessary to document compliance with the applicable regulations, to complete the necessary institutional interactions, and to prepare a summary statement and recommendation for the Secretary of Energy. Documentation will be needed for demonstrating compliance with 40 CFR Part 191, the RCRA-related regulations, and other applicable Federal and State regulations, such as the National Environmental Policy Act (NEPA) of 1969. NEPA documentation will include another supplemental environmental impact statement (SEIS) and updated safety analysis reports for the WIPP and the shipping containers. All of these documents will be reviewed by the cognizant DOE organizations whose concurrence is needed. The purpose of the review is to ensure that the documentation is adequate and appropriate to support the determination of compliance, to obtain the necessary permits and approvals, and to comply with DOE orders.

To operate as a waste-disposal facility under RCRA regulations, two separate documents are required. One will be a petition to the EPA to grant a no-migration variance in accordance with the provisions of 40 CFR Part 268. If the EPA deems the documentation adequate, it will grant a no-migration variance under conditions to be enforced by the EPA. The other document will be an application to the State of New Mexico for an RCRA permit under Part B. The State permit will be issued under State procedures, which include public notice, comment, and an opportunity for public hearing. The conditions of this permit will be enforced by the State.

Once the process of documentation and review (both internal and external) has been completed, the DOE will prepare an internal summary report for the Secretary of Energy. This report will include a recommendation as to whether waste disposal at the WIPP should begin. Given a determination of compliance with the applicable regulations and a favorable record of decision on the new SEIS, and a favorable readiness review, the Secretary will decide whether the WIPP should begin receiving TRU waste for permanent disposal. If land-withdrawal legislation mandates or the DOE signs with another agency a memorandum of understanding that provides for an independent certification of the DOE's compliance determination, this decision process will be amended.

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1. INTRODUCTION

The U.S. Department of Energy (DOE) has begun a Test Phase at the Waste Isolation Pilot Plant (WIPP), an underground facility for the disposal of transuranic (TRU) radioactive wastes. The objective of the Test Phase is to determine whether the WIPP will comply with certain regulations of the U.S. Environmental Protection Agency (EPA). If a determination of compliance can be made, permanent disposal in the WIPP can begin.

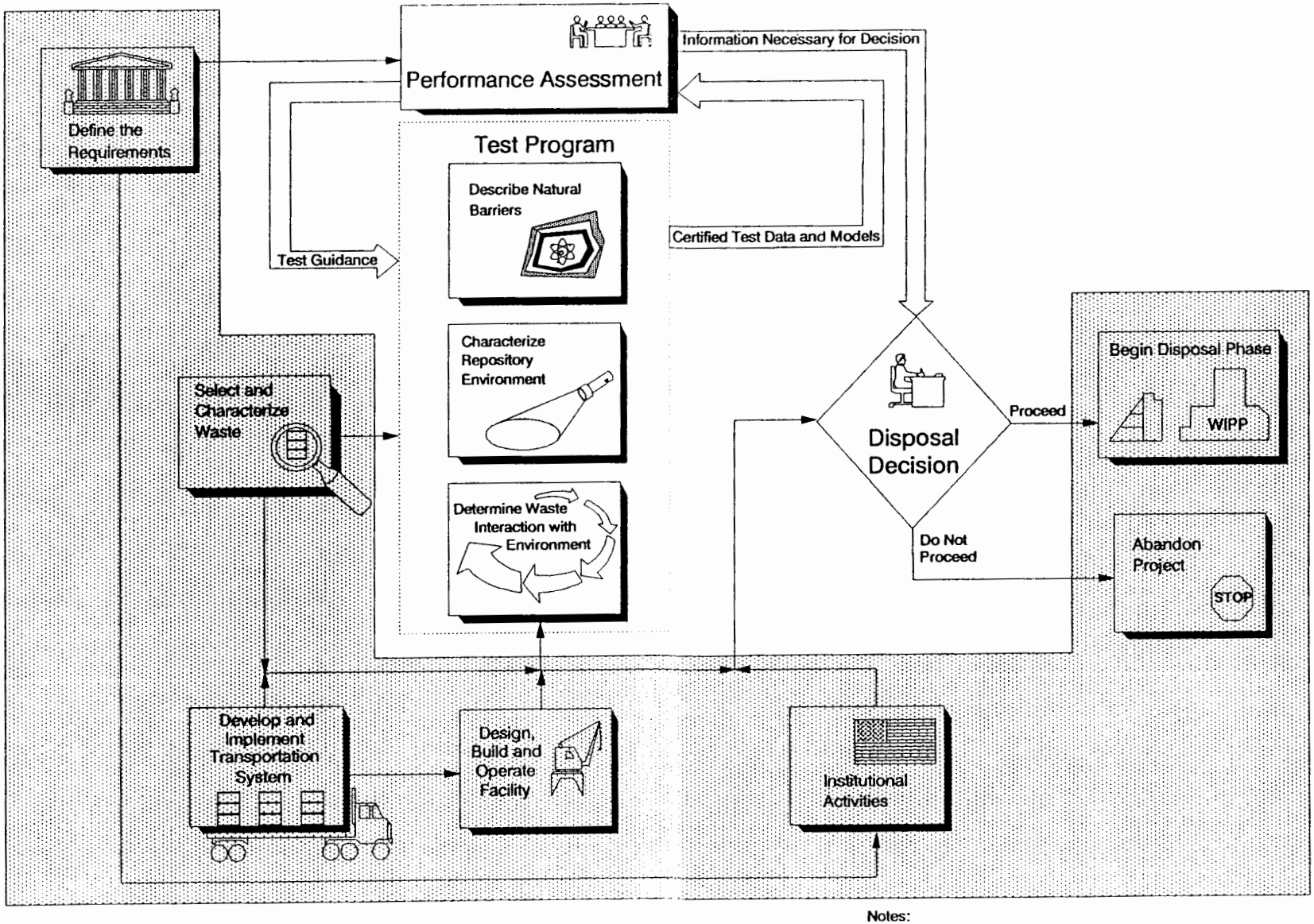
1.1 The purpose and scope of this document

This document presents the strategy for the Test Phase. Its purpose is to provide the project participants, decisionmakers, and interested parties with an understanding of the logic, objectives, and interfaces of the activities to be conducted during the Test Phase. These activities are grouped into (1) performance assessments conducted to determine compliance with regulations issued by the EPA, (2) a program of tests that will be conducted to provide the basis for a determination of compliance, and (3) the process by which the DOE will decide whether TRU wastes can be emplaced in the WIPP for permanent disposal.

As can be seen from Figure 1, the Test Phase is part of a much larger set of activities involved in the WIPP project and is needed to support the disposal decision. However, a comprehensive discussion of the multitude of other activities (those shown in the shaded portion of Figure 1) is not provided in this document. Furthermore, this document does not address the operational safety of the WIPP or the DOE's strategy for complying with other Federal and State environmental regulations; these issues are addressed in other documents (DOE, 1990a and 1990b, respectively).

Just as the Test Phase is only a part of the WIPP program, so the Test Phase strategy is to be viewed as part of a larger strategy that will be more comprehensive in time and scope, including a program strategy for all TRU wastes for which the DOE is responsible and a long-term strategy for the WIPP. The latter, to be developed in fiscal year 1992, will expand the time horizon to include the disposal phase; it will also expand the scope to include all regulatory requirements, WIPP operations, waste transportation, and institutional activities. These more-comprehensive strategies will support the decisionmaking process by assessing program uncertainties and potential impacts on elements of the TRU-waste-management program other than the WIPP.

The Test Phase strategy depends on a number of assumptions that appear valid in today's regulatory, technical, and institutional climate. These assumptions are identified in the discussion that follows. However, as the WIPP and other elements of the TRU-waste-management program evolve, some of these assumptions may change.



Notes:

1) Shaded portion not emphasized in this document

2) Arrows show major interactions, not necessarily time flow

Figure 1. The WIPP program.

1.2 Background

Purpose of the WIPP. The DOE was authorized and funded by the Congress to provide a facility for demonstrating the safe disposal of TRU radioactive wastes produced by national-defense activities. This facility, called the WIPP, has been developed in southeastern New Mexico. It is an underground facility excavated more than 2000 feet below the surface in a bedded-salt formation. If compliance with applicable regulations can be demonstrated with information from the Test Phase, the WIPP will be used to provide permanent disposal for TRU wastes.

Development in phases. The TRU wastes will remain radioactive for many thousands of years, and some of the wastes contain chemicals defined as hazardous under the Resource Conservation and Recovery Act (RCRA). To preclude premature decisions and to ensure that adequate information exists to support the commitment of resources to developing a facility that must remain safe both in the near term and over the thousands of years required by current regulations for waste isolation, the DOE decided to develop the facility in several phases. The process began with a siting phase during which several sites were evaluated and a preferred site was selected, extensive surface-based testing was conducted to evaluate the suitability of the site, a repository appropriate to the conditions of the site was designed, and analyses were conducted to determine the safety of the WIPP facility. This phase ended with the publication of an environmental impact statement in 1980 (DOE, 1980) and a decision to proceed with the next phase – site and preliminary design validation, during which two shafts were constructed, an underground testing area was excavated, and various experiments were conducted. The design validation was followed by further collection of data about the site and by the construction of the WIPP. The surface facilities needed to start receiving waste were built and considerable underground excavation was completed, including rooms for further experimentation and some rooms designed for permanent waste emplacement. The WIPP is now in the Test Phase and is ready for the start of in-situ experiments with TRU waste. The goal of the Test Phase is to develop the basis by which a determination of regulatory compliance can be made. The Test Phase will end when a decision is made to begin disposal operations in the WIPP or to abandon the project if it cannot be determined that compliance can be achieved.

The key regulations governing the WIPP. In 1985, after the validation program was completed and WIPP construction was begun, the EPA issued environmental standards for the disposal of TRU waste as Part 191 of Title 40 of the Code of Federal Regulations (40 CFR Part 191). And in 1986, the EPA issued a notice that the hazardous elements in TRU wastes are subject to the land-disposal requirements of the RCRA. The requirements of these regulations are given in Section 3.1. In 1987, the EPA's standards for long-term disposal (Subpart B of 40 CFR Part 191) were vacated by a U.S. court of appeals and remanded to the EPA for revision. However, the DOE entered into an agreement with the State of New Mexico that, until the revised standards are issued, it will proceed with its planning for long-term performance assessment as if the 1985 standards were still in effect. The RCRA, enacted in 1976, has since been amended by several laws, including the Hazardous and Solid Waste Amendments Act of 1984.

