JAN 17 1992

ACNW/PHASE 2 IPA

MEMORANDUM FOR: Raymond F. Fraley, Executive Director
Advisory Committee on Nuclear Waste

THRU: Abraham L. Eiss, ACNW Liaison
Special Issues Group
Office of Nuclear Material Safety
and Safeguards

FROM: B.J. Youngblood, Director
Division of High-Level Waste Management
Office of Nuclear Material Safety
and Safeguards

SUBJECT: TRANSMITTAL OF PHASE 2 ITERATIVE PERFORMANCE ASSESSMENT PROGRAM PLAN TO THE ADVISORY COMMITTEE ON NUCLEAR WASTE

The purpose of this memorandum is to provide the Advisory Committee on Nuclear Waste (ACNW) with a copy of the Program Plan for Phase 2 of the staff's iterative performance assessment (IPA) for a geologic repository. In August 1991, the Division of High-Level Waste Management staff committed to provide the ACNW with a copy of this plan, when finalized, for its information. The staff's Phase 2 IPA efforts are currently underway and are a continuation of the work discussed during the October 16, 1991, briefing to the ACNW.

If you have any questions or require additional information about this plan, please contact the IPA Project Manager Michael P. Lee at 504-2421 or Norman A. Eisenberg, the IPA Coordinator, at 504-2324.

Original Signed by

B.J. Youngblood, Director
Division of High-Level Waste Management
Office of Nuclear Material Safety
and Safeguards

Enclosure: As stated

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
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DEC 1 9 1991

MEMORANDUM FOR: Iterative Performance Assessment Project Team

FROM: Michael P. Lee, Project Manager
Repository Licensing and Quality Assurance
Project Directorate
Division of High-Level Waste Management
Office of Nuclear Material Safety
and Safeguards

SUBJECT: PHASE 2 ITERATIVE PERFORMANCE ASSESSMENT (IPA) PROGRAM PLAN

The purpose of this memorandum is to provide you with copies of the Phase 2 IPA Program Plan. This version supersedes the November 1990 Draft Program Plan and is pursuant to the 1988 Memorandum of Understanding between the Divisions of High-Level Waste Management (in the Office of Nuclear Material Safety and Safeguards (NMSS)) and Engineering (in the the Office of Nuclear Regulatory Research (RES)) on high-level waste (HLW) performance assessment activities.

This IPA Program Plan describes the work that is planned to be completed by the IPA Project Team by June of 1992. The IPA Project Team consists of staff from: NMSS, RES, and the Center for Nuclear Waste Regulatory Analyses (CNWRA). This plan has been formulated with input from the the three IPA Program Coordinators and the IPA Project Manager and has been coordinated with you during its development.

The IPA Project is an important component of the U.S. Nuclear Regulatory Commission's (NRC's) HLW program. Therefore, it is important that you become familiar with the respective resource allocations and schedules for your respective efforts. In this regard, please advise your Section Leader and IPA Team Lead of progress and/or problems you encounter. Early identification and correction of problems will help to ensure that the project remains on schedule and within budget. Norman A. Eisenberg, the lead technical staff member and Michael P. Lee, the IPA Project Manager will be working with you to track and coordinate this effort.

The IPA Program Plan will be formally transmitted to the CNWRA by Seth M. Coplan, the NRC CNWRA Performance Assessment Program Element Manager.

If you have any questions regarding the IPA Program Plan, please contact Norman A. Eisenberg (x20324) or Michael P. Lee (x20421).

Michael P. Lee, Project Manager
Repository Licensing and Quality Assurance
Project Directorate
Division of High-Level Waste Management
Office of Nuclear Material Safety
and Safeguards

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Enclosure: As stated
cc: HLW Branch Chiefs
MSilberberg, WMB/RES
WPatrick, CNWRA

Program Plan for Phase 2
Iterative Performance Assessment Activities
to be Conducted Jointly by NMSS, RES, and CNWRA

December 17, 1991

PREFACE

The scope for Phase 2 of the Iterative Performance Assessment (IPA), as reflected in this final Program Plan, has been narrowed from that proposed in the November 1990 draft Program Plan due to a reconfiguration of the scheduled work (August 30, 1991 memorandum from M.V. Federline to B.J. Youngblood). The description of tasks and subtasks from the November 1990 draft Program Plan are included for reference in this document (see Appendix H). This reconfiguration involved: (1) an increased emphasis on technical management and coordination; (2) a refocusing of certain activities; (3) the postponement until some later Phase of IPA of particular activities not on the critical path; and (4) the reassignment of some key individuals to assist in the completion of certain essential activities. This revised approach to the completion of the Phase 2 effort was coordinated with the Office of Nuclear Regulatory Research (RES) (Waste Management Branch) and with the Center for Nuclear Waste Regulatory Analyses (CNWRA) management.

This program plan documents the anticipated activities required for the completion of IPA Phase 2, commencing in October 1991 and ending no later than June 1992. It is consistent with conditions and progress at the beginning of FY92; since then, some of the bases for this plan have changed. As a result, some schedules, personnel, and resource allocations have been made. These adjustments are not reflected in this plan but are accounted for elsewhere. This plan serves as a general guide for IPA activities and as a baseline for adjustments since October 1991.

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I. INTRODUCTION

This program plan describes the second phase of the IPA activities to be carried out under the NMSS/RES Memorandum of Understanding (MOU) of September 1, 1988. This plan (1) describes the work to be performed under various Phase 2 subtasks; (2) outlines the schedule for the work; (3) shows how the subtasks are interrelated; and (4) identifies the individuals on the staff of the U.S. Nuclear Regulatory Commission (NRC) and of the CNWRA responsible for accomplishing the work.

Work performed under Phase 1 of the NMSS/RES MOU demonstrated the staff capability to conduct a performance assessment for a geologic repository for high-level radioactive waste (HLW). The initial effort provides a basis for Phase 2 and subsequent iterations. The purpose of the Phase 1 analysis was not to evaluate the site, but instead to demonstrate the NRC staff capability to perform such an analysis, and thus enhance the ability of the staff to review the U.S. Department of Energy's (DOE) performance assessments and other aspects of the DOE HLW program. Although the initial effort achieved these goals, the work was performed under a tight schedule with limited resources. Due to these limitations, some important activities planned for the first phase were deferred until Phase 2.

The IPA Phase 2 work, and subsequent, iterations will attempt to improve on the Phase 1 study by using more refined models and treating a more comprehensive set of phenomena and scenarios.

II. PURPOSE

As the name indicates, an IPA activity involves repeated iterations of assessing the performance of an HLW repository. Phase 2 is one such iteration. Therefore, the overall objectives which apply to each iteration (an iteration is anticipated every 18 to 24 months) apply to the Phase 2 activities as well.

The overall objective for the IPA activity at the NRC is to develop, maintain, and enhance the NRC staff capability to do an effective review of DOE's HLW performance assessments in its application for HLW disposal. IPA also provides a tool for technical integration because it provides the structure for examining couplings between phenomena that might not be adequately evaluated within the limits of a specific technical discipline. In addition, the multi-disciplinary involvement with data inputs, assumptions, and code development more clearly defines activities and interfaces of the many disciplines involved. In this way, IPA also contributes to programmatic integration.

Although the responsibility for the review of performance assessments in the license application cannot be delegated to others by the NRC staff, it is expected that contractors to the NRC, notably the CNWRA, will provide technical input to assist the NRC in this review.

In addition to the primary objective to develop, maintain, and enhance the staff capability to review performance assessments, there are other objectives of IPA. These include:

1. Support the development of regulatory guidance and the License Application Review Plan, especially in developing and refining the basis for the review strategies and review methods for the performance objectives;

2. Provide practical insights into the feasibility of implementing existing requirements of 10 CFR Part 60 and 40 CFR Part 191, and the alternatives that might be considered; and

3. Support the pre-license application reviews of DOE's site characterization program (including field and laboratory studies, early performance assessments and performance allocations, and design analyses).

IPA will achieve these objectives by illustrating how site characterization data and general information can be used to demonstrate regulatory compliance. In the course of such exercises, the need for additional site characterization data, regulatory guidance, or potential change to regulations will be revealed. Sensitivity and uncertainty analyses will be key to identifying those data, assumptions, or regulatory interpretations with the greatest potential for introducing uncertainty into demonstrations of compliance. Similarly, auxiliary analyses will provide information on sources of uncertainty in the models used in various stages of the IPA.

IPA complements the Systematic Regulatory Analysis (SRA) process by feeding the results of integrated technical analyses back into the SRA process. As mentioned previously, knowledge gained through IPA will be used to reevaluate the significance of key technical uncertainties initially identified in an SRA analysis, and thereby provide a quantitative basis for determining the need to revise the key technical uncertainties and associated review strategies. As the SRA process is developed, it will help to ensure that IPA activities are appropriately focused to contribute in a logical fashion to regulatory products and, eventually, the review of the license application, by ensuring that the work performed is relevant to the regulatory process.

IPA will provide information for the NRC's Performance Assessment Strategy and the NRC's Overall Review Strategy (ORS). The ORS will describe the NRC's comprehensive approach to pre-License Application and License Application reviews. Once the ORS is completed, the Performance Assessment Strategy will be revised, if needed, to reflect the goals and general framework of the ORS. The ORS is scheduled for completion in early 1992.

In addition to these general IPA objectives, Phase 2 has the unique objective of providing the means for NRC to acquire and evaluate the Tuff Performance Assessment Methodology developed by Sandia National Laboratories (SNL) under contract to the NRC. The project with SNL for this developmental work was closed at the end of FY90; the CNWRA is now the principal contractor to the NRC

for HLW activities. The tuff methodology was transferred from SNL to NRC and the CNWRA in FY90-91.

III. SCOPE

Performance assessment is considered by the NRC to be comprised of two parts: (1) a quantitative estimation of total system performance through the use of predictive models, and (2) detailed subsidiary modeling to support and to evaluate the assumptions, data, and modeling approaches used to obtain the quantitative estimates of performance.

40 CFR Part 191 specifies total system performance measures and requirements in terms of: (1) cumulative releases of radionuclides to the accessible environment; (2) individual dose; and (3) groundwater contamination.

The total system performance measure for an HLW repository, expressed as a complementary cumulative distribution function (CCDF) of radionuclide release to the accessible environment over 10,000 years, can be estimated by following the steps outlined in the information flow chart (Figure 1). These steps are described briefly below.

1. System Description -- For the purposes of modeling, the repository system is described in terms of its component parts, which include the waste form, the engineered barrier, and site characteristics. Raw field and laboratory data are reduced to data sets suitable for input into mathematical models designed to describe the performance of the system. The system structure and the description of ongoing natural processes at the site are determined from both qualitative and quantitative data.

2. Scenario Analysis -- Scenario classes representing possible alternative future states of the repository system environment are identified and screened. Probabilities are estimated for those scenarios selected.

3. Consequence Analysis -- The consequence in terms of cumulative release of radionuclides to the accessible environment over a specified period of time (usually 10,000 or more years) is calculated for each scenario class, normally for numerous realizations of possible parameter values.

4. Performance Measure Calculation -- The probabilities of the consequences for each scenario class are calculated and combined into a curve of consequences versus the probability that such consequences will be exceeded, i.e., a CCDF. Certain types of consequences might also be used to compare separately to standards for maximum doses to individuals and maximum concentration in groundwater.

5. Sensitivity and Uncertainty Analysis -- Sensitivity analyses investigate the change in performance measures caused by incremental changes in the values of input parameters and data. Uncertainty analyses attempt to quantify the uncertainty in performance estimates and to relate those

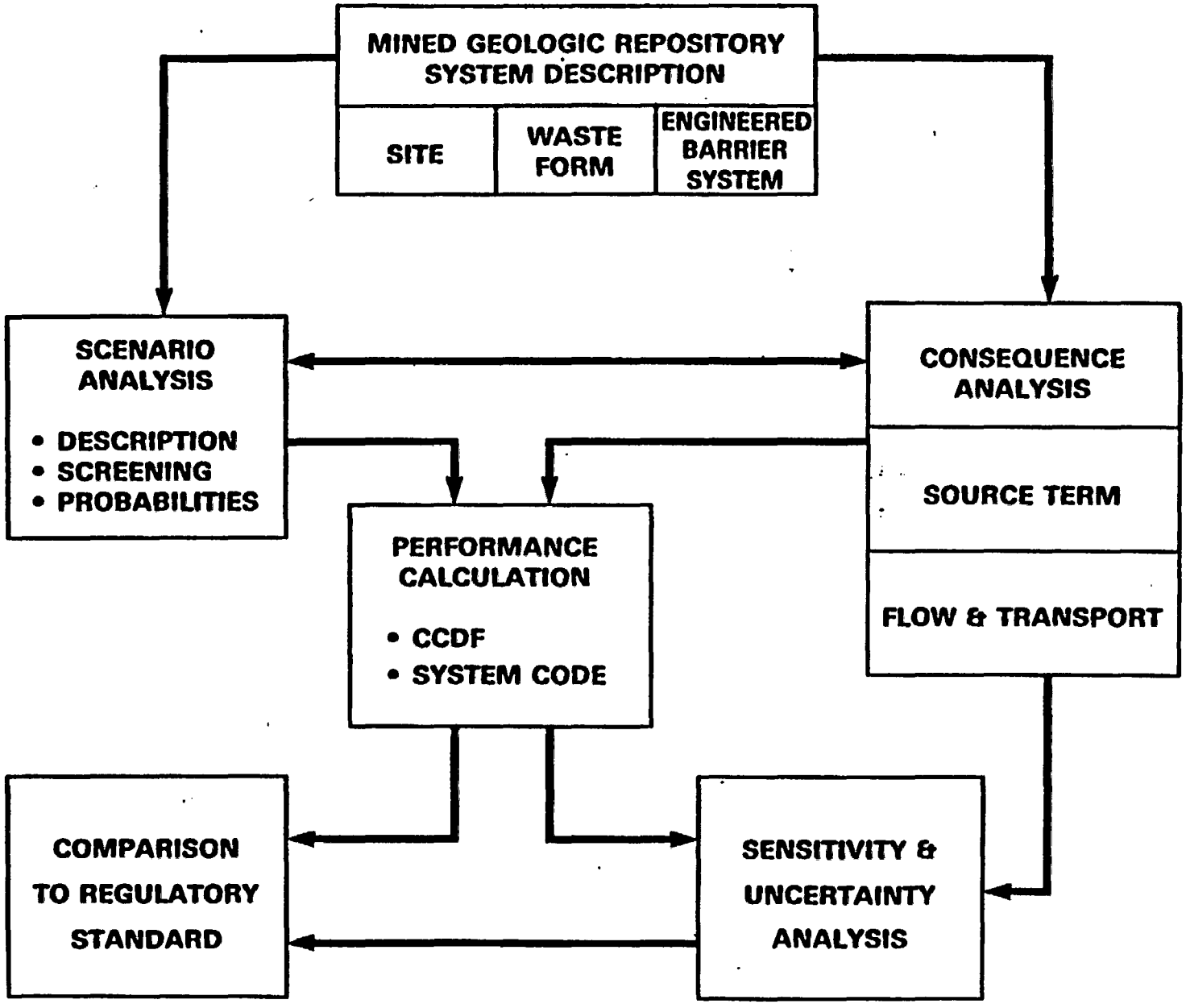


Figure 1 - Components of a total system performance assessment.

6. Comparison to Regulatory Standards and Documentation of Results -- Comparison to regulatory standards must take into account both the estimated performance of the repository (obtained from predictive modeling) and the uncertainty inherent in such estimates (obtained from sensitivity and uncertainty analyses and other studies). The most effective documentation must make the assumptions used in the analysis and their bases clear, and the implication of their use explicit.

A Task and Subtask structure to accomplish these steps in performance assessment are described in Section V. and Appendix H.

IV. PLANNING ASSUMPTIONS

Some of the important assumptions underlying the planning for the Phase 2 work are:

1. Phase 1 demonstrated the staff's capability to conduct a performance assessment for an HLW repository. The focus of Phase 2 will be to enhance this capability and to produce a more realistic, more meaningful performance assessment.

2. A significant effort will be the acquisition and evaluation of the SNL tuff methodology by the NRC and CNWRA.

3. The NRC staff, both the Office of Nuclear Material Safety and Safeguards (NMSS) and RES, will work jointly with the CNWRA staff to accomplish the goals of Phase 2.

4. An effort will be made to conduct the work over a longer time period than was done in Phase 1 and to use the additional time to involve to a greater degree all the disciplines and staff appropriate to a well-executed performance assessment.

5. Activities for Phase 2 will be completed in June 1992 with the issuance of a draft final report. These activities are shown schematically in Appendix A, using a Program Evaluation and Review Technique (PERT) chart.

V. WORK BREAKDOWN SCHEDULE AND ORGANIZATION

Because the iterative performance assessment work is being performed on a cooperative basis by staff from two different NRC Offices (NMSS and RES) and from the CNWRA, a unique organizational structure has been developed. This structure, which uses a matrix management approach to supply and direct resources from the three participating organizations, is described schematically in Figure 2. The four main tiers of the organization consist of a Management Board, Technical Coordinators, Task Leaders, and Subtask Leaders. Both the Management Board and Technical Coordinator tiers have one representative from each of the three participating organizations. In

ITERATIVE PERFORMANCE ASSESSMENT ORGANIZATION

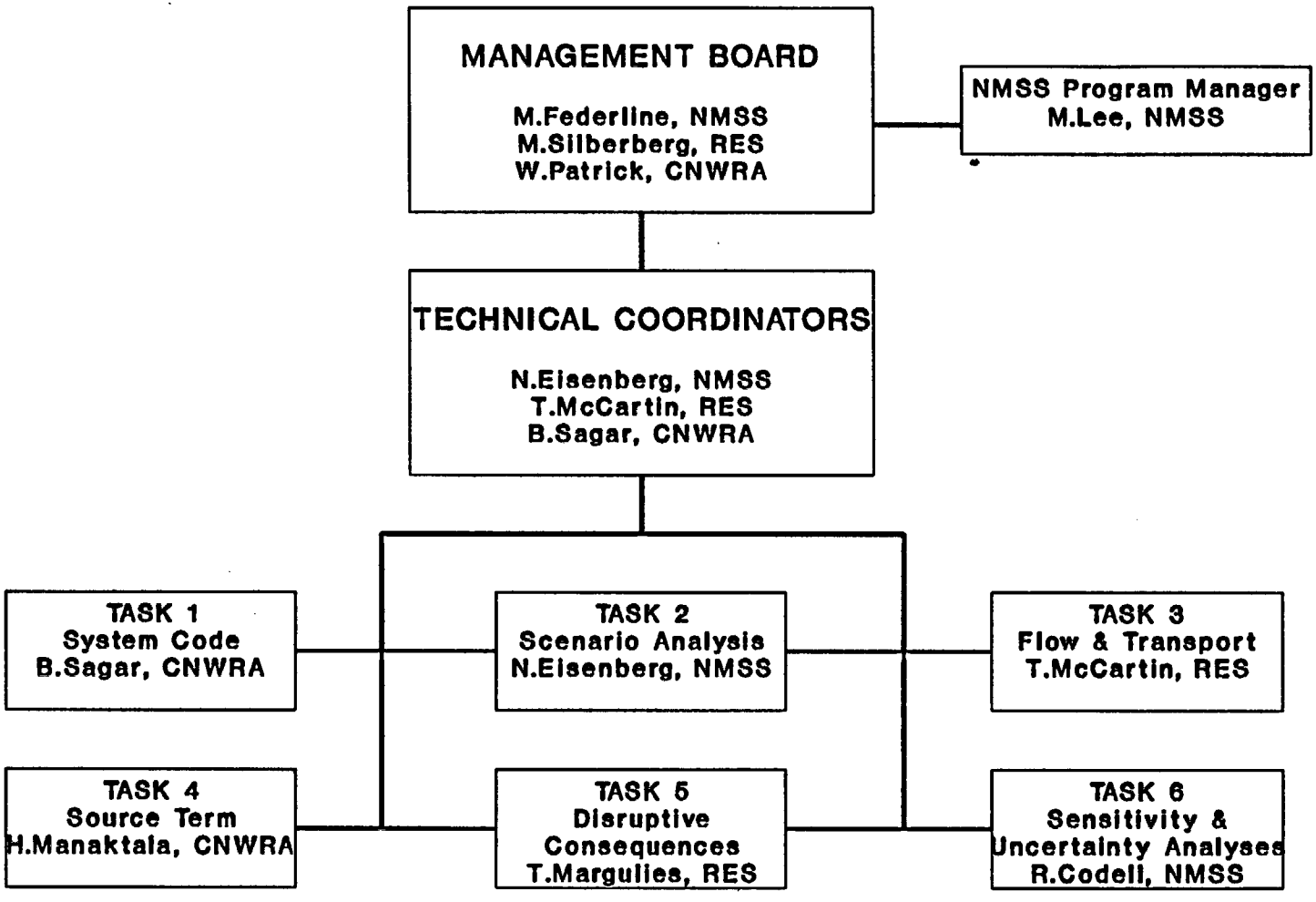


Figure 2

addition, a single Task Leader is assigned to each of the six primary technical areas and one Subtask Leader to each of the various subtasks under the six Tasks.