The next steps in the WIPP project. The DOE has conducted extensive studies of the site and the performance of the WIPP and has not identified any attributes that would disqualify it as a potential repository. Additional information is needed to better define the mechanisms of repository behavior and to reduce the uncertainties in current predictions. For example, concerns have been raised about the possibility that the gas generated by the waste underground in the WIPP could, over the long term, build up to unacceptable pressures, leading to possible releases of radioactive or chemically hazardous materials into the environment. The DOE has made a commitment that no waste will be permanently emplaced in the WIPP until compliance with the

EPA regulations has been determined. To make these determinations and to address the uncertainties about the long-term safety of the WIPP, the DOE is now conducting the Test Phase.

2. THE TEST PHASE

2.1 Focus and principal activities

The Test Phase consists of three major elements: the test program, performance assessment, and the decision process. Its principal focus is the performance assessment needed to evaluate compliance with the requirements of EPA regulations for long-term waste isolation and the collection of the data needed for the assessment. The basic logic for the Test Phase is shown in Figure 2.

Performance assessment. Performance assessment, described in more detail in Section 3, will include developing the approach to determining compliance, conducting the analyses necessary to evaluate compliance, and documenting the results. The assessments will be made in an iterative process in which analyses will be refined as more data from the test program become available. The results of these iterative assessments will be evaluated to specify how the test program should proceed, including any changes that are deemed necessary. Performance assessment will also evaluate engineered alternatives to the existing waste and the WIPP configuration in the event alternatives are required for compliance.

The collection of data for performance assessments has been under way since the site-evaluation studies begun in 1975; it has been conducted through field tests at the site, studies performed in the WIPP underground excavations, and laboratory experiments. However, no tests with TRU waste have been conducted to study the behavior of the waste or its interactions in the repository environment. The performance assessments conducted to date have used assumed waste properties and bounding assumptions about waste-interaction mechanisms and parameters, and their results have uncertainties that can be reduced by testing with TRU waste.

Test program. To collect the data needed to reduce uncertainties in performance assessments, the DOE plans to conduct a program of underground tests with TRU waste, laboratory tests, and other investigations. This program, described in Section 4, consists of three principal activities:

- Collecting additional information about the natural barriers at the site.
- Characterizing the underground WIPP environment.
- Studying the interactions of the waste with the underground WIPP environment.

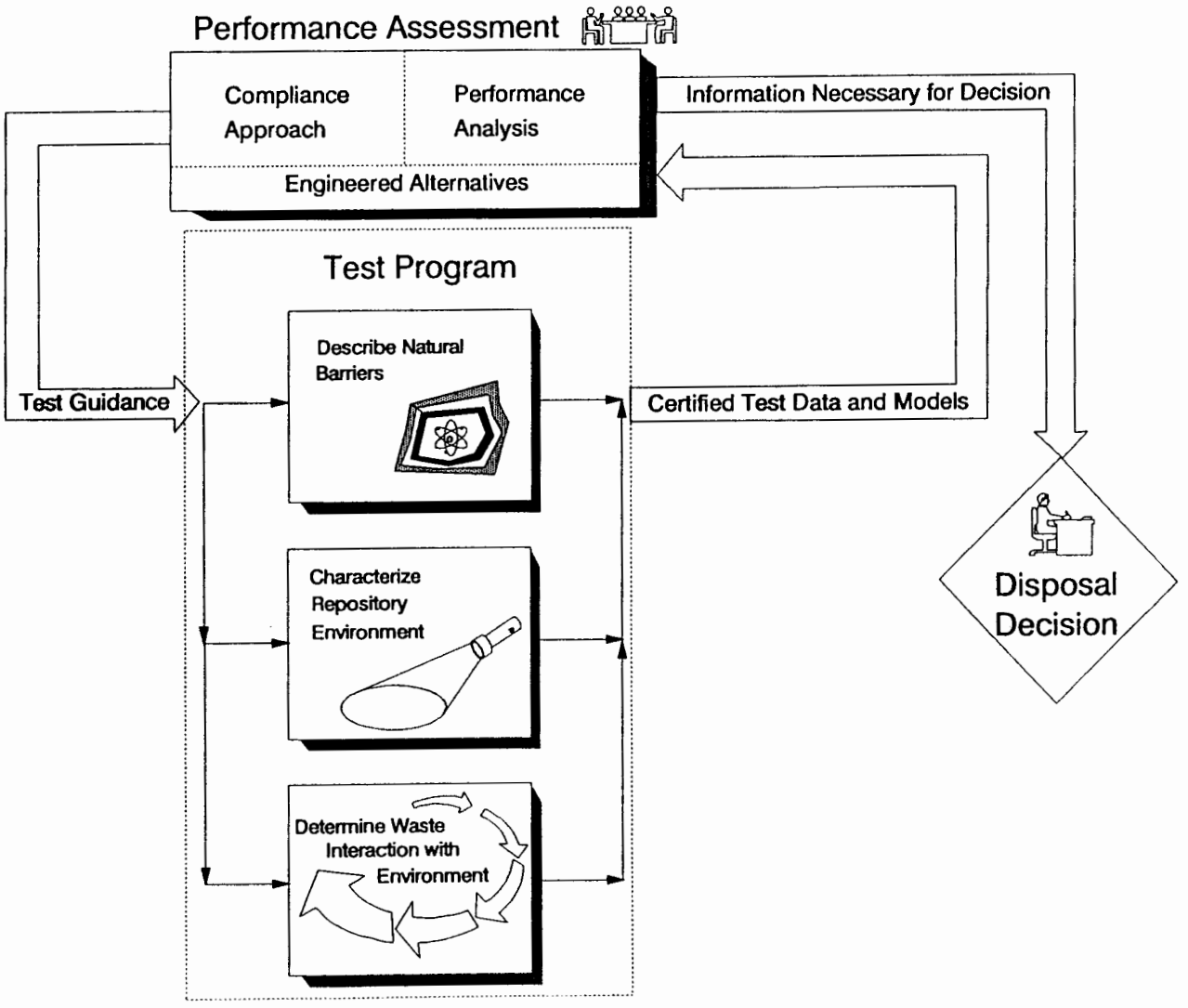


Figure 2. Activities conducted in the WIPP Test Phase.

Decision process. The decision process will consist of all the activities necessary to document compliance (or noncompliance) with applicable regulations, to complete the necessary institutional interactions, and to prepare a determination of whether compliance can be achieved.

2.2 Plans for using waste

To conduct the underground tests, the DOE plans to emplace TRU waste, in the containers that would be used for disposal (drums or standard waste boxes), in the WIPP underground excavations. All tests with waste will be conducted in accordance with the conditions imposed by the EPA in its decision, announced in the *Federal Register* on November 14, 1990 (EPA, 1990), to grant the DOE's petition for a "no-migration variance." The conditions specify, among other things, that all waste emplaced in the WIPP for the tests is to be fully retrievable, the testing period is limited to a maximum of 10 years, and waste emplacement is limited to 1 percent of the WIPP's design capacity, or 8500 drums. The amount of waste used will be less than 8500 drums and will be kept to the minimum needed for the purposes of the Test Phase. The current DOE Test Phase plan (DOE, 1990c) identifies approximately 0.5 percent of capacity as the amount of waste needed for the test program.

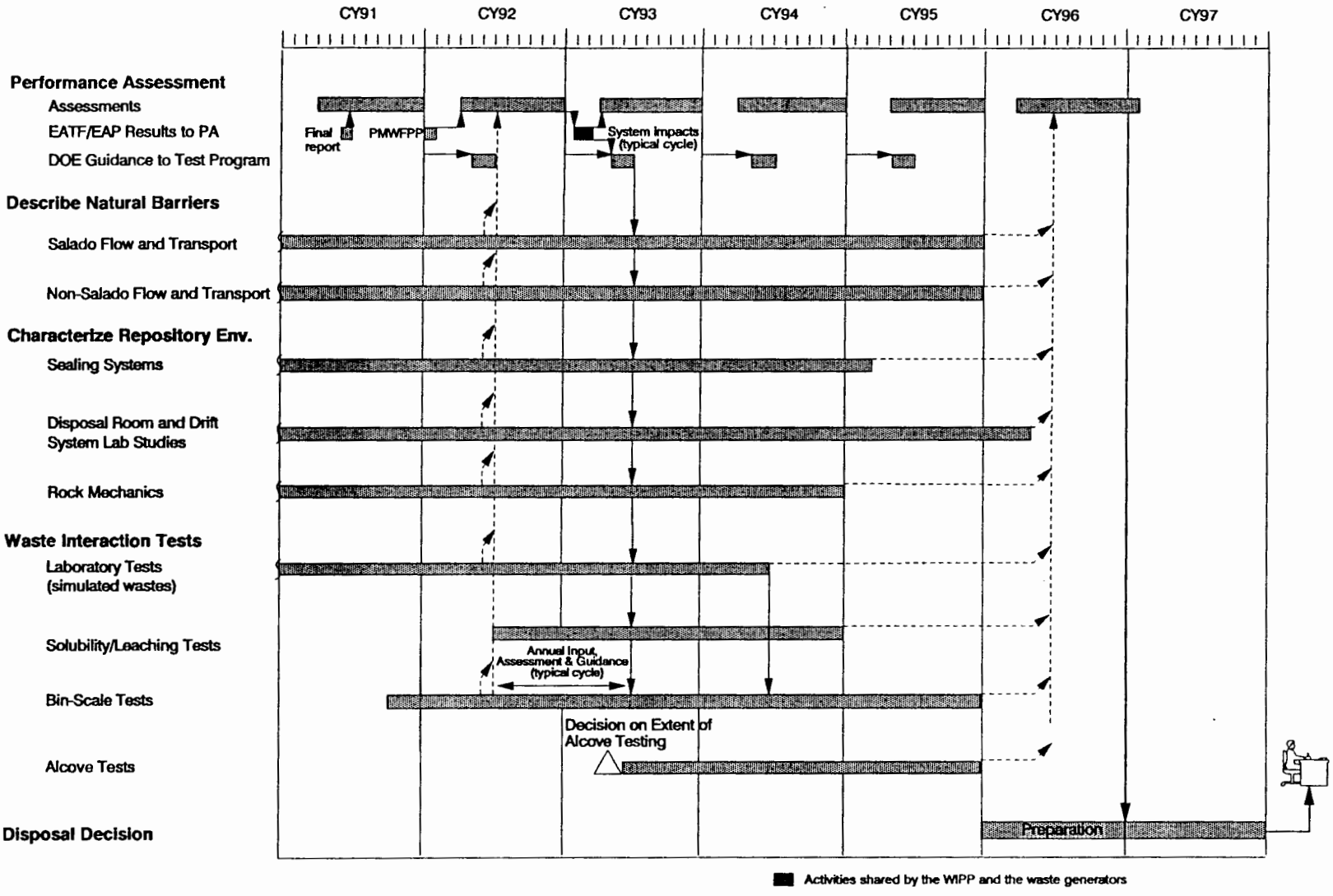
At the beginning of the program, the tests will use contact-handled TRU waste as it currently exists. They will be followed as soon as practicable by tests with some modified waste. Further testing with modified waste will be conducted if it appears that waste modifications will be necessary to achieve compliance. Although two types of TRU waste (contact-handled and remotely handled TRU wastes) will eventually be emplaced in the WIPP if disposal is allowed to begin, only contact-handled TRU waste will be used in the tests. The DOE has decided that no tests with remotely handled TRU waste are necessary to support the disposal decision, because contact-handled (CH) waste represents most (97 percent by volume) of the TRU waste, CH-waste packaged in drums or boxes can be safely handled (it emits very little penetrating radiation), and tests with CH-waste will yield the data necessary for projecting the behavior of the remotely handled waste.