The three member Management Board is comprised of:

M.V. Federline, Chief, HLHP/NMSS;
M. Silberberg, Chief, WMB/RES; and
W.C. Patrick, Technical Director, CNWRA

The Management Board is responsible for defining the goals of various activities and approving the schedule, allocation of resources, and deliverables. The Management Board can revise activities defined under contract with the CNWRA by changing the contract through appropriate channels. The Management Board will be supported by the NMSS Program Manager, M. Lee. He will assist by: (1) tracking manpower expended for various Tasks and Subtasks versus planned expenditures; (2) tracking achievement of intermediate milestones; (3) participating in periodic Management Meetings among Task Leaders, Technical Coordinators, and line managers; and (4) providing general oversight with regard to Division, Office, and NRC policy and commitments.

Three technical coordinators will provide technical direction and integration for the various iterative performance assessment activities. Each organization participating in this cooperative effort is represented by a Technical Coordinator. The Technical Coordinators are:

N. Eisenberg, NMSS/HLHP
T. McCartin, RES/WMB
B. Sagar, CNWRA

N. Eisenberg, NMSS, is the Lead Coordinator. These coordinators will work with the NMSS Program Manager to: (1) conduct periodic management meetings between line managers and task leaders; (2) provide periodic briefings on progress to upper management; (3) identify any significant technical, scheduling, or staffing problems for consideration at the periodic management meetings; and (4) act as the organizational contacts for iterative performance assessment activities.

Each of the six major divisions of technical activity has a technical Task Leader designated to lead the activity. The distribution of the technical activities and the corresponding Task Leaders are as follows:

1. System Code -- Task Leader: B. Sagar (CNWRA)

2. Scenario Analysis -- Task Leader: N. Eisenberg (NMSS)

3. Flow and Transport -- Task Leader: T. McCartin (RES)

4. Source Term -- Task Leader: H. Manaktala (CNWRA)

5. Disruptive Consequences Analysis -- Task Leader: T. Margulies (RES)

6. Sensitivity and Uncertainty Analyses -- Task Leader: R. Codell (NMSS)

The responsibilities of each technical Task Leader include: (1) first-line technical management of the Technical Team assigned to the Task, which involves deciding, in concert with other Technical Team members, on the technical approaches to be implemented, determining levels of detail and precision for various subtasks, providing technical assignments for assigned staff, and coordinating the subtasks with each other; (2) coordination of activities performed by various staff members supporting the task; (3) the function of principal spokesperson reporting on task activities; and (4) coordination with the Technical Coordinators.

Each Task consists of several Subtasks, each led by a technical Subtask Leader. The duties and responsibilities of the technical Subtask Leader are similar to those of the Task Leader, except limited to the particular Subtask. The technical Subtask Leaders will play a role similar to a Principal Investigator in some other organizational schemes. Technical Team members are listed for each Subtask in the Task Detail Report (Appendix D).

In order to establish effective communication among the various tiers of organization, periodic meetings/teleconference will be held. Management meetings/teleconferences will be held monthly to review progress, to evaluate resource consumption (staff-time), and to raise any problems to an appropriate level of management. Participation in the management meetings/teleconferences will include: the three-member Management Board, involved NRC Section Leaders, the three IPA Coordinators, and the NMSS Project Manager, who will issue minutes for the meetings/teleconference. Technical Management meetings/teleconference will be held bi-monthly to discuss technical progress, to raise potential problems, to address means for more effective coordination, and to recommend solutions to problems. Participation in the Technical Management meetings/teleconference will include the IPA Coordinators, the six Task Team Leads, the involved NRC Section Leaders, and the NMSS Project Manager, who will issue minutes for the meetings/teleconference. On a less-regular basis, but approximately every two months, a large technical meeting involving as many participants as practicable will be held to discuss technical progress, problems, results, and questions. Team Leads will have technical meetings with participants as needed.

The work breakdown schedule consists of six main technical tasks and another technical coordination task. They are:

<u>Task 0 -- IPA Coordination</u>
This activity provides for coordination between Tasks and among the three organizations performing this work. The three coordinators will propose plans for technical work to the Management Board, monitor and report on technical progress and promote communication within and among NMSS, RES, and CNWRA.

Task 1 -- System Code

This activity will develop a system code to calculate a CCDF to estimate the performance of the repository. The system code will be consistent with the overall concept and logic of repository performance assessment adopted by these analysts. The system code will accept probabilistic information on scenario occurrences developed in Task 2 and consequence modules developed in Task Nos. 3, 4, and 5.

Activities under this task will include: (1) the digitization of parametric distributions and other data bases, including information related to scenarios; (2) the testing of codes to calculate consequences; and (3) the coding of an executive program to exercise the consequence models with the appropriate data bases. This activity will also incorporate the ability to estimate dose-to-man from repository operations.

Task 2 -- Scenario Analysis

The purpose of Task 2 is to provide the scenario analysis needed to perform the Phase 2 performance assessment. Components of the scenario analysis include: (1) identification and enumeration of scenarios that are relevant to the proposed geologic repository at Yucca Mountain; (2) screening of scenarios to make the analysis more tractable, but still sufficiently complete; and (3) estimation of the probabilities of scenarios retained in the analysis. Activities will be devoted to an evaluation of the Sandia scenario analysis methodology and to the development of an improved, mathematically robust scenario analysis methodology.

Task 3 -- Flow and Transport

This task will develop and implement models for flow and transport in the far-field zone; i.e., the region beyond the engineered barrier where the effects of heat produced by the waste are not important. This task will consider flow of groundwater in the saturated and unsaturated zones in greater detail than those used in the Phase 1 analyses. Transport of radionuclides in the far field will consider phenomena such as sorption and matrix diffusion. Additionally, models for transport of radionuclides in the gaseous state, particularly C-14, will be incorporated into the overall systems model. Auxiliary analyses will explore the appropriateness of the assumptions used in developing these computational modules.

Task 4 -- Source Term

This activity will provide the computational module used to estimate the flux of radionuclides moving from the engineered barrier system into the geosphere for transport to the accessible environment. Calculation of this radionuclide flux will involve consideration of: (1) hydrologic, thermal, and geochemical conditions near the repository; (2) waste package failure; (3) waste form dissolution; and (4) mass transfer of radionuclides from the waste packages, the underground facility, and the nearby geosphere into the far field (the source term includes enough of the geosphere near the mined facility to be able to model the efflux of radionuclides, taking into account the perturbation of the geosphere by the excavation and emplaced waste).

Task 5 -- Disruptive Consequences Analysis

The Disruptive Consequence analyses will focus on investigating the staff's capability to model additional scenarios beyond the four modeled in the Phase 1 demonstration (a base case, a pluvial case, exploratory drilling under undisturbed conditions, and drilling under pluvial conditions).

In doing so, this activity will provide computational modules to estimate the movement of radionuclides from the repository to the accessible environment for certain types of disruptive scenarios involving, for example, volcanism, and human intrusion.

Task 6 -- Sensitivity and Uncertainty Analyses

This task will assess the uncertainty and sensitivities for the Phase 2 modeling study. It will improve upon the Phase 1 analyses by using more sophisticated sensitivity and uncertainty methods, along with making more realistic assumptions about how input variables for the Monte Carlo analyses were sampled.

Detailed descriptions of these tasks and the subtasks comprising them were developed in the November 1990 draft program plan and are reproduced in Appendix H of this document.

Task Nos. 1, 2, and 6 correspond respectively to Steps 1 (System Description), 2 (Scenario Analysis), and 5 (Sensitivity and Uncertainty Analysis) of a total performance assessment described in Section III of this plan. Task Nos. 3, 4, and 5 comprise the Consequence Analysis, Step 3. Currently the System Description, Step 1, does not have a separate work breakdown element; instead this activity is distributed among the corresponding process consequence modeling efforts (i.e., Task Nos. 3, 4, and 5).

Subtasks comprising each Task are listed in Table 1. In addition, several appendices are provided to clarify further the breakdown of work. Appendix A provides a PERT chart of the IPA Phase 2 tasks, covering from October 1991 to the completion of the work in June 1992. Appendix B is an outline report showing, along with the planned start and finish for each subtask, the float built into the overall schedule. Appendix C gives a short description, the scheduled start and finish dates, and the total staff hours for the various subtasks. Appendix D provides the staff loadings for each subtask. Appendix E is a Gantt chart for IPA Phase 2 Tasks for the period October 1991 to the scheduled completion of Phase 2 in June 1992. Appendix F shows the anticipated total staff hours required for each staff member until the completion of Phase 2. Appendix G details the anticipated work load, by subtask, for individual staff members. Finally, Appendix H includes the original Subtask descriptions taken from the November 1990 Draft Program Plan.

VI. MILESTONES

Critical milestones for the completion of IPA Phase 2 include:

Task 1 -- System Code

11/91	Complete dose module
10/91	Complete modifications to system code
10/91	Contribute to working draft on system code modifications
02/92	Delivery of all modules to system code team
04/92	Complete trial runs of complete system code
04/92	Complete system code production runs
05/92	Complete Task 1 Working Draft
05/92	Complete Task 1 Rough Draft

Task 2 -- Scenario Analysis

01/92	Complete evaluation of SNL methodology and accompanying documentation
02/92	Complete development of improved scenario method and accompanying documentation
03/92	Contribute scenario probabilities for system code production runs
03/92	Complete Task 2 Working Draft
04/92	Complete Task 2 Rough Draft

Task 3 -- Flow and Transport

11/91	Complete gas flow and transport module
02/92	Complete liquid flow and transport module
03/92	Complete Task 3 Working Draft
03/92	Complete Task 3 Rough Draft

Task 4 -- Source Term

12/91	Complete waste form dissolution module
11/91	Complete waste package failure module
12/91	Complete source term transport module
11/91	Complete waste package environmental conditions module
02/92	Complete integrated source term module
03/92	Complete Task 4 Working Draft
03/92	Complete Task 4 Rough Draft

Task 5 -- Disruptive Consequences

01/92	Complete volcanism module
05/92	Complete Task 5 Working Draft
05/92	Complete Task 5 Rough Draft

Task 6 -- Sensitivity and Uncertainty Analysis

04/92	Complete sensitivity & uncertainty methodology write-up
05/92	Perform sensitivity & uncertainty analysis on production run results
05/92	Complete Task 6 Working Draft
06/92	Complete Task 6 Rough Draft

Final Documentation

06/92	Assemble Total Rough Draft
06/92	Complete Total First Draft IPA Phase 2
06/92	Issue First Draft IPA Phase 2

Although this plan was generated to avoid overscheduling any single staff member (starting and ending times of various tasks were adjusted to accomodate this constraint), the plan provides some room for adjustment as the work proceeds. The Outline Report (Appendix B) shows columns for "float" and "free float" times. "Float" is the amount of time (in days) a task could slip without delaying completion of IPA Phase 2, whereas "free float" is the amount of time a task could slip without delaying completion of any other task. Thus, it is possible that the completion of tasks with "float" values greater than zero could be delayed; however, such a delay may cause overscheduling of individual staff working on the task. For this reason, the schedule for critical milestones given above is for general guidance. The completion of these milestones will be tracked, but deviations from the schedule do not automatically imply a slip in the overall schedule for completion of IPA Phase 2.

However, key milestones on the critical path cannot be slipped without delaying completion of Phase 2. These milestone dates, which must be adhered to, are:

	02/18/92	Completion of the liquid flow and transport module
*	02/18/92	Delivery of all modules to the system code team
*	04/15/92	Completion of the system code production runs
	05/04/92	Completion of sensitivity and uncertainty analyses
	06/02/92	Completion of the Task 6 Rough Draft
*	06/02/92	Delivery of Rough Drafts from all Tasks
*	06/17/92	Completion of the IPA Phase 2 First Draft

Key milestones marked by an asterisk (*) apply to all Teams. As an example, it is possible that the completion of any computational module could be slipped until February 18, 1992, at the very latest. However, as mentioned above, any slips in schedule may cause overscheduling of individual resources and should be undertaken with caution.

VI. DELIVERABLES

The major deliverable for the IPA Phase 2 activity will be a staff report summarizing the work performed (assumptions made, modeling performed, quantitative results obtained, auxiliary analyses made), insights gained, conclusions reached, and recommendations for future performance assessment activities, including improving the analyses. A draft Table of Contents for this report is laid out in Table 2. Table 3 provides a list of the planned major accomplishments for Phase 2. Finally, in addition to the staff report, journal articles, papers, and presentations will be prepared as appropriate.

Table 1. IPA Phase 2 Subtasks

Number	Subtask Description
001	Initiate restructured Task 1 -- System Code
002	Develop computational module to calculate doses
003	Task 1 Rough Draft contribution to IPA Phase 2 Rough Draft
004	Revise and modify Task 1 Working Draft
005	Task 1 Working Draft for revision into Rough Draft
006	Write Task 1 Working Draft
007	Computer output from production runs of system code
008	Production runs of system code for Phase 2 scenarios
009	Trial runs of system code with all modules
010	Determine variables and their distributions for LHS
011	All computational consequence modules delivered
012	Coordinate consequence module development with other tasks
013	Computational module for individual and population dose
014	Modify system code and documentation for it
015	Description of modifications to system code
016	Initiate restructured Task 2 -- Scenario Analysis
017	Develop an improved scenario analysis method
018	Document improved scenario method
019	Select one scenario analysis method from alternates for analysis
020	Use scenario analysis method to define scenarios and probabilities
021	Probabilities of scenarios for use in Phase 2 analysis
022	Write Task 2 Working Draft -- Team 2 activities and results
023	Review and modify Task 2 Working Draft to Task 2 Rough Draft
024	Task 2 Rough Draft -- Team 2 contribution to IPA Phase 2 Rough Draft
025	Evaluate SNL scenario methodology
026	Document evaluation of SNL scenario methodology
027	Initiate restructure Task 3 -- Flow and Transport
028	Meeting to discuss completion of Task 3
029	Develop model for groundwater flow and transport
030	Developed flow and transport model for liquid phase
031	Write up model for groundwater flow and transport
032	Working Draft for Task 3
033	Review and modify Task 3 Working Draft into Rough Draft
034	Task 3 contribution to Phase 2 IPA Rough Draft
035	Develop module for gas transport of radionuclides (C-14)

Table 1. IPA Phase 2 Subtasks (continued)

Number	Subtask Description
036	Computer module to calculate gas transport of radionuclides
037	Write up gaseous radionuclide flow and transport model
038	Auxiliary analysis for infiltration from precipitation
039	Document the auxiliary analysis on precipitation
040	Evaluate how well Kd's estimate radionuclide transport
041	Document auxiliary analysis evaluating Kd's
042	Partial evaluation of SNL tuff flow and transport codes
043	Document auxiliary analysis of SNL tuff code evaluation
044	Auxiliary analysis of 2D partially saturated flow at Yucca Mountain
045	Document auxiliary analysis of 2D partially saturated flow at Yucca Mountain
046	Auxiliary analysis of 3D partially saturated flow at Yucca Mountain
047	Document auxiliary analysis of 3D unsaturated flow at Yucca Mountain
048	Scoping literature survey of gas flow at Yucca Mountain
049	Document auxiliary analysis of thermally- and barometrically-driven gas flow
050	Initiate restructured Task 4 -- Source Term
051	Develop waste package failure model
052	Computer module to estimate waste package failure
053	Integrate the component source term modules
054	Complete source term computational module
055	Write Task 4, Source Term, Working Draft
056	Completed Working Draft for Task 4
057	Review and modify Task 4 Working Draft into Rough Draft
058	Task 4 Rough Draft contribution to Phase 2 Rough Draft
059	Develop model for waste form dissolution
060	Completed waste form dissolution module
061	Develop model for transport of radionuclides from source
062	Completed module to calculate transport from source
063	Initiate restructured Task 5 -- Disruptive Consequences
064	Develop models to describe consequences of volcanism
065	Completed computational module for volcanism consequences
066	Write Task 5 Working Draft
067	Task 5 Working Draft
068	Review and modify Task 5 Working Draft into Rough Draft
069	Task 5 Rough Draft

Table 1. IPA Phase 2 Subtasks (continued)

Number	Subtask Description
070	Initiate restructured Task 6 -- Sensitivity and Uncertainty
071	Write part of Task 6 Working Draft describing methods for Sensitivity and Uncertainty analyses
072	Prepare sensitivity and uncertainty analysis methods
073	Perform sensitivity and uncertainty analysis on production runs
074	Completed sensitivity and uncertainty analysis on Phase 2 output
075	Write Task 5 Working Draft, including sensitivity and uncertainty analyses
076	Completed Task 6 Working Draft
077	Review and modify Task 6 Working Draft
078	Task 6 contribution to Phase 2 Rough Draft
079	Assemble complete Rough Draft
080	Review and modify Total Rough Draft
081	Issue First Draft of Phase 2 report to management
082	Phase 2 First Draft
084	Completed Task 2 Working Draft
085	Geochemical analysis of C-14 transport
086	Document the C-14 analysis
087	2D planar regional, saturated flow model
088	Document regional, saturated flow model
089	Initiate restructured Task 0 -- Coordination
090	IPA Phase 2 Coordination
094	Develop model for repository environment (thermal, chemical, hydrological conditions)
095	Computer module to calculate repository environment

Table 2. Draft Table of Contents for the Staff Report for Phase 2 of the Iterative Performance Assessment

Executive Summary

1.0 Introduction
- 1.1 Scope and limitation of the Phase 2 IPA
- 1.2 Staffing and Organization

2.0 System Code
- 2.1 Description of Phase 2 System Code
  - 2.1.1 Performance Assessment Methodological Context
  - 2.1.2 Operational Description
- 2.2 Improvements and Changes since Phase 1
  - 2.2.1 Addition of Dose Computation
  - 2.2.2 Operation by Calling Subroutines for Consequence Calculations
  - 2.2.3 Graphics Capability
- 2.3 Auxiliary Analyses
  - 2.3.1 Evaluation of FPPA and Importance Sampling Methods to CCDF Generation
  - 2.3.2 Others

3.0 Scenario Analysis
- 3.1 Evaluation of SNL Scenario Analysis Method
- 3.2 Development of an Improved Scenario Analysis Method
- 3.3 Scenario Analysis for Phase 2
- 3.4 Auxiliary Analyses - as appropriate

4.0 Flow and Transport
- 4.1 Summary of Relevant Literature
- 4.2 Flow and Radionuclide Transport Model for Gaseous Releases
- 4.3 Flow and Radionuclide Transport Model for Radionuclide Releases in Groundwater
- 4.4 Computer Modules for Estimating Radionuclide Releases via Fluid Pathways
- 4.5 Auxiliary Analyses
  - 4.5.1 Evaluate SNL Flow and Transport Codes
  - 4.5.2 Evaluate Model Assumptions
  - 4.5.3 Regional Flow Model
  - 4.5.4 Three-Dimensional Flow Analysis
  - 4.5.5 Others

Table 2. Draft Table of Contents for the Staff Report for Phase 2 of the Iterative Performance Assessment (continued)

5.0 Source Term
- 5.1 Summary of Relevant Literature
- 5.2 Hydrologic, Thermal, and Geochemical Repository Conditions
- 5.3 Waste Package Failure
- 5.4 Waste Form Dissolution
- 5.5 Mass Transfer
- 5.6 Source Term Model and Computer Module
- 5.7 Auxiliary Analyses (as appropriate)

6.0 Disruptive Consequence Analysis
- 6.1 Summary of Relevant Literature
- 6.2 Improved Drilling Model and Code
- 6.3 Modeling for Additional Scenario Classes
- 6.4 Auxiliary Analyses
  - 6.4.1 Geologic Analysis of Volcanism at Yucca Mountain
  - 6.4.2 Others

7.0 Analytical Results
- 7.1 Caveats Concerning the Results
- 7.2 Conditional CCDF's for Various Scenario Classes
- 7.3 Total System CCDF

8.0 Sensitivity and Uncertainty Analyses
- 8.1 Phase 2 Sensitivity Analysis
- 8.2 Phase 2 Uncertainty Analysis
- 8.3 Evaluation of Alternative Sensitivity and Uncertainty Analysis Methods

9.0 Tentative Conclusions
- 9.1 Caveats Concerning Conclusions
- 9.2 Adequacy of Methodology
- 9.3 Adequacy of Scientific Basis for Analysis
- 9.4 Discussion of Important Parameters, Phenomena, Features of Models, and Modeling Assumptions
- 9.5 Discussion of Aspects of the Site Important to Performance
- 9.6 Discussion of Regulatory Issues

Table 3. Planned Accomplishments for IPA Phase 2

Overall

- All the steps required in a performance assessment will be executed. This is a minimum requirement for calculating a meaningful CCDF. Consequence analyses for the calculation of the CCDF will be supported by limited auxiliary analyses.

- The performance assessment methodology for tuff developed by SNL will be evaluated to a limited degree. This evaluation will determine whether additional research or development of the methodology by the CNWRA is necessary.

Task-Specific

Task 1 The total system code, including consequence modules will be expanded and improved. A dose modeling capability will be added.

Task 2 The SNL scenario analysis methodology will be evaluated to a limited extent. A more robust scenario analysis methodology will be developed and applied.

Task 3 A flow simulator will be incorporated into the consequence module. Radionuclide transport in an unsaturated medium will receive a more direct treatment. There will be an improved treatment of the transition between matrix flow and fracture flow. The capability to model radionuclide transport in the gaseous phase will be added.

Task 4 There will be a more mechanistic treatment of waste package failure. Waste form dissolution and mass transfer to the geosphere will receive improved treatment.

Task 5 The capability to model the consequences of volcanic scenarios will be added. The treatment of drilling scenarios will be improved if time and resources permit.

Task 6 Sensitivity and uncertainty analyses will be conducted on the estimates of total system performance. Additional sensitivity and uncertainty analysis methods will be evaluated.