No formal operations demonstration or pilot room-scale tests are currently planned to support the disposal decision. The need, feasibility, and extent of any formal operations demonstration or pilot room-scale tests will be reevaluated by the DOE (consistent with the June 1990 record of decision on the final supplemental environmental impact statement (DOE 1990b)) as the Test Phase proceeds.

2.3 Timing

The general timing of the activities in the Test Phase is shown in Figure 3. The program will be conducted in annual cycles of interaction between testing and performance assessment. During each of these annual cycles, the results of testing will provide models and input data for performance assessment. Performance assessment, in turn, will provide the basis for guidance from the DOE in its annual direction to the test program and the national TRU-waste management program. The DOE will specify, on the basis of the performance assessments, what additional data are needed to support compliance determinations and decide through sensitivity studies which parameters are most important to the performance of the WIPP.

Figure 3 shows a nominal date for output from the final performance assessment as the end of 1996. It is possible, if the necessary and sufficient data are available and a revised Subpart B of 40 CFR Part 191 is promulgated in a timely manner, that this analysis could be completed much earlier and output provided to the decision process as early as 1993. This would happen only if



Abbreviations: EATF, Engineered Alternatives Task Force; EAP, Engineered Alternatives Program; PMWFPP, Preliminary Modified Waste Form Production Plan

Figure 3. Time-phased activities for the WIPP Test Phase.

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regulatory compliance can be determined with sufficient confidence. Therefore, it should be understood that *the determination of regulatory compliance could occur several years before the nominally expected date.* Conversely, the test program may need to be extended to include additional tests for confirmation purposes.

2.4 Assumptions

The key assumptions on which the strategy for the Test Phase is based are as follows:

- The reference design for the WIPP is the design described in the Final Safety Analysis Report (DOE, 1990a).
- The basis for assessing compliance with the TRU-waste disposal standards is the 1985 version of Subpart B of 40 CFR Part 191 until revised standards are promulgated.
- The revised standards promulgated by the EPA as Subpart B of 40 CFR Part 191 will not be significantly different from the remanded standards and hence will not require a radically different approach to the determination of compliance.
- Waste-generator sites and the transportation system are adequately prepared to support the test program.
- Funding for fiscal year 1992 is based on the President's budget; funding for later years is based on program requirements.
- Bin-scale tests will be performed underground at the WIPP.
- Data collection may continue beyond the decision to dispose for the purpose of confirming previous compliance evaluations.

2.5 Milestones

Some important milestones associated with the WIPP Test Phase are listed in Table 1. *These milestones support the time-phased activities presented in this document for the Test Phase and may change as the test program progresses.*

Table 1. Milestones for the WIPP Test Phase

Activity	Date (calendar year)
Start dry bin tests in the WIPP	Third quarter 1991
Start solubility and leaching tests	Third quarter 1992
Start radionuclide-retardation tests	Fourth quarter 1991
Complete large-scale seal test plan	Fourth quarter 1992
Subpart B of 40 CFR 191 repromulgated (expected date)	Second quarter 1993
Decide on extent of alcove testing	Second quarter 1993
Decide on engineered alternatives (earliest expected date)	Second quarter 1994
Complete final performance assessments for RCRA and Subpart B of 40 CFR Part 191	Fourth quarter 1996[a]
Decide on permanent disposal in the WIPP	Fourth quarter 1997[b]

[a] Final performance assessment may be completed as early as 1993.
[b] A decision on permanent disposal in the WIPP may be made as early as 1995.

2.6 Uncertainties in strategy

The time-phased activities presented in this strategy are meant to communicate the strategic relationships of these activities and should be considered estimates. Currently it is not clear how much time will be needed to complete some of the necessary prerequisite activities, such as characterizing the wastes to be used in testing to satisfy the RCRA and providing sufficient quantities of modified waste forms. Nor is it clear how much time will be needed to collect suitable and sufficient data from the tests. These and other uncertainties will be evaluated and contingencies will be identified in the more-comprehensive long-term strategy to be developed in fiscal year 1992.

3. PERFORMANCE ASSESSMENT

Performance assessments will be conducted for the WIPP to evaluate compliance with the EPA regulations for the long-term disposal of TRU wastes (Subpart B of 40 CFR Part 191) and the long-term disposal of wastes containing hazardous elements (RCRA-related regulations). Performance assessment is a set of activities that will allow the DOE to predict whether the repository system, its subsystems, and its components will meet the requirements for safety after permanent closure. It is an iterative process of comparing the site-specific performance goals of repository systems, subsystems, and components with calculated performance predictions, using increasingly more-detailed site-specific models, data and design information.

Conceptual and numerical models are being developed to assess the performance of the repository system, its subsystems, and key components determined to be important to safety or waste isolation. These models will be exercised to define uncertainties and provide further guidance to the test program for data acquisition, the refinement of performance goals, and design changes.

3.1 Regulatory requirements

The EPA regulations in the vacated and remanded Subpart B of 40 CFR Part 191 limit the cumulative releases of radioactive materials to the "accessible" environment for 10,000 years after closure. The regulation requires the DOE to determine that this requirement can be met under the conditions expected to occur at the WIPP site for 10,000 years after closure and also to evaluate disturbed conditions, such as inadvertent human intrusion. The EPA standards also specify limits for the annual radiation dose that can be delivered to individual members of the public and groundwater-protection requirements for 1000 years after closure under undisturbed conditions.

The RCRA-related EPA regulations specify restrictions on the land disposal of hazardous elements. Land disposal is to be permitted only if it can be predicted, to a reasonable degree of certainty, that the hazardous constituents will not migrate from the disposal unit for as long as the wastes remain hazardous. The no-migration prediction must include an analysis performed to identify and quantify any aspects of the prediction that contribute significantly to uncertainty.

3.2 Approach to the determination of compliance

Compliance with Subpart B of 40 CFR Part 191. A formal process for evaluating compliance with the quantitative requirements of Subpart B of 40 CFR Part 191 has been established and documented (Marietta et al., 1989). Basically, the approach consists of identifying the processes and events that might affect the long-term waste-isolation capability of the WIPP, developing scenarios that describe how these processes and events could affect long-term isolation capability, and estimating the cumulative releases of radionuclides caused by all significant processes and events. The estimates are based on models that describe the flow of gases and liquids in the rocks in and around the waste panels (i.e., the areas, including rooms and drifts, in which waste may be emplaced) of the WIPP. These models reflect both the theoretical understanding and experimental data concerning the processes and events that may be experienced by the disposal system at the

site. The results of the modeling exercises are given as probabilities of exceeding the EPA's cumulative-release limits. Before they are used in evaluating the compliance of the WIPP with Subpart B of 40 CFR Part 191, the DOE will establish acceptability criteria for the results of performance assessments and of the test program.

The currently identified additional information needed to assess WIPP performance is summarized in Table 2. The various activities in the test program will provide the information in the form of data sets consisting of specific parameters to be used in performance assessments and in certified models for analyses. (To be certified, models must be subjected to sufficient verification and validation as well as quality assurance.) A representative data set for the information in Table 2 was developed to support recent performance assessments. This representative data set will be supplemented and confirmed by the test program. Sensitivity studies conducted to determine the relative importance of parameters used in the calculations indicate that the critical parameters are the transport characteristics in the rock units overlying the repository (primarily the retardation of waste transport in the Rustler Formation); local radionuclide geochemistry in the waste rooms (primarily the solubility of uranium, neptunium, thorium, plutonium, radium, and lead in WIPP brine); gas generation and migration rates; the closure and compaction state of the drifts and shafts; and the characteristics relevant to human intrusion.

Table 2. Primary information needed for the WIPP performance assessment

Natural barrier data	Waste panel
Radionuclide retardation	Radionuclide solubility and leaching
Dual-porosity flow	Gas generation
Salado fluid flow	Gas dissipation
Marker-bed transport (gas and fluid)	Backfill permeability
Climate change	Human-intrusion characteristics
	Salt fracture
Repository characteristics	**Waste interactions**
Seal system	Radionuclide solubility and leaching
Seal performance	Gas generation
Permeability of the disturbed rock zone	RCRA inventory of volatile organic compounds
Shaft, drift, and borehole closure	RCRA nongas inventory
Permeability of the seal system	Geochemical retardation
Seal material	Waste-materials inventory
	Radionuclide inventory

Significant progress has been made in evaluating compliance with Subpart B of 40 CFR Part 191. The critical scenarios have been identified, including those associated with human intrusion. These scenarios are related to mining potash near the WIPP and drilling into waste rooms, with a subsequent connection to potentially pressurized brine reservoirs in the Castile Formation beneath the repository.