APPENDIX A

PERT CHART FOR IPA PHASE 2 TASKS
(OCTOBER 1991 TO JUNE 1992)

Appendix A
PERT Chart

General.

The PERT (Program Evaluation and Review Technique) Chart is a visual representation of the project as a sequence of linked tasks. Each task is represented by a rectangular box. A milestone, i.e. the endpoint of an activity producing a product or deliverable, is denoted by a box with notched corners in this PERT chart. Milestones are "tasks" with zero duration. Single tasks may branch out into several tasks and several tasks may "neck down" to a single task or milestone. Thus, activities may transpire in parallel.

Each task on the PERT chart has, in order of appearance:

- a number
- a name
- a task lead
- the task duration in days
- the scheduled start date
- the scheduled finish date

Each task is also related to, in general, two other tasks: the predecessor task and the successor task. For all the tasks on this PERT chart, the predecessor to a task must be completed before the task can begin. The chaining together of these dependent tasks, which the PERT chart, in part, represents, is the primary determinant of the schedule, .

The tasks connected by lines composed of asterisks represent the "critical path" for this project. The critical path is the shortest path for completion of the work; any delay in any of the tasks lying on the critical path will delay completion of the entire project.

In this display the project start is denoted by "P1" and the project end by "P2".

Important Points about the Reconfigured Program.

The scope of work for IPA Phase 2, as reflected in this final Program Plan, was narrowed due to a reconfiguration of the scheduled work (August 30, 1991 memorandum from M. Federline to B.J. Youngblood). This PERT chart lays out the anticipated activities required for the completion of IPA Phase 2, commencing in October 1991 and ending in June 1992. In looking at the PERT chart, the following points should be kept in mind:

1. The work still is organized largely into seven major Tasks, six of which are technical tasks and the seventh involving program coordination.

2. The technical tasks are:

    1. System Code

2. Scenario Analysis
3. Flow and Transport
4. Source Term
5. Disruptive Consequences
6. Sensitivity and Uncertainty Analysis

3. Each of these major technical Tasks begins with a "Restart" milestone for the restructured program planned from 10/01/91.

4. Each of the six technical Tasks produces a "Rough Draft" documenting the analyses performed and results obtained under the Task, for inclusion in the Draft Final Report for Phase 2. The production of this Rough Draft involves: (1) writing a Task N Working Draft; (2) a completion Milestone for the Working Draft; (3) revising and modifying the Task N Working Draft; and (4) a completion Milestone for the Task N Rough Draft. (N.B. "Milestone" boxes have notched corners, task boxes do not.)

5. The series of tasks concluding Phase 2 are similar to those for each of the six technical Tasks: (1) Assemble the Total Rough Draft (from the pieces provided by each team); (2) Revise and Modify the Total Rough Draft; (3) Issue the First Draft to Management; and (4) a completion Milestone for the First Draft.

6. Prior to completing the documentation of the First Draft, a critical sequence of tasks includes: (1) delivery of all computational modules to the system code team; (2) trial runs of the system code with all computational modules; and (3) production runs.

7. Since the sensitivity and uncertainty analysis can only be performed after all the production runs are complete, these tasks are on the critical path.

Although this plan was generated to avoid overscheduling any single staff member (starting and ending times of various tasks were adjusted to accomodate this constraint), the plan provides some room for adjustment as the work proceeds. The Outline Report (Appendix B) shows columns for "float" and "free float" times. "Float" is the amount of time (in days) a task could slip without delaying completion of IPA Phase 2, whereas "free float" is the amount of time a task could slip without delaying completion of any other task. Thus, it is possible that the completion of tasks with "float" values greater than zero could be delayed; however, such a delay may cause overscheduling of individual staff working on the task. Deviations from the schedule do not automatically imply a slip in the overall schedule for completion of IPA Phase 2.

However, key milestones on the critical path cannot be slipped without delaying completion of Phase 2. These milestone dates, which must be adhered to, are:

	02/18/92	Completion of the liquid flow and transport module
*	02/18/92	Delivery of all modules to the system code team

*	04/15/92	Completion of the system code production runs
	05/04/92	Completion of sensitivity and uncertainty analyses
	06/02/92	Completion of the Task 6 Rough Draft
*	06/02/92	Delivery of Rough Drafts from all Tasks
*	06/17/92	Completion of the IPA Phase 2 First Draft

Key milestones marked by an asterisk (*) apply to all Teams. As an example, it is possible that the completion of any computational module could be slipped until February 18, 1992, at the very latest. However, as mentioned above, any slips in schedule may cause overscheduling of individual resources and should be undertaken with caution.

APPENDIX B

OUTLINE REPORT FOR IPA PHASE 2

Appendix B
Outline Report

The abreviated outline report in this appendix does not provide all the information found on the PERT chart, but does provide information in addition to that found on the PERT chart. Specifically, this outline report does not provide information on task leads or the relationships, among tasks. This report does provide the following information:

Column	Heading	Meaning
1	Heading/Task	task name, same as on PERT chart
2	Task ID	task number, same as on PERT chart
3	Pr	priority, higher numbers indicate a higher priority task
4	Dur	task duration in days, same as on PERT chart
5	Schd Start	scheduled start date
6	Schd Finish	scheduled finish date
7	Total Hours	total number of person-hours required to complete this task; this is resource time, not elapsed time
8	Float	time, in days, this task can slip without affecting completion of a critical task, hence project end date
9	Free Float	time, in days, this task can slip without affecting completion of any other task

These last two items are very important for managers who wish to determine whether schedule slippage on a given task will impact completion of the project or will merely delay completion of intermediate milestones, internal to the project. This is a major reason for including the outline in the program plan appendices. All the information, as defined above, is largely self-explanatory. The priority is used within the project management software in order to force certain tasks (i.e. higher priority tasks) to be scheduled ahead of other (lower priority) tasks.

Outline
11-13-91 10:45a

Project: FINAL.PJ
Revision: 8

Phase 2 Iterative Performance Assessment

Heading/Task	Task ID	Pr	Dur	Schd Start	Schd Finish	Total Hours	Float	Free Float
FINAL.PJ	P1		184	10-01-91<	06-24-92	14866	0	0
±Restart Task 1	001	50	0	10-01-91<	10-01-91	0	12	2
±Dev. Dose Module	002	50	30	10-03-91	11-07-91	260	10	0
±Task 1 Rough Dr.	003	50	0	05-14-92	05-14-92	0	12	12
±Rev.&Mod. T1 WD	004	50	10	05-06-92	05-14-92	110	0	0
±Task 1 Wrkg. Dr.	005	50	0	05-06-92	05-06-92	0	0	0
±Write Task1 WD	006	50	10	04-28-92	05-06-92	120	0	0
±Prod. Run Output	007	50	0	04-21-92	04-21-92	0	0	0
±Production Runs	008	50	5	04-15-92	04-21-92	210	0	0
±Trial Runs	009	55	30	02-28-92	04-08-92	721	0	0
±Dev. LHS Strtgy	010	50	10	04-08-92	04-15-92	148	0	0
±All Modules Del.	011	50	0	02-18-92	02-18-92	0	0	0
±Coord. Mod. Dev.	012	50	10	11-14-91	11-20-91	60	28	28
±Dose Module	013	50	0	11-07-91	11-07-91	0	38	38
±Mod. Sys. Code	014	50	10	10-16-91	10-29-91	60	93	0
±Contr. to WD	015	50	0	10-29-91	10-29-91	0	101	101
± Restart Task 2	016	50	0	10-01-91<	10-01-91	0	0	0
±ST212-Imp. Meth.	017	45	20	11-07-91	02-10-92	204	0	0
±Doc. Imp. Scen.	018	50	10	02-10-92	02-24-92	166	0	0
±Choose Method	019	50	2	02-24-92	02-26-92	58	0	0
±Use Chosen Meth.	020	50	10	02-26-92	03-16-92	292	0	0
±System Code Prob	021	50	0	03-16-92	03-16-92	0	0	0
±Write Task 2 WD	022	50	10	03-16-92	03-27-92	144	0	0
±Rv. & Mod. T2 WD	023	50	10	03-27-92	04-09-92	136	0	0
±Task 2 Rough Dr.	024	50	0	04-09-92	04-09-92	0	38	38
±ST211-SNL Meth.	025	45	20	11-25-91	12-20-91	384	0	0
±Doc. SNL Eval.	026	50	10	12-20-91	01-06-92	172	0	0
±Restart Task 3	027	50	0	10-01-91<	10-01-91	0	0	0
±Restart Meeting	028	75	3h	10-04-91<	10-04-91	30	0h	0h
±Dev. Liquid Mod.	029	70	100	11-12-91	02-18-92	1515	0	0
±Liquid F&T Mod.	030	50	0	02-18-92	02-18-92	0	0	0
±Write GW F&T WD	031	70	10	02-19-92	03-02-92	142	23	0
±Task 3 Wrkg. Dr.	032	50	0	03-02-92	03-02-92	0	23	0
±Rev.&Mod. T3 WD	033	70	10	03-03-92	03-16-92	540	23	0
±Task3 Rough Drft	034	50	0	03-16-92	03-16-92	0	55	55
±Dev. Gas Module	035	70	30	10-04-91	11-12-91	320	0	0
±Gas F&T Mod.	036	50	0	11-12-91	11-12-91	0	37	37
±Write Gas F&T WD	037	50	10	01-08-92	01-22-92	104	39	28
±ST321-Precip.	038	40	5	10-04-91	10-10-91	36	110	0
±Document ST321	039	40	10	10-10-91	10-24-91	72	110	87
±ST322-KD Approx.	040	40	10	10-04-91	10-18-91	72	110	0
±Document ST322	041	40	5	10-18-91	10-24-91	36	110	87
±ST323-SNL Codes	042	40	10	10-18-91	10-25-91	100	0	0
±Document ST323	043	40	10	10-25-91	12-06-91	120	69	58
±ST324-2D Unsat.	044	40	10	10-04-91	10-18-91	72	105	0
±Document ST324	045	40	10	10-18-91	10-31-91	72	105	82
±ST325-3D Unsat.	046	40	10	10-04-91	10-18-91	72	105	0
±Document ST325	047	40	10	10-18-91	10-31-91	72	105	82
±ST326-Therm. Air	048	40	10	12-24-91	01-08-92	74	39	10

Across: 1 Down: 2
Project: FINAL.PJ
Revision: 8

Outline
11-13-91 10:45a

Phase 2 Iterative Performance Assessment

Heading/Task	Task ID	Pr	Dur	Schd Start	Schd Finish	Total Hours	Float	Free Float
±Document ST326	049	40	10	01-22-92	02-04-92	72	40	19
± Restart Task 4	050	50	0	10-01-91	10-01-91	0	0	0
±WP Flr. Module	052	50	0	11-05-91	11-05-91	0	17	17
±WP Failure Model	051	60	40	10-08-91	11-05-91	440	0	0
±WP Env.Cond.Mdl.	094	60	40	10-01-91	11-29-91	300	0	0
±WP E.Cnd. Module	095	50	0	11-29-91	11-29-91	0	2	2
±Integrt. Modules	053	60	10	01-31-92	02-13-92	80	0	0
ST Module	054	50	0	02-13-92	02-13-92	0	0	0
±Write Task 4 WD	055	60	20	02-13-92	03-12-92	509	0	0
±Task4 Wrkng. Dr.	056	50	0	03-12-92	03-12-92	0	0	0
±Rev.&Mod. T4 WD	057	60	10	03-12-92	03-26-92	216	0	0
±Task4 Rough Dr.	058	55	0	03-26-92	03-26-92	0	48	48
±WF Dissol. Model	059	60	40	12-06-91	01-31-92	807	0	0
±WF Dissl. Module	060	50	0	01-31-92	01-31-92	0	0	0
±ST Transport Mdl	061	60	40	11-06-91	12-05-91	400	0	0
±ST Trnpt. Module	062	50	0	12-05-91	12-05-91	0	0	0
±Restart Task 5	063	50	0	10-01-91<	10-01-91	0	0	0
±Volcanism Model	064	55	80	10-01-91	01-21-92	1400	0	0
±Volcanism Module	065	55	0	01-21-92	01-21-92	0	0	0
±Write Task 5 WD	066	45	10	04-14-92	05-01-92	187	0	0
±Task 5 Wrkg. Dr.	067	45	0	05-01-92	05-01-92	0	0	0
±Rev.&Mod. T5 WD	068	45	10	05-01-92	05-15-92	192	0	0
±Task 5 Rough Dr.	069	45	0	05-15-92	05-15-92	0	12	12
±Restart Task 6	070	50	0	10-01-91	10-01-91	0	95	66
±Write Meth. Sect	071	50	20	02-12-92	04-13-92	160	6	6
±Prepare Methods	072	50	20	01-07-92	02-12-92	158	43	43
±Perform S&U Anal	073	50	10	04-21-92	05-04-92	184	0	0
±Complete S&U An.	074	50	0	05-04-92	05-04-92	0	0	0
±Write Task 6 WD	075	50	10	05-04-92	05-18-92	152	0	0
±Task 6 Wrkg. Dr.	076	50	0	05-18-92	05-18-92	0	0	0
±Rev.&Mod. T6 WD	077	50	10	05-18-92	06-02-92	152	0	0
±Task 6 Rough Dr.	078	50	0	06-02-92	06-02-92	0	0	0
±Assemble Tot. RD	079	50	1	06-02-92	06-03-92	35	0	0
±Rev.&Mod. Tot.RD	080	50	10	06-04-92	06-17-92	620	0	0
±Issue First Dr.	081	50	5	06-18-92	06-24-92	120	0	0
P2 First Draft	082	50	0	06-24-92	06-24-92	0	0	0
±Task 2 Wrkg. Dr.	084	50	0	03-27-92	03-27-92	0	0	0
±C-14 Analysis	085	50	5	12-02-91	01-15-92	68	51	0
±Document C-14	086	50	5	01-15-92	01-22-92	68	51	28
±Regional Flow	087	50	5	10-04-91	10-11-91	40	113	0
±Doc. Reg. Flow	088	50	5	10-11-91	10-21-91	40	113	90
±Restart Coord.	089	50	0	10-01-91	10-01-91	0	37	35
±Coordination	090	48	131	11-21-91	06-01-92	1772	2	2

APPENDIX C

TASK SUMMARY REPORT

Appendix C
Task Summary Report

The Task Summary Report provides information on the 95 tasks for the Phase 2 IPA in a convenient summary format. For each task the following is given:

Column	Heading	Meaning
1	Heading/Task	task name, same as on PERT chart
2	Task ID	task number, same as on PERT chart
3	Task Description	a short description of the task or milestone
4	Pr	priority, higher numbers indicate a higher priority task
5	Dur	task duration in days, same as on PERT chart
6	Schd Start	scheduled start date
7	Schd Finish	scheduled finish date
8	Total Hours	total number of person-hours required to complete this task; this is resource time, not elapsed time

Although the Task Summary Report provides information similar to that provided by the Task Outline Report (Appendix B), the inclusion of the Task Description, instead of the float and free float, provides more information on the nature of the various tasks.

Heading/Task	Task ID	Task Description	Pr	Dur	Schd Start	Schd Finish	Total Hours
Restart Task 1	001	Initiate restructured Task 1 = System Code	50	0	10-01-91	10-01-91	
Dev. Dose Module	002	Develop computational module to calculate doses	50	30	10-03-91	11-07-91	260
Task 1 Rough Dr.	003	Task 1 - System Code. Rough Draft input to Final Rept.	50	0	05-14-92	05-14-92	
Rev.&Mod. T1 WD	004	Revise and Modify Task 1 Working Draft	50	10	05-06-92	05-14-92	110
Task 1 Wrkg. Dr.	005	Task 1 Working Draft for revision into Rough Draft	50	0	05-06-92	05-06-92	
Write Task1 WD	006	Write Task 1 Working Draft	50	10	04-28-92	05-06-92	120
Prod. Run Output	007	Computer output from production runs of system code	50	0	04-21-92	04-21-92	
Production Runs	008	Production runs of system code for Phase 2 scenarios	50	5	04-15-92	04-21-92	210
Trial Runs	009	Trial runs of system code with all modules	55	30	02-28-92	04-08-92	721
Dev. LHS Strtgy	010	Determine variables and their distributions for LHS	50	10	04-08-92	04-15-92	148
All Modules Del.	011	All computational consequence modules delivered	50	0	02-18-92	02-18-92	
Coord. Mod. Dev.	012	Coordinate consequence module development w/other tasks	50	10	11-14-91	11-20-91	60
Dose Module	013	Computational module for individual & population dose	50	0	11-07-91	11-07-91	
Mod. Sys. Code	014	Modify System Code and Documentation for it	50	10	10-16-91	10-29-91	60
Contr. to WD	015	Description of modifications to system code	50	0	10-29-91	10-29-91	
Restart Task 2	016	Initiate Restructured Task 2 - Scenario Analysis	50	0	10-01-91	10-01-91	
ST212-Imp. Meth.	017	Develop an improved scenario analysis method	45	20	11-07-91	02-10-92	204
Doc. Imp. Scen.	018	Document improved scenario method	50	10	02-10-92	02-24-92	166
Choose Method	019	Select one scenario analysis method from alts. for anal.	50	2	02-24-92	02-26-92	58
Use Chosen Meth.	020	Use scenario analysis method to define scenarios & probs	50	10	02-26-92	03-16-92	292
System Code Prob	021	Probabilities of scenarios for use in Phase 2 analysis	50	0	03-16-92	03-16-92	
Write Task 2 WD	022	Write Task 2 Working Draft - Team 2 Activities & Results	50	10	03-16-92	03-27-92	144
Rv. & Mod. T2 WD	023	Review and Modify Task 2 Working Draft to Task 2 RD	50	10	03-27-92	04-09-92	136
Task 2 Rough Dr.	024	Task 2 Rough Draft - Team 2 Contribution to P2 RD	50	0	04-09-92	04-09-92	
ST211-SNL Meth.	025	Evaluate SNL scenario methodology	45	20	11-25-91	12-20-91	384
Doc. SNL Eval.	026	Document evaluation of SNL scenario methodology	50	10	12-20-91	01-06-92	172
Restart Task 3	027	Initiate Restructure Task 3 - Flow and Transport	50	0	10-01-91	10-01-91	
Restart Meeting	028	Meeting to discuss completion of Task 3	75	3h	10-04-91	10-04-91	30
Dev. Liquid Mod.	029	Develop model for groundwater flow and transport	70	100	11-12-91	02-18-92	1515
Liquid F&T Mod.	030	Developed flow and transport model for liquid phase	50	0	02-18-92	02-18-92	
Write GW F&T WD	031	Write up model for groundwater flow and transport	70	10	02-19-92	03-02-92	142
Task 3 Wrkg. Dr.	032	Working Draft for Task 3	50	0	03-02-92	03-02-92	
Rev.&Mod. T3 WD	033	Review and modify Task 3 Working Draft into Rough Dr.	70	10	03-03-92	03-16-92	540
Task3 Rough Drft	034	Task 3 Contribution to Phase 2 IPA Rough Draft	50	0	03-16-92	03-16-92	
Dev. Gas Module	035	Develop module for gas transport of radionuclides>>C-14	70	30	10-04-91	11-12-91	320
Gas F&T Mod.	036	Computer module to calculate gas transport of radionucld	50	0	11-12-91	11-12-91	
Write Gas F&T WD	037	Write up gaseous radionuclide flow and transport model	50	10	01-08-92	01-22-92	104
ST321-Precip.	038	Auxiliary analysis for infiltration from precipitation	40	5	10-04-91	10-10-91	36
Document ST321	039	Document the auxiliary analysis on precipitation	40	10	10-10-91	10-24-91	72
ST322-KD Approx.	040	Evaluate how well KD's estimate radionuclide transport	40	10	10-04-91	10-18-91	72
Document ST322	041	Document auxiliary analysis evaluating KD's	40	5	10-18-91	10-24-91	36
ST323-SNL Codes	042	Partial evaluation of SNL tuff flow and transport codes	40	10	10-18-91	10-25-91	100
Document ST323	043	Document auxiliary analysis of SNL tuff code evaluation	40	10	10-25-91	12-06-91	120
ST324-2D Unsat.	044	Auxiliary analysis of 2D parially saturated flow at YM	40	10	10-04-91	10-18-91	72
Document ST324	045	Document auxiliary analysis of 2D parially sat. flow	40	10	10-18-91	10-31-91	72
ST325-3D Unsat.	046	Auxiliary analysis of 3D parially saturated flow at YM	40	10	10-04-91	10-18-91	72
Document ST325	047	Document auxiliary analysis of 3D unsaturated flow at YM	40	10	10-18-91	10-31-91	72
ST326-Therm. Air	048	Scoping, literature survey of gas flow at Yucca Mt.	40	10	12-24-91	01-08-92	74
Document ST326	049	Document auxiliary analysis of therm. & barom. gas flow	40	10	01-22-92	02-04-92	72
Restart Task 4	050	Initiate Restructured Task 4 - Source Term	50	0	10-01-91	10-01-91	
WP Failure Model	051	Develop waste package failure model	60	40	10-08-91	11-05-91	440
WP Flr. Module	052	Computer module to estimate waste package failure	50	0	11-05-91	11-05-91	
Integrt. Modules	053	Integrate the component source term modules	60	10	01-31-92	02-13-92	80
ST Module	054	Complete source term computational module	50	0	02-13-92	02-13-92	
Write Task 4 WD	055	Write Task 4, Source Term, Working Draft	60	20	02-13-92	03-12-92	509