A preliminary performance assessment was recently completed (Bertram-Howery et al., 1990), and its results suggest that compliance with Subpart B of 40 CFR Part 191 can be achieved. However, sufficient uncertainty exists in the data and models that predictions of compliance are premature at present. Reduction of these uncertainties through model development and the collection of additional data will be one of the principal objectives of the test program.

Compliance with RCRA-related regulations. The approach to evaluating compliance with the RCRA-related regulations will be based on the evaluation performed to obtain the no-migration determination from the EPA. Further evaluations will be consistent with the basic models and computer codes used for assessing compliance with Subpart B of 40 CFR Part 191. Acceptability criteria will be developed by the DOE and used to ensure that the methodology is consistent with, and meets the requirements of, the regulations. Investigations during the Test Phase will be directed at providing more-specific estimates of source terms by examining waste compositions and further characterizing the existing waste.

3.3 Strategy for evaluating compliance

Cyclical approach. As shown in Figure 4, the performance-assessment process, including the test program described in Section 4, will be conducted in annual cycles. In each cycle, data from the test program will be used to update scenarios as well as conceptual and numerical models, and the models will be exercised to evaluate compliance. Guidance for the test program will be provided by specifying information needs and associated parameters; it will include guidance to the TRU-waste-management program, such as recommended changes in waste forms or containers or additional requirements for technology development and demonstration, as appropriate. If at the end of any cycle the results of this process show, at a sufficient level of confidence, that compliance is achieved (or that compliance cannot be achieved), then the DOE will begin the decision process described in Section 5. If the level of confidence is insufficient, another cycle of testing and assessment will begin.

Engineered alternatives. Existing, largely unprocessed TRU waste (designated Level I waste) will be used in the initial testing-and-assessment process of the Test Phase. The Level I waste consists of a variety of waste forms classified into 15 different categories, including solidified organic liquids, cemented inorganic particles, combustible wastes, and metals. In each cycle, if compliance cannot be demonstrated with existing waste forms, the results of sensitivity studies will be examined to determine the proper guidance for the test program. In addition to specific modifications of the tests, potential engineered measures that may be used to achieve a higher

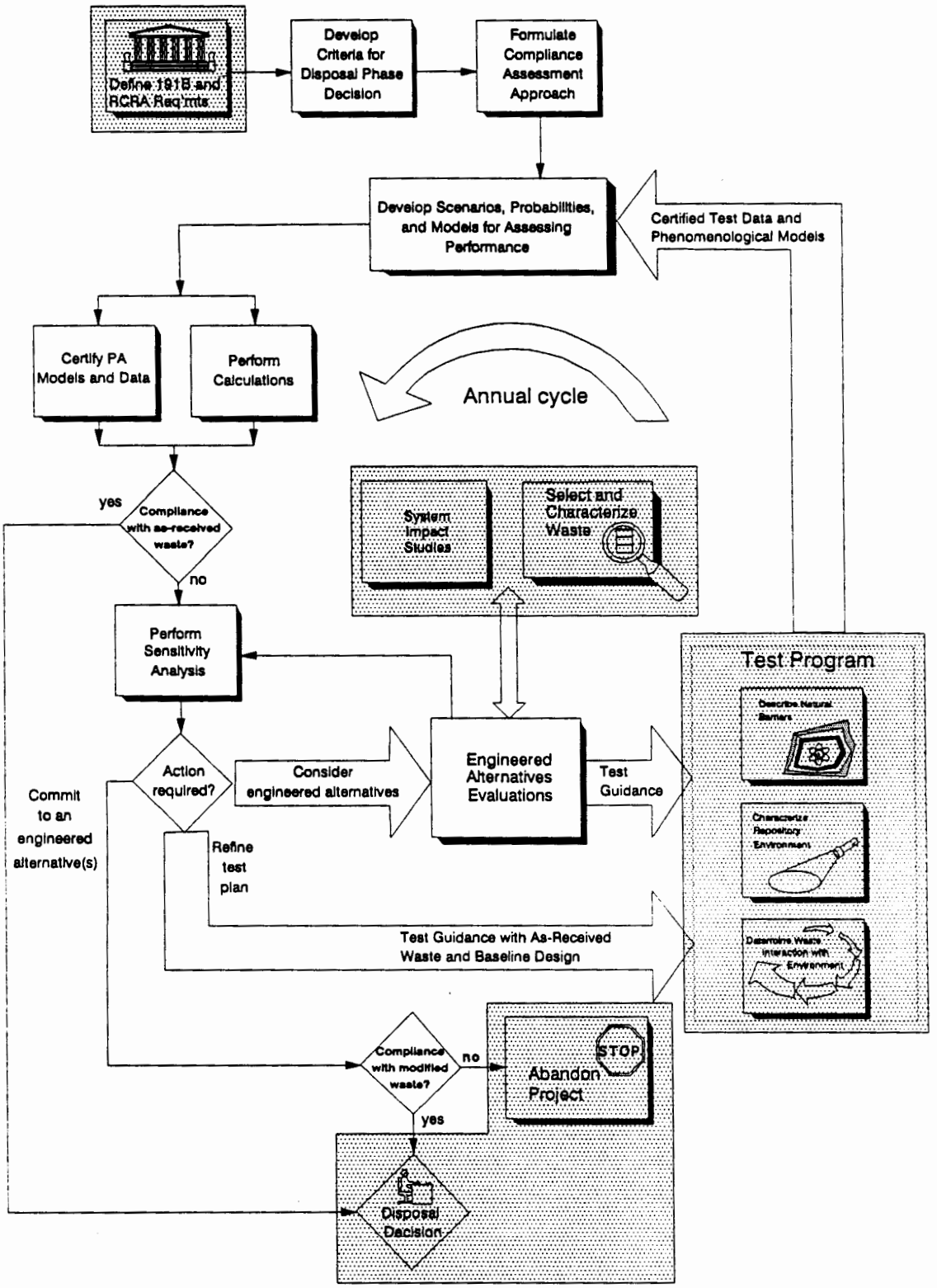

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Figure 4. Performance assessment.

level of confidence in compliance will be tested and evaluated. These measures include modifications of the waste forms and of the facility configuation, such as changes in the materialsto be used for backfilling the repository after waste has been emplaced.

The DOE will also conduct system studies to assess impacts on the rest of the TRU-waste-management system (i.e., system components other than the WIPP, such as waste generators and potential treatment facilities) so that the disposal decision can be based on an evaluation of the entire TRU-waste-management system.

To be prepared for these studies, the DOE established in 1989 the Engineered Alternatives Task Force (EATF) to identify and select various modifications, analyze their relative effectiveness, and evaluate the feasibility of implementing the alternatives that seem most promising. The EATF issued a report that explains the methods used to evaluate the relative effectiveness of selected alternatives in relation to the existing waste forms, the existing WIPP design, and the feasibility of implementing those alternatives (DOE, 1991). Impacts on TRU-waste generators have also been considered in a preliminary fashion.

The EATF identified a number of waste-form modifications that have been classified into two levels. Level II consists of wastes that have been treated to reduce the rate of, but not the potential for, gas generation; an example of such treatment is shredding waste and solidifying in concrete. Level III consists of wastes that have been treated to eliminate the potential for gas generation; an example of such treatment is incineration.

The DOE plans to use the results obtained by the EATF in assessing the performance of the WIPP with modified wastes and alternative WIPP configurations. The Engineered Alternatives Program (EAP), in a follow-up to the EATF work, will develop a production plan for the modified waste forms for the test program. Once the initial cycles of testing with Level I (existing) wastes have been initiated, tests with the identified Level II wastes will begin, depending on availability, as early as possible in the test program. The performance-assessment cycle will continue to refine tests and engineered modifications until either compliance can be demonstrated or it becomes clear that compliance cannot be cost-effectively demonstrated. The expected timing of performance-assessment activities is shown in Figure 5.

4. THE TEST PROGRAM

As mentioned in Section 2, the test program consists of activities directed at (1) describing the natural barriers that can provide long-term isolation at the WIPP site, (2) characterizing the environment expected to prevail in the WIPP underground after waste emplacement and into the distant future, and (3) determining the interactions of the waste with the underground environment. The various tests performed in each of these categories are briefly described below.

The principal purpose of the test program is to provide necessary and sufficient information to support a credible and defensible prediction of WIPP performance over the next 10,000 years. This includes reducing or defining uncertainties in the available information about the site and the