Heading/Task	Task ID	Task Description	Pr	Dur	Schd Start	Schd Finish	Total Hours
Task4 Wrkng. Dr.	056	Completed Working Draft for Task 4	50	0	03-12-92	03-12-92	
Rev.&Mod. T4 WD	057	Review and Modify Task 4 Working Draft into Rough Draft	60	10	03-12-92	03-26-92	216
Task4 Rough Dr.	058	Task 4 Rough Draft - contribution to Phase 2 Rough Draft	55	0	03-26-92	03-26-92	
WF Dissol. Model	059	Develop model for waste form dissolution	60	40	12-06-91	01-31-92	807
WF Dissl. Module	060	Completed Waste Form Dissolution Module	50	0	01-31-92	01-31-92	
ST Transport Mdl	061	Develop model for transport of radionuclides from source	60	40	11-06-91	12-05-91	400
ST Trnpt. Module	062	Completed module to calculate transport from source	50	0	12-05-91	12-05-91	
Restart Task 5	063	Initiate Restructured Task 5 - Disruptive Consequences	50	0	10-01-91	10-01-91	
Volcanism Model	064	Develop models to describe consequences of volcanism	55	80	10-01-91	01-21-92	1400
Volcanism Module	065	Completed computational module for volcanism consequence	55	0	01-21-92	01-21-92	
Write Task 5 WD	066	Write Task 5 Working Draft	45	10	04-14-92	05-01-92	187
Task 5 Wrkg. Dr.	067	Task 5 Working Draft	45	0	05-01-92	05-01-92	
Rev.&Mod. T5 WD	068	Review and modify Task 5 Working Draft into Rough Draft	45	10	05-01-92	05-15-92	192
Task 5 Rough Dr.	069	Task 5 Rough Draft	45	0	05-15-92	05-15-92	
Restart Task 6	070	Initiate Restructured Task 6 - Sensitivity & Uncertainty	50	0	10-01-91	10-01-91	
Write Meth. Sect	071	Write part of Task 6 Wrkng Dr. describing methods for SU	50	20	02-12-92	04-13-92	160
Prepare Methods	072	Prepare sensitivity and uncertainty analysis methods	50	20	01-07-92	02-12-92	158
Perform S&U Anal	073	Perform sensitivity & uncertainty analysis on prod. runs	50	10	04-21-92	05-04-92	184
Complete S&U An.	074	Completed sens. & uncert. analysis on Phase 2 output	50	0	05-04-92	05-04-92	
Write Task 6 WD	075	Write Task 6 Working Draft, including sens. & uncert.	50	10	05-04-92	05-18-92	152
Task 6 Wrkg. Dr.	076	Completed Task 6 Working Draft	50	0	05-18-92	05-18-92	
Rev.&Mod. T6 WD	077	Review and modify Task 6 Working Draft	50	10	05-18-92	06-02-92	152
Task 6 Rough Dr.	078	Task 6 Contribution to Phase 2 Rough Draft	50	0	06-02-92	06-02-92	
Assemble Tot. RD	079	Assemble Complete Rough Draft	50	1	06-02-92	06-03-92	35
Rev.&Mod. Tot.RD	080	Review and Modify Total Rough Draft	50	10	06-04-92	06-17-92	620
Issue First Dr.	081	Issue First Draft of Phase 2 Report to Management	50	5	06-18-92	06-24-92	120
P2 First Draft	082	Phase 2 First Draft	50	0	06-24-92	06-24-92	
Task 2 Wrkg. Dr.	084	Completed Task 2 Working Draft	50	0	03-27-92	03-27-92	
C-14 Analysis	085	Geochemical analysis of C-14 transport	50	5	12-02-91	01-15-92	68
Document C-14	086	Document the C-14 Analysis	50	5	01-15-92	01-22-92	68
Regional Flow	087	2-D planar regional, saturated flow model	50	5	10-04-91	10-11-91	40
Doc. Reg. Flow	088	Document regional, saturated flow model	50	5	10-11-91	10-21-91	40
Restart Coord.	089	Initiate Restructured Task 0 - Coordination	50	0	10-01-91	10-01-91	
Coordination	090	IPA Phase 2 Coordination	48	131	11-21-91	06-01-92	1772
WP Env.Cond.Mdl.	094	Develop model for repository environment (Th., Ch., Hy.)	60	40	10-01-91	11-29-91	300
WP E.Cnd. Module	095	Computer module to calculate repository environment	50	0	11-29-91	11-29-91	
							======
							14866

APPENDIX D

TASK DETAIL REPORT

Appendix D
Task Detail Report

The Task Detail Report contains all the information contained in the Task Summary Report; that is, for each task the following is given:

Column	Heading	Meaning
1	Heading/Task	task name, same as on PERT chart
2	Task ID	task number, same as on PERT chart
3	Task Description	a short description of the task or milestone
4	Pr	priority, higher numbers indicate a higher priority task
5	Dur	task duration in days, same as on PERT chart
6	Schd Start	scheduled start date
7	Schd Finish	scheduled finish date
8	Total Hours	total number of person-hours required to complete this task; this is resource time, not elapsed time

In addition, however, the Task Detail Report also lists each person assigned to the task, the scheduled start and scheduled finish dates for that person's contribution to the task, and the total hours scheduled for that person to spend on that task. It is this detailed breakdown of time commitments to various tasks that should allow individual participants in the Phase 2 IPA and their managers knowledgably to schedule their activities.

Task Name / Resource Name	Task ID	Task Description	Pr	Dur	Schd Start	Schd Finish	Total Hours
Restart Task 1	001	Initiate restructured Task 1 = System Code	50	0	10-01-91	10-01-91	
Sagar	001		50	0	10-01-91	10-01-91	

							0
Dev. Dose Module	002	Develop computational module to calculate doses	50	30	10-03-91	11-07-91	
Neel	002		50	30	10-03-91	11-07-91	200
Sagar	002		50	30	10-03-91	10-04-91	12
Janetzke	002		50	30	10-03-91	11-06-91	48

							260
Task 1 Rough Dr.	003	Task 1 - System Code. Rough Draft input to Final Rept.	50	0	05-14-92	05-14-92	
Sagar	003		50	0	05-14-92	05-14-92	

							0
Rev.&Mod. T1 WD	004	Revise and Modify Task 1 Working Draft	50	10	05-06-92	05-14-92	
Sagar	004		50	10	05-06-92	05-11-92	20
Neel	004		50	10	05-06-92	05-14-92	50
Janetzke	004		50	10	05-06-92	05-13-92	40

							110
Task 1 Wrkg. Dr.	005	Task 1 Working Draft for revision into Rough Draft	50	0	05-06-92	05-06-92	
Sagar	005		50	0	05-06-92	05-06-92	

							0
Write Task1 WD	006	Write Task 1 Working Draft	50	10	04-28-92	05-06-92	
Janetzke	006		50	10	04-28-92	05-05-92	40
Neel	006		50	10	04-28-92	05-06-92	50
Sagar	006		50	10	04-28-92	05-04-92	30

							120
Prod. Run Output	007	Computer output from production runs of system code	50	0	04-21-92	04-21-92	
Sagar	007		50	0	04-21-92	04-21-92	

							0
Production Runs	008	Production runs of system code for Phase 2 scenarios	50	5	04-15-92	04-21-92	
Sagar	008		50	5	04-15-92	04-21-92	20
Janetzke	008		50	5	04-15-92	04-21-92	32
McCartin	008		50	5	04-15-92	04-21-92	30
Codell	008		50	5	04-15-92	04-21-92	32
Eisenberg	008		50	5	04-15-92	04-21-92	32
Manaktela	008		50	5	04-15-92	04-21-92	32
Margulies	008		50	5	04-15-92	04-21-92	32

							210
Trial Runs	009	Trial runs of system code with all modules	55	30	02-28-92	04-08-92	
Eisenberg	009		55	30	02-28-92	03-10-92	60
Codell	009		55	30	02-28-92	03-02-92	12

Task Name / Resource Name	Task ID	Task Description	Pr	Dur	Schd Start	Schd Finish	Total Hours
McCartin	009		55	30	02-28-92	03-02-92	12
Margulies	009		55	30	02-28-92	03-23-92	126
Gureghian	009		55	30	02-28-92	03-11-92	68
Neel	009		55	30	02-28-92	03-06-92	40
Sagar	009		55	30	02-28-92	03-10-92	60
Manaktela	009		55	30	02-28-92	02-28-92	4
Manaktela	009		55	30	03-02-92	03-02-92	4
McCartin	009		55	30	03-13-92	04-08-92	148
Codell	009		55	30	03-06-92	03-11-92	26
Manaktela	009		55	30	03-03-92	03-03-92	4
Manaktela	009		55	30	03-04-92	03-04-92	4
Manaktela	009		55	30	03-05-92	03-05-92	4
Manaktela	009		55	30	03-06-92	03-06-92	4
Manaktela	009		55	30	03-09-92	03-09-92	4
Manaktela	009		55	30	03-10-92	03-10-92	4
Manaktela	009		55	30	03-11-92	03-11-92	4
Manaktela	009		55	30	03-19-92	03-26-92	44
Gureghian	009		55	30	03-19-92	03-20-92	7
Codell	009		55	30	03-17-92	03-31-92	82

							721
Dev. LHS Strtgy	010	Determine variables and their distributions for LHS	50	10	04-08-92	04-15-92	
Codell	010		50	10	04-08-92	04-15-92	40
Sagar	010		50	10	04-08-92	04-10-92	16
McCartin	010		50	10	04-08-92	04-10-92	16
Manaktela	010		50	10	04-08-92	04-14-92	30
Eisenberg	010		50	10	04-08-92	04-10-92	16
Margulies	010		50	10	04-08-92	04-14-92	30

							148
All Modules Del.	011	All computational consequence modules delivered	50	0	02-18-92	02-18-92	
Eisenberg	011		50	0	02-18-92	02-18-92	

							0
Coord. Mod. Dev.	012	Coordinate consequence module development w/other tasks	50	10	11-14-91	11-20-91	
Sagar	012		50	10	11-14-91	11-20-91	40
Eisenberg	012		50	10	11-14-91	11-18-91	20

							60
Dose Module	013	Computational module for individual & population dose	50	0	11-07-91	11-07-91	
Neel	013		50	0	11-07-91	11-07-91	

							0
Mod. Sys. Code	014	Modify System Code and Documentation for it	50	10	10-16-91	10-29-91	
Janetzke	014		50	10	10-16-91	10-29-91	40
Sagar	014		50	10	10-16-91	10-18-91	20