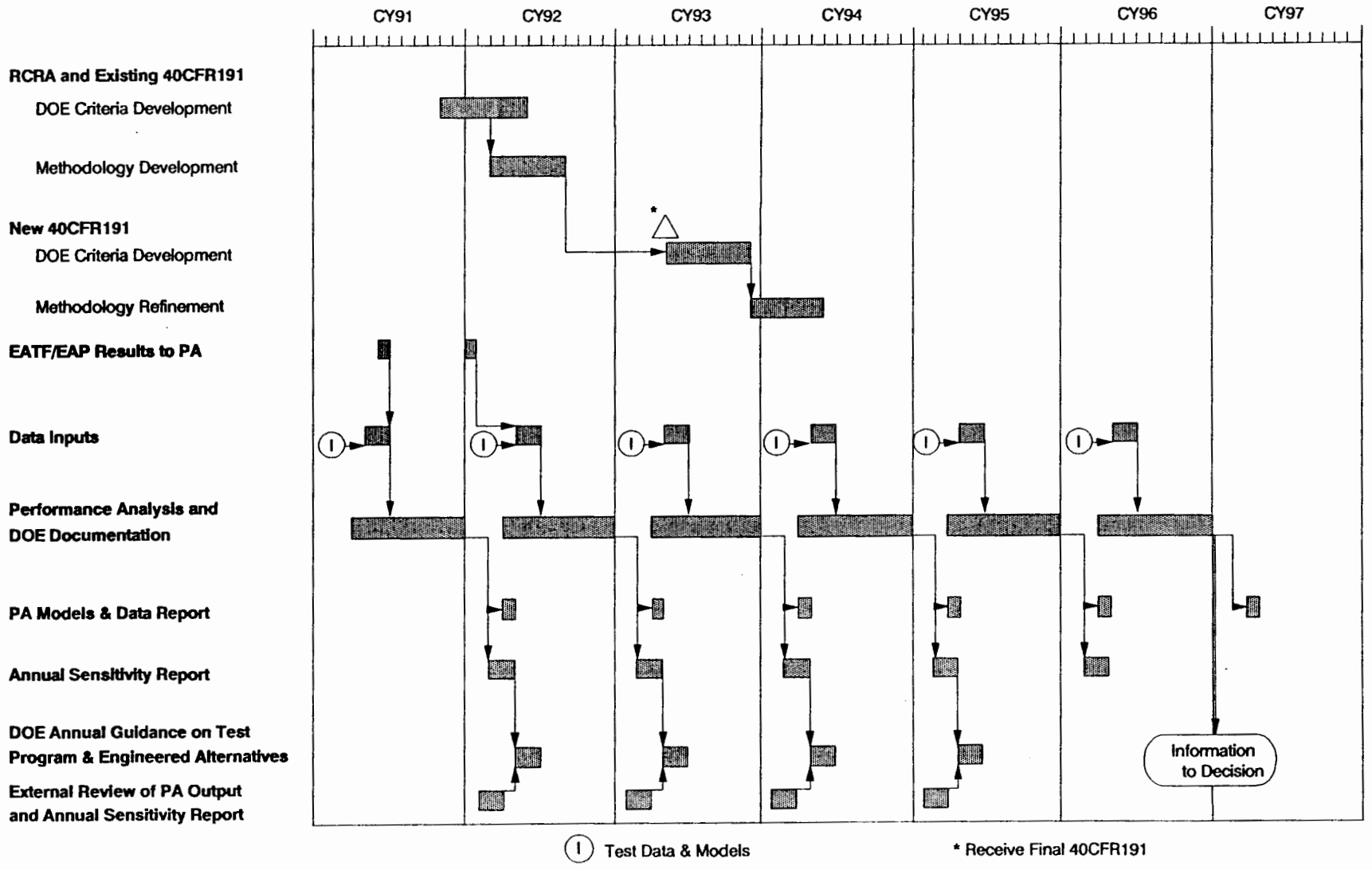

Figure 5. Timing for performance assessment.

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behavior of the rock units at the site; providing input data for performance assessments; collecting data needed for predicting the future behavior of the waste in the WIPP underground; and developing, verifying, and validating models to be used in performance assessment and design. All data and models from the test program will be subjected to a formal process of quality assurance in accordance with DOE requirements. The scope of the test program and the general rationale for the tests have been developed and documented (Bertram-Howery et al., 1989; DOE, 1990c). The relationship of the various testing activities is shown in Figure 6, and the expected timing of the principal activities is shown in Figures 7, 8, and 9.

4.1 Describing the natural barriers

There are multiple natural barriers at the WIPP site that would contribute to safe isolation of TRU waste over the long term. The first barriers are the bedded salt and anhydrite units of the Salado Formation—the host rock for the WIPP underground repository; these units do not admit the flow of groundwater, which is the principal natural mechanism for transporting nongaseous constituents released from the waste. Other barriers lie above the repository; they consist of multiple rock units, only a few of which admit the flow of groundwater. The Rustler Formation, which lies just above the Salado, supports such a flow, but at a very low velocity—about 1 meter per year. Even if radionuclides or nongaseous RCRA-regulated constituents were transported through these barriers—for example, as a result of human intrusion—it is expected that their migration toward the environment would be blocked or significantly retarded by hydrologic or geochemical processes in the rock units through which they would pass. Similarly, possible release paths for gaseous RCRA-regulated constituents will be studied.

The investigations of natural barriers will be directed at understanding the travel of waste constituents through or past the various barriers. This requires a detailed knowledge of the various rock formations, groundwater flow, and the mechanisms for blocking or retarding the transport of waste constituents. The investigations will focus on two rock units: the Salado Formation and the above-lying Rustler Formation (non-Salado).

Extensive studies of the geologic, hydrologic, and geochemical conditions at the site have been performed since the start of site characterization in 1975. Since 1978, the data collected in these studies have been used to model, at increasing levels of refinement, the performance of the natural barriers. These studies are being extended to provide detailed data for performance assessments and to reduce or define the uncertainties associated with the currently available data. They will include laboratory tests to determine the physical and chemical properties of the rocks and brine; studies in the field; and the development, verification, and validation of models. The model-validation effort will include collaboration with international experts. The specific information needs that will be supplied by these studies to performance assessment are shown in Table 2, and the expected timing for each category of testing is shown in Figure 7.

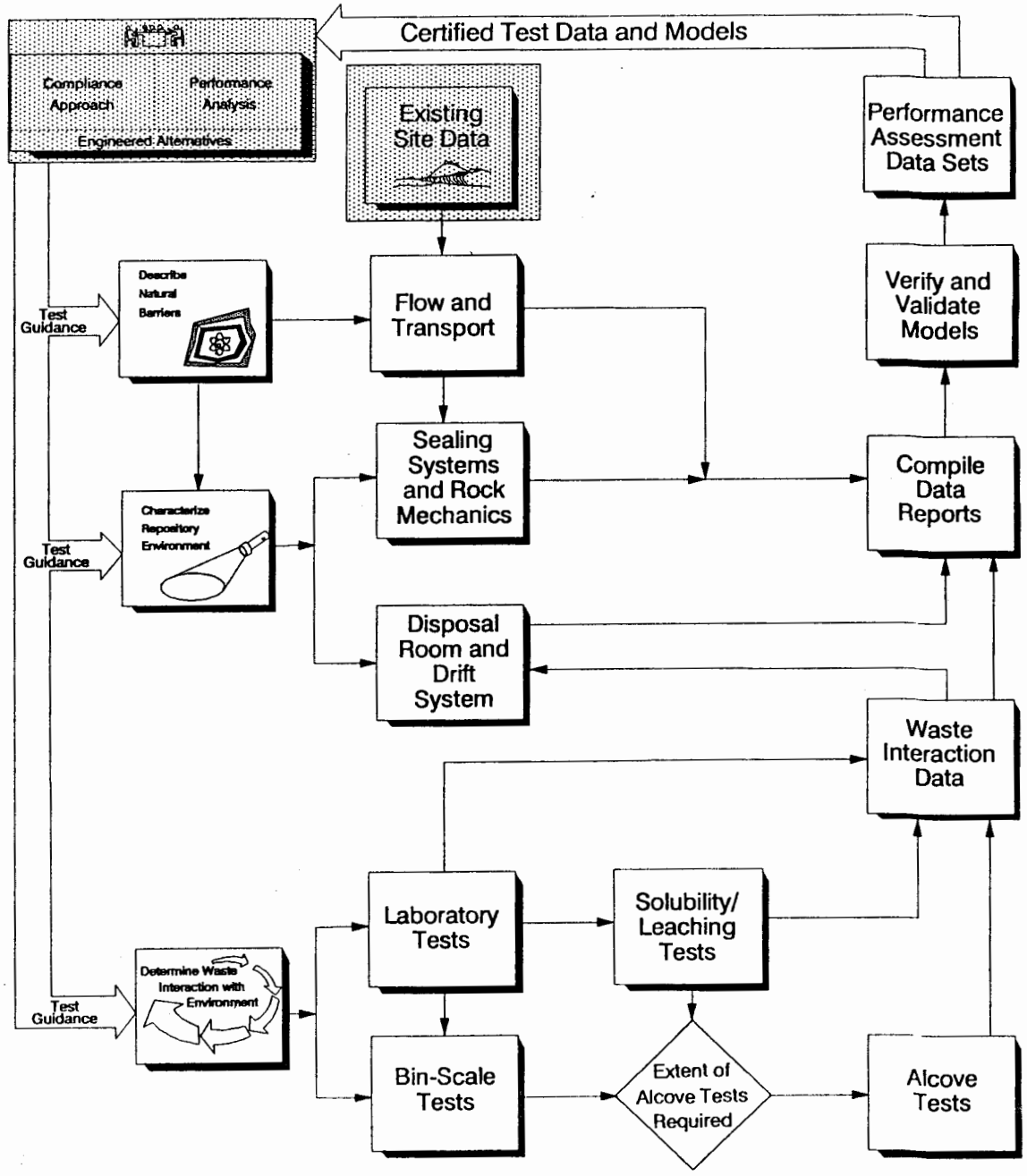

Figure 6. The WIPP test program.

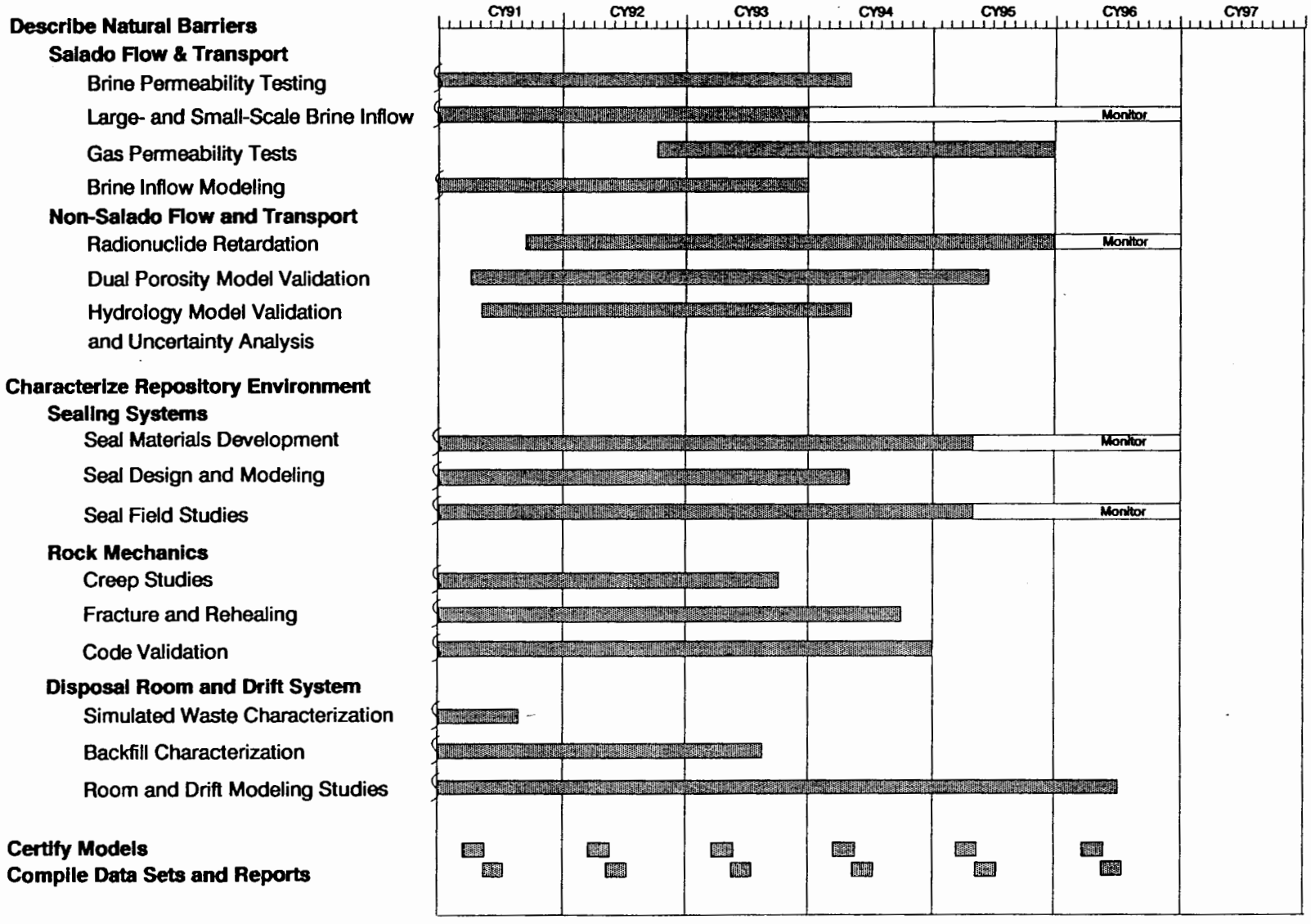

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Figure 7. Timing for describing natural barriers and characterizing repository environment.

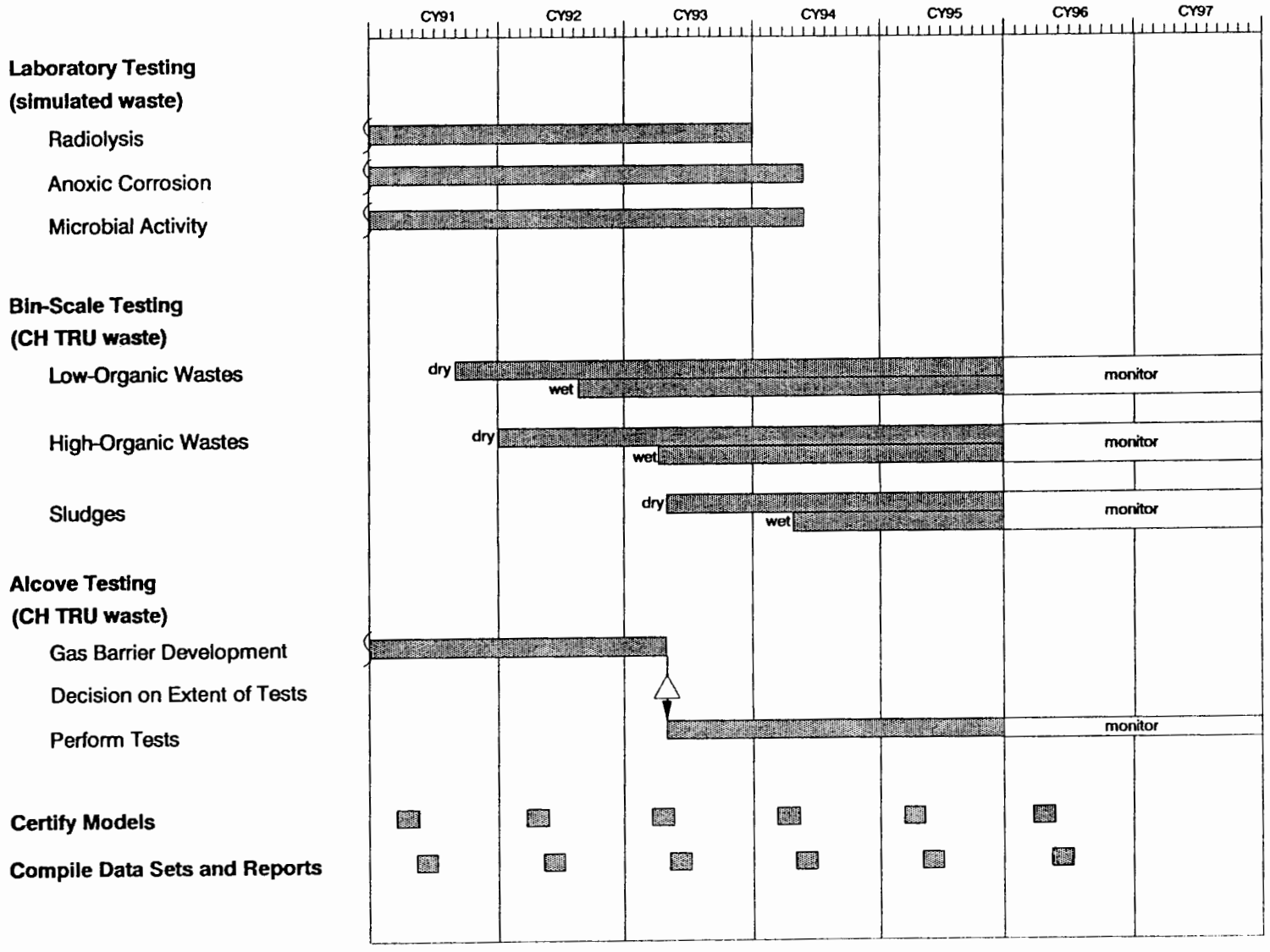

Figure 8. Timing for determining waste interaction with environment: gas-generation tests.

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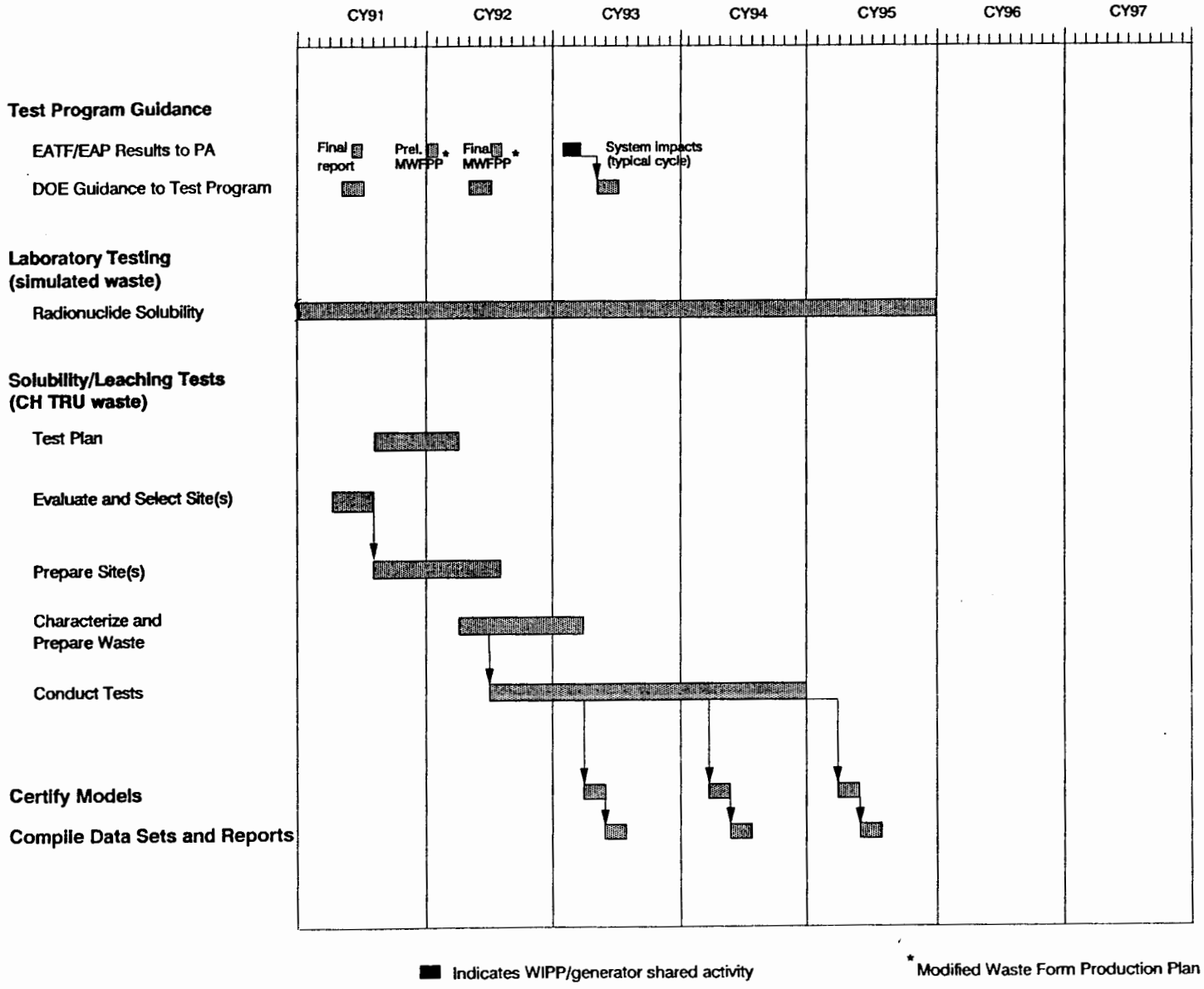

Figure 9. Timing for determining waste interaction with environment: solubilty/leaching tests.

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4.1.1 Salado flow and transport

For the Salado Formation, the work includes the development of models for brine inflow and coupled two-phase (liquid and gas) flows; these models take into account the forces (lithostatic and waste-generated-gas pressures) that tend to drive in opposite directions any brine that might occur in the repository.

Both brine and gas flows are important to performance. Brine constitutes about 0.5 percent by weight of the salt at the WIPP horizon, and of particular interest is intergranular brine, which was trapped between grains of salt. The excavation of an opening allows this brine to move toward the lower pressures in the excavation. The brine appears today on tunnel walls as moisture that quickly evaporates in the dry underground air, but moisture builds up in some closed holes, and it would likewise accumulate in the WIPP disposal rooms when they are closed. If sufficient quantities of brine come in contact with the waste, the containers may corrode and generate gases.

The studies of brine and gas flow address the rates, total potentials, and variabilities of flow. They will include variabilities due to the presence of anhydrite layers above and below the WIPP excavations; these layers are more permeable to brine and gas than is the salt. Large-scale data on brine inflow will be obtained from experiments in the "brine inflow" room.

Geochemistry studies examine the physical and chemical characteristics of the brines and their variability. The results will be used in assessing performance and developing performance criteria for seals.

Studies are also being conducted of the dominant physical and chemical processes active in that portion of the Salado Formation disturbed by excavation of the underground openings. These include laboratory studies of threshold pressure, permeability, and porosity.

4.1.2 Non-Salado flow and transport

The studies of the Rustler and surrounding formations are directed at developing defensible models of the mechanisms involved in fluid flow and radionuclide transport from above the repository to the accessible environment. Existing two-dimensional models for flow in the Culebra Member of the Rustler Formation will be extended to three dimensions in order to investigate alternative conceptual models, to predict regional flow patterns, to predict the effects of climate change, and to predict the effects of exploratory gas-well drilling in regions surrounding the site. Uncertainty analyses will be performed as appropriate.

The hypothesized path for the transport of radionuclides to the environment includes the Culebra Dolomite. Tests conducted in the field with tracers indicate that the Culebra behaves as a dual-porosity medium, in which flow through fractures and diffusion into the rock matrix dominate liquid transport. Given the important radionuclide-retarding effect of diffusion into the matrix, the dual-porosity interpretation will be examined and validated. Alternative interpretations of the tracer

tests will be sought through participation in an international research program (INTRAVAL) and sensitivity studies of the dual porosity model will be conducted.

Chemical retardation of radionuclides in the Culebra will be investigated in laboratory experiments that include fundamental mechanisms tests (adsorption, precipitation, and ion-exchange tests) and combined-effects tests (batch and column experiments). A panel of experts will evaluate the existing data and review the experiments. The feasibility and advantages of a large-scale sorbing-tracer test will be investigated. A field-scale transport model will be developed to predict effective retardation factors, taking explicit account of local variations in water and substrate chemistry.

4.2 Characterizing the repository environment

Tests and studies in this category address two basic phenomena important to long-term performance: salt creep and brine inflow. Processes related to these phenomena can affect the progression of events and perhaps long-term performance. For example, if the pressure in the repository remains low for a sufficient time, lithostatic pressure behind the surrounding salt can squeeze brine into the rooms. The gases that would be generated by brine interactions with the waste may, for example, interfere with creep-induced closure. On the other hand, if gas generation is sufficiently rapid, it would prevent or retard brine inflow, lowering the attendant gas-evolution potential, but perhaps driving away from the repository hazardous gases that had been contained in the waste. Because of the need to understand the progression of such events and the associated uncertainties, the DOE has identified a series of tests to characterize the WIPP underground environment. As shown in Figure 7, most of these tests are under way.

Another objective of these studies is to obtain information needed for developing two types of engineered barriers for the WIPP: backfill for all underground excavations and long-term seals that would be installed in the shafts, drifts, and boreholes.

Long-term seals will serve two functions: blocking the connection established by the WIPP shafts between the host rock (the Salado Formation) and the overlying aquifers and isolating waste rooms, panels of rooms, and shafts within the Salado Formation. The guiding assumption is that the seals in the Salado need serve only until the salt has become completely reconsolidated and permeability is thereby reduced. Since this interval is expected to be much longer than the time allotted for the test program, but not long enough to fully demonstrate the design, the DOE will select seal materials and designs in a phased process that will culminate before the WIPP is prepared for permanent closure. Small-scale seal material and design tests under way now will progress to large-scale emplacement demonstrations for both shaft and drift seals before the decision process begins. Seal-material evaluations and the results of in-situ tests will be used to develop criteria for seal performance and a detailed conceptual design.

The tendency of salt to creep in response to pressure is a phenomenon essential to long-term performance. This creep flow is expected to heal fractures induced by mining, close up the underground openings, consolidate the backfill, and entomb the waste by crushing it and the backfill into a compact mass. An accurate model of this time-dependent phenomenon is necessary

for a defensible performance assessment, and this requires a detailed understanding of fracture generation, fracture healing, and creep flow. In addition, it is important to learn whether there is a scale effect for creep and to study the behavior of the marker (anhydrite) beds that lie above and below the salt bed of the repository because the response of anhydrite to pressure gradients is different from that of salt.

Fracture generation, fracture healing, and creep flow will be studied in laboratory and in-situ tests. The results of these tests will be used in assessing performance, in designing seals, and in selecting materials for backfill. To study creep in three dimensions, which is important in seal design and evaluation, the tests will use large thin-walled cylinders of salt under shear and thick-walled cylinders under controlled stress gradients.

One of the engineered barriers that will be used if waste is disposed of in the WIPP is backfilling around waste containers with crushed salt or other crushed materials. The backfill will consolidate with time and may include additives like bentonite, which would sorb brine, various radionuclides, and heavy metals. Thus, in addition to hastening the closure of the underground openings and helping to entomb the waste in a compact mass, backfill may inhibit the inflow of brine and retard the transport of materials from the waste.

Laboratory studies will be conducted to (1) determine the characteristics of the backfill, (2) determine whether backfill additives would remove gas or prevent its production in the presence or absence of free brine, and (3) quantify the effects of additives on the chemical conditions in the underground. Since bentonite and similar additives swell when absorbing liquids, the studies will also address mechanical parameters like creep-closure rates and shear strength. The results will be used in performance assessment and in selecting materials for backfill. The backfill studies will be complemented by laboratory studies of waste-container collapse to determine rates and final states of compaction.

4.3 Waste-interaction tests

Besides the data collected from studies of natural barriers and the repository environment, performance assessment requires information that can be obtained only from tests with waste, whether real or simulated. The needed information includes data on the generation of gases, which can interfere with room closure and may drive hazardous elements in the waste beyond acceptable boundaries, and information on waste leachability by, and solubility in, brine. The uncertainties in the currently available information on some of these waste characteristics are too great for defensible performance assessments.

The tests designed to provide information on waste interactions are divided into laboratory tests with simulated waste and more-definitive, follow-on tests with real waste. The gas-generation tests are to be conducted in the WIPP underground in specially designed bins. As the bin tests progress, their results will be evaluated to determine to what extent additional tests should be conducted in underground rooms (alcoves) to provide a more realistic environment.

4.3.1 Laboratory tests

The laboratory tests with simulated wastes have several objectives. They will quantify the production of hydrogen by the oxygen-free corrosion of metals under various moisture conditions, and they will quantify the effects of microbial degradation of the nonradioactive constituents of TRU waste. Laboratory tests will be used to determine whether radiolysis makes plastics and rubbers more susceptible to biological degradation and to investigate the effects of waste compaction on gas generation by radiolysis. They will also quantify the efficacy of proposed backfill additives in removing gas or preventing its production. If necessary, the tests will investigate the biodegradation of volatile organic compounds and the compatibility of soluble and volatile waste components with backfill components (e.g., bentonite) and cementitious seal components (e.g., salt-based grout).

Because of their early start (see Figure 8) and scope, and the controlled nature of laboratory testing, these tests are expected to provide guidance for the bin tests and tests of solubility and leaching. They are also expected to aid in the quantitative and qualitative interpretation of bin-test results.

4.3.2 Solubility and leaching tests

Predictions of the chemical behavior of radionuclides in WIPP brines are necessary to determine the source term (i.e., the quantities of the important radionuclides in the WIPP inventory that will be mobilized for possible transport to the accessible environment) and the scenario-dependent rates at which these radionuclides will be mobilized. Because most plausible release scenarios involve advective or diffusive transport of radionuclides dissolved or suspended in aqueous fluids, the radionuclide source term ideally comprises (1) the product of the equilibrium or steady-state concentrations of radionuclides in brines that could enter WIPP disposal rooms after they are filled and sealed and the volumes of these brines, and (2) the rates at which these concentrations are attained and these volumes accumulate. The solubility and leaching tests will determine how processes distribute radionuclides between brines and solids.

These critically important tests will be conducted with real contact-handled TRU waste. The test plans will be completed early in 1992, and the tests are expected to be completed in 1994, as shown in Figure 9.

4.3.3 Bin tests

Bin tests will be conducted with real contact-handled TRU waste in the WIPP underground testing areas. Their principal objective is to provide data on gas evolution from the waste under realistic repository conditions, and hence most of these tests will reproduce the oxygen-free environment that is expected to occur in the WIPP underground as time passes. The waste contains various materials from which gases can evolve; they include cellulosic materials, plastics, rubber materials, and other organic materials; corroding steels, aluminum, and noncorroding metals; solid inorganic materials; inorganic sludges; and cements. The tests will examine various mechanisms for gas generation over the long term. Among them are the evolution of hydrogen

from the corrosion of metals; the evolution of hydrogen and oxygen through the radiolysis of brine or water in the waste; and the evolution of carbon dioxide, methane, nitrogen, and hydrogen sulfide from the bacterial decomposition of organic materials.

Test objectives. The current suite of tests is designed to evaluate the rates and the total potential production of gases for evaluating compliance with Subpart B of 40 CFR Part 191. It is not expected, however, to provide representative information about hazardous wastes across the total DOE waste inventory, although some data gathered in the bins, such as the evolution of volatile organic compounds, will be relevant to the evaluation of compliance with RCRA requirements (Lappin et al., 1991). The results of the bin tests will provide the DOE with additional data to predict gas generation for the entire inventory of the TRU wastes expected to be disposed of in the WIPP.

Test phases. The bin tests will be conducted in phases and will examine low-organic, high-organic, and sludge waste under wet and dry conditions and the effects of modifying the wastes by adding "getters" for carbon dioxide or supercompacting the waste. Testing will evaluate waste with brine, salt, and backfill in the bins to more closely simulate the postclosure repository environment. The first phase will be a limited set of experiments designed to gather preliminary data on the existing TRU waste. The results of the initial tests will be gas-generation rates under dry conditions and variabilities for each waste category. The variability results will determine how many replicate bins for each waste category will be needed in subsequent dry and wet tests. These subsequent tests will use modified waste forms with uncertain gas-generation potentials (Level II waste) under both dry and wet conditions.

Quantities and sources of waste. It is currently assumed that the waste for the bin tests will be taken from the drums at the Rocky Flats Plant or the Idaho National Engineering Laboratory. Waste from other sites may also be used for these tests. To be acceptable, the waste must be certified to meet the WIPP waste-acceptance criteria.

Timing. As shown in Figure 8, testing can begin as soon as all prerequisites in accordance with the Secretary's Decision Plan, including bin preparation and WIPP readiness for the Test Phase, are complete. The actual schedule will depend on the availability and acceptability of waste that can be shipped to the WIPP.

4.3.4 Alcove tests

An important result of the test program will be a determination that there is sufficient information about gas generation and hazardous materials in TRU waste. From this the DOE will decide to what extent alcove tests will be conducted. These tests will use TRU waste in the containers (55-gallon drums or the somewhat larger standard waste boxes) that would be used for disposal. The tests will be conducted in specially prepared alcoves—large rooms but somewhat smaller than those that would be used for actual waste disposal. The primary basis for this decision will be the need for a more representative environment and more information from a larger sample of TRU wastes in the WIPP environment.

Rationale. The need for alcove tests is predicated on the current belief that for confidence in performance assessments maximum assurance is required about the evolution of gas quantities and species over the long term. It is currently believed that this assurance is best provided by a combination of laboratory, bin, and alcove tests. The alcove tests will allow for engineered alternatives other than those currently planned (supercompaction, other selected modified waste forms, and engineered backfill) to be incorporated into the tests. The alcoves could be used to verify that predictions from the smaller-scale, more-selective laboratory and bin tests are satisfactory for the assessment of long-term performance.

Description of tests. The alcove tests will replicate, as closely as possible, the environment expected to be present in the WIPP over the long term and will use amounts of waste more representative of the actual repository. The currently estimated waste quantity for an alcove test is approximately 1050 drum-equivalents per alcove, and the wastes would be selected from INEL and RFP inventories to be typical of wastes from all expected sources. The plan calls for five waste alcoves and one empty alcove as a control to determine conditions in a sealed room unaffected by waste. One waste alcove will be filled with drums as they currently exist at the storage sites. Two alcoves, which will not be backfilled, will be filled with waste drums to which the selected backfill mix and expected brine quantity have been added. Because waste retrievability must be ensured, backfill standoff bulkheads will be used for the duration of the test, in order to prevent the compaction of the backfill, which could result in the breaching of waste containers.

Timing. A prerequisite to implementing alcove tests is assurance that an adequate alcove seal can be emplaced. The design of the seals will be tested before emplacing waste and conducting the alcove tests. This strategy assumes that 2 to 3 years of data collection will be required to develop enough information to determine useful rates of gas evolution. However, the actual duration of the alcove tests will be included in the decision on the extent of the alcove test as shown in Figure 8.

5. THE DECISION PROCESS

The decision process will involve all the activities necessary to document compliance with the applicable regulations, to complete the necessary institutional interactions, and to prepare a summary statement and recommendation for the Secretary of Energy on which a final determination of compliance can be based after an external review. Documentation will be needed for compliance with the EPA regulations in Subpart B of 40 CFR Part 191 and the regulations related to the RCRA. Compliance with other applicable Federal and State regulations will also be documented. All of these documents will be reviewed by the cognizant DOE organizations (e.g., the Office of the Assistant Secretary for the Environment, Safety and Health) whose concurrence is needed. The purpose of the review will be to ensure that the documentation is adequate and appropriate to support the determination of compliance, to obtain the necessary permits and approvals, and to comply with DOE orders. The necessary permits and approvals are identified in the final supplemental environmental impact statement for the WIPP (DOE, 1990b). The principal activities to be conducted during the decision process are shown in Figure 10.

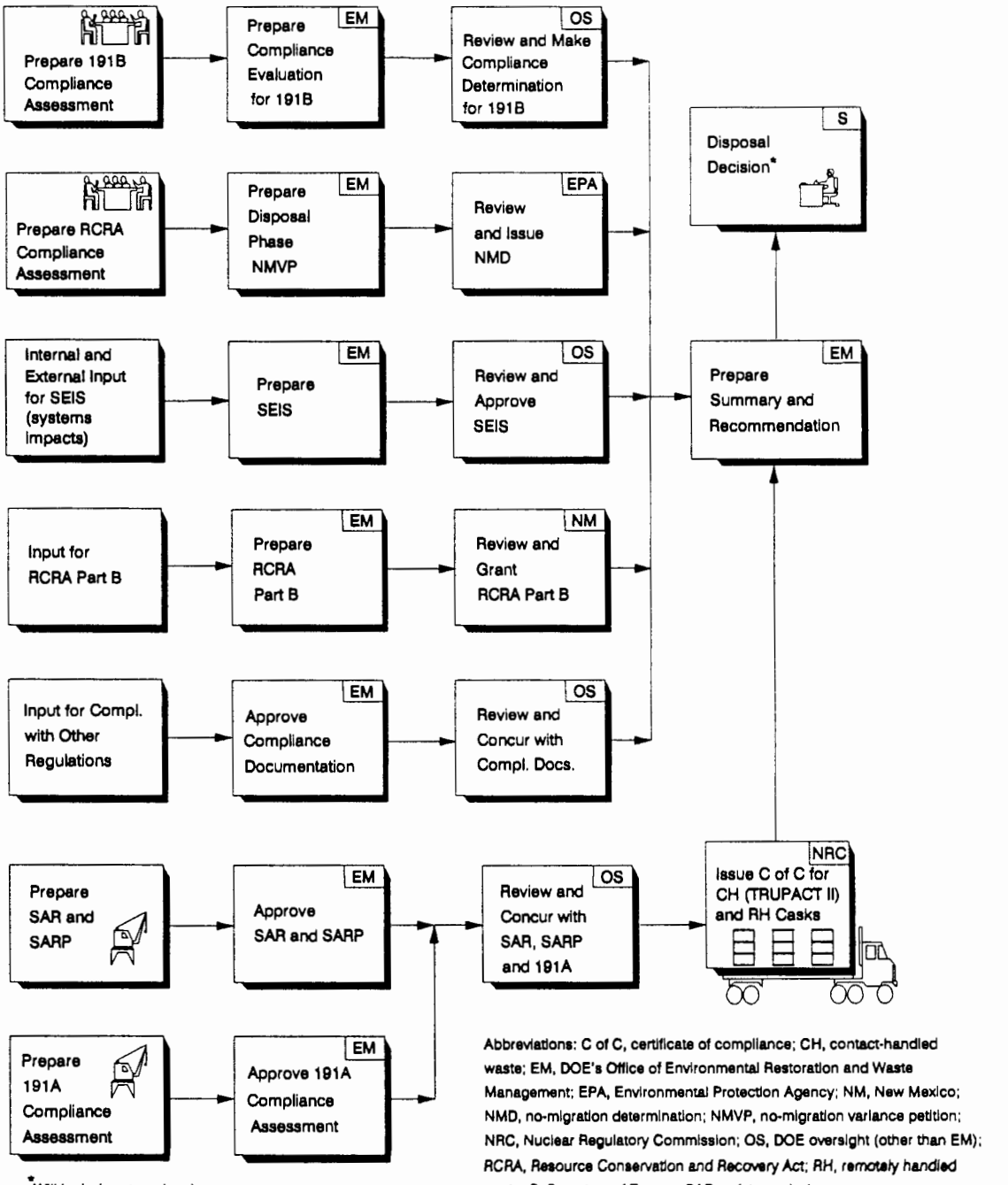

Figure 10. Decision process.

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The documentation of compliance with the RCRA regulations will be presented in two separate documents. One will be a petition to the EPA for a no-migration variance in accordance with the provisions of 40 CFR Part 268. This petition will be reviewed by the EPA. If the EPA deems the documentation of compliance to be adequate, it will grant a no-migration variance under conditions to be enforced by the EPA. The other document will be an application to the State of New Mexico for an RCRA permit under Part B. (For the test phase, the WIPP has received an RCRA permit under Part A as an "interim-status" facility subject to the requirements of 40 CFR Part 265.) The Part B permit is significantly broader than a no-migration finding, since it will impose the applicable technical and general facility standards of 40 CFR Part 264 and the requirements of 40 CFR Part 270. The State permit will be issued under State procedures, which include public notice, comment, and an opportunity for a public hearing. The conditions of this permit will be enforced by the State.

The DOE will take all necessary steps to meet the requirements of the NEPA and to comply with applicable DOE orders. The DOE will also conduct various institutional activities, prepare and issue the necessary notices, and perform the planning necessary for the disposal phase, including a readiness review to determine that waste acceptance for permanent disposal can begin at the WIPP.

In accordance with the NEPA, the DOE will issue another supplemental environmental impact statement (SEIS). This document will analyze the potential short- and long-term impacts of TRU-waste disposal in the WIPP, using the data collected during the Test Phase. Some of the analyses in the SEIS will be based on the results of the performance assessments discussed in Section 3, but the sources of input for the SEIS will not be limited to the Test Phase activities described in this document; input will also be provided by various other ongoing WIPP programs, such as the environmental monitoring program. The SEIS will be issued first as a draft for public comment and revised to reflect the comments before it is issued as the final SEIS. Public hearings will be held as part of this process.

In addition, the DOE will update as needed the WIPP final safety analysis report (FSAR). The FSAR is a systematic analysis of the potential hazards associated with WIPP operations. The DOE will also update as appropriate other documentation related to the operation of the WIPP or to waste transportation; this includes the safety analysis report for packaging, which has been prepared for the TRUPACT II containers in which the waste will be shipped.

Once the process of documentation and review (both internal and external) has been completed, the DOE will prepare an internal summary report for the Secretary of Energy. This report will include a recommendation as to whether waste disposal at the WIPP should begin. Given a determination of compliance with the applicable regulations, a favorable record of decision on the new SEIS, and a favorable readiness review, the Secretary will decide whether the WIPP should begin receiving TRU waste for permanent disposal. If land-withdrawal legislation or a DOE memorandum of understanding with another agency mandates an independent certification of the DOE's compliance determination, this decision process will be amended. The time required to prepare the documentation and to complete the various other activities mentioned above is estimated to be between 12 and 24 months.

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