							60
Contr. to WD	015	Description of modifications to system code	50	0	10-29-91	10-29-91	

Task Name / Resource Name	Task ID	Task Description	Pr	Dur	Schd Start	Schd Finish	Total Hours
Sagar	015		50	0	10-29-91	10-29-91	
							0
Restart Task 2	016	Initiate Restructured Task 2 - Scenario Analysis	50	0	10-01-91	10-01-91	
Eisenberg	016		50	0	10-01-91	10-01-91	
							0
ST212-Imp. Meth.	017	Develop an improved scenario analysis method	45	20	11-07-91	02-10-92	
Trapp	017		45	20	11-07-91	11-14-91	40
Ibrahim	017		45	20	11-07-91	11-27-91	84
Eisenberg	017		45	20	11-07-91	11-13-91	32
Eisenberg	017		45	20	11-18-91	11-20-91	20
Eisenberg	017		45	20	02-05-92	02-10-92	28
							204
Doc. Imp. Scen.	018	Document improved scenario method	50	10	02-10-92	02-24-92	
P. Brooks	018		50	10	02-10-92	02-12-92	20
Ibrahim	018		50	10	02-10-92	02-12-92	20
Eisenberg	018		50	10	02-10-92	02-20-92	54
Park	018		50	10	02-10-92	02-24-92	72
							166
Choose Method	019	Select one scenario analysis method from alts. for anal.	50	2	02-24-92	02-26-92	
P. Brooks	019		50	2	02-24-92	02-26-92	14
Trapp	019		50	2	02-24-92	02-25-92	8
Ibrahim	019		50	2	02-24-92	02-25-92	12
Eisenberg	019		50	2	02-24-92	02-25-92	10
Park	019		50	2	02-24-92	02-26-92	14
							58
Use Chosen Meth.	020	Use scenario analysis method to define scenarios & probs	50	10	02-26-92	03-16-92	
Park	020		50	10	02-26-92	03-10-92	72
Trapp	020		50	10	02-26-92	03-03-92	36
P. Brooks	020		50	10	02-26-92	03-10-92	72
Ibrahim	020		50	10	02-26-92	03-10-92	72
Eisenberg	020		50	10	02-26-92	02-27-92	14
Eisenberg	020		50	10	03-11-92	03-16-92	26
							292
System Code Prob	021	Probabilities of scenarios for use in Phase 2 analysis	50	0	03-16-92	03-16-92	
Eisenberg	021		50	0	03-16-92	03-16-92	
							0
Write Task 2 WD	022	Write Task 2 Working Draft - Team 2 Activities & Results	50	10	03-16-92	03-27-92	
Eisenberg	022		50	10	03-16-92	03-27-92	72
Park	022		50	10	03-16-92	03-27-92	72
							144

Task Name / Resource Name	Task ID	Task Description	Pr	Dur	Schd Start	Schd Finish	Total Hours
Rv. & Mod. T2 WD	023	Review and Modify Task 2 Working Draft to Task 2 RD	50	10	03-27-92	04-09-92	
Park	023		50	10	03-27-92	04-09-92	72
Eisenberg	023		50	10	03-27-92	04-08-92	64

							136
Task 2 Rough Dr.	024	Task 2 Rough Draft - Team 2 Contribution to P2 RD	50	0	04-09-92	04-09-92	
Eisenberg	024		50	0	04-09-92	04-09-92	

							0
ST211-SNL Meth.	025	Evaluate SNL scenario methodology	45	20	11-25-91	12-20-91	
Trapp	025		45	20	11-25-91	12-03-91	40
Ibrahim	025		45	20	11-25-91	11-25-91	2
P. Brooks	025		45	20	11-25-91	12-17-91	120
Park	025		45	20	11-25-91	12-20-91	144
Ibrahim	025		45	20	11-26-91	11-26-91	2
Ibrahim	025		45	20	11-27-91	12-12-91	76

							384
Doc. SNL Eval.	026	Document evaluation of SNL scenario methodology	50	10	12-20-91	01-06-92	
Park	026		50	10	12-20-91	01-06-92	72
Trapp	026		50	10	12-20-91	12-23-91	8
Ibrahim	026		50	10	12-20-91	12-26-91	20
P. Brooks	026		50	10	12-20-91	01-06-92	72

							172
Restart Task 3	027	Initiate Restructure Task 3 - Flow and Transport	50	0	10-01-91	10-01-91	
McCartin	027		50	0	10-01-91	10-01-91	

							0
Restart Meeting	028	Meeting to discuss completion of Task 3	75	3h	10-04-91	10-04-91	
McCartin	028		75	3h	10-04-91	10-04-91	3
Ford	028		75	3h	10-04-91	10-04-91	3
Codell	028		75	3h	10-04-91	10-04-91	3
Nicholson	028		75	3h	10-04-91	10-04-91	3
Sagar	028		75	3h	10-04-91	10-04-91	3
Gureghian	028		75	3h	10-04-91	10-04-91	3
Wescott	028		75	3h	10-04-91	10-04-91	3
Pohle	028		75	3h	10-04-91	10-04-91	3
Bradbury	028		75	3h	10-04-91	10-04-91	3
Chery	028		75	3h	10-04-91	10-04-91	3

							30
Dev. Liquid Mod.	029	Develop model for groundwater flow and transport	70	100	11-12-91	02-18-92	
McCartin	029		70	100	11-12-91	01-30-92	429
Nicholson	029		70	100	11-12-91	11-26-91	80
Pohle	029		70	100	11-12-91	12-03-91	113
Bradbury	029		70	100	11-12-91	12-04-91	120
Chery	029		70	100	11-12-91	11-27-91	89
Wescott	029		70	100	11-12-91	12-11-91	159

Task Name / Resource Name	Task ID	Task Description	Pr	Dur	Schd Start	Schd Finish	Total Hours
Ford	029		70	100	11-12-91	02-18-92	525
							1515
Liquid F&T Mod.	030	Developed flow and transport model for liquid phase	50	0	02-18-92	02-18-92	
McCartin	030		50	0	02-18-92	02-18-92	
							0
Write GW F&T WD	031	Write up model for groundwater flow and transport	70	10	02-19-92	03-02-92	
Ford	031		70	10	02-19-92	03-02-92	72
McCartin	031		70	10	02-19-92	02-27-92	50
Wescott	031		70	10	02-19-92	02-21-92	20
							142
Task 3 Wrkg. Dr.	032	Working Draft for Task 3	50	0	03-02-92	03-02-92	
McCartin	032		50	0	03-02-92	03-02-92	
							0
Rev.&Mod. T3 WD	033	Review and modify Task 3 Working Draft into Rough Dr.	70	10	03-03-92	03-16-92	
Murphy	033		70	10	03-03-92	03-05-92	24
Ford	033		70	10	03-03-92	03-16-92	80
Nicholson	033		70	10	03-03-92	03-16-92	30
Wescott	033		70	10	03-03-92	03-16-92	80
Pohle	033		70	10	03-03-92	03-16-92	80
Bradbury	033		70	10	03-03-92	03-16-92	80
Chery	033		70	10	03-03-92	03-13-92	72
Codell	033		70	10	03-03-92	03-06-92	30
McCartin	033		70	10	03-03-92	03-12-92	64
							540
Task3 Rough Drft	034	Task 3 Contribution to Phase 2 IPA Rough Draft	50	0	03-16-92	03-16-92	
McCartin	034		50	0	03-16-92	03-16-92	
							0
Dev. Gas Module	035	Develop module for gas transport of radionuclides>>C-14	70	30	10-04-91	11-12-91	
Wescott	035		70	30	10-04-91	11-12-91	200
Codell	035		70	30	10-04-91	10-28-91	120
							320
Gas F&T Mod.	036	Computer module to calculate gas transport of radionucld	50	0	11-12-91	11-12-91	
Wescott	036		50	0	11-12-91	11-12-91	
							0
Write Gas F&T WD	037	Write up gaseous radionuclide flow and transport model	50	10	01-08-92	01-22-92	
Wescott	037		50	10	01-08-92	01-22-92	72
Codell	037		50	10	01-08-92	01-14-92	32
							104

Task Name / Resource Name	Task ID	Task Description	Pr	Dur	Schd Start	Schd Finish	Total Hours
ST321-Precip.	038	Auxiliary analysis for infiltration from precipitation	40	5	10-04-91	10-10-91	
Chery	038		40	5	10-04-91	10-10-91	36

							36
Document ST321	039	Document the auxiliary analysis on precipitation	40	10	10-10-91	10-24-91	
Chery	039		40	10	10-10-91	10-24-91	72

							72
ST322-KD Approx.	040	Evaluate how well KD's estimate radionuclide transport	40	10	10-04-91	10-18-91	
Bradbury	040		40	10	10-04-91	10-18-91	72

							72
Document ST322	041	Document auxiliary analysis evaluating KD's	40	5	10-18-91	10-24-91	
Bradbury	041		40	5	10-18-91	10-24-91	36

							36
ST323-SNL Codes	042	Partial evaluation of SNL tuff flow and transport codes	40	10	10-18-91	10-25-91	
Gureghian	042		40	10	10-18-91	10-25-91	40
Sagar	042		40	10	10-18-91	10-25-91	40
McCartin	042		40	10	10-18-91	10-23-91	20

							100
Document ST323	043	Document auxiliary analysis of SNL tuff code evaluation	40	10	10-25-91	12-06-91	
Sagar	043		40	10	10-25-91	10-30-91	20
McCartin	043		40	10	10-25-91	11-01-91	40
Gureghian	043		40	10	10-25-91	11-05-91	58
Gureghian	043		40	10	12-06-91	12-06-91	2

							120
ST324-2D Unsat.	044	Auxiliary analysis of 2D parially saturated flow at YM	40	10	10-04-91	10-18-91	
Pohle	044		40	10	10-04-91	10-18-91	72

							72
Document ST324	045	Document auxiliary analysis of 2D parially sat. flow	40	10	10-18-91	10-31-91	
Pohle	045		40	10	10-18-91	10-31-91	72

							72
ST325-3D Unsat.	046	Auxiliary analysis of 3D parially saturated flow at YM	40	10	10-04-91	10-18-91	
Ababou	046		40	10	10-04-91	10-18-91	72

							72
Document ST325	047	Document auxiliary analysis of 3D unsaturated flow at YM	40	10	10-18-91	10-31-91	
Ababou	047		40	10	10-18-91	10-31-91	72

							72

Task Name / Resource Name	Task ID	Task Description	Pr	Dur	Schd Start	Schd Finish	Total Hours
ST326-Therm. Air	048	Scoping, literature survey of gas flow at Yucca Mt.	40	10	12-24-91	01-08-92	
Wescott	048		40	10	12-24-91	01-08-92	74

							74
Document ST326	049	Document auxiliary analysis of therm. & barom. gas flow	40	10	01-22-92	02-04-92	
Wescott	049		40	10	01-22-92	02-04-92	72

							72
Restart Task 4	050	Initiate Restructured Task 4 - Source Term	50	0	10-01-91	10-01-91	
Manaktela	050		50	0	10-01-91	10-01-91	

							0
WP Failure Model	051	Develop waste package failure model	60	40	10-08-91	11-05-91	
Chang	051		60	40	10-08-91	10-29-91	120
Nair	051		60	40	10-08-91	10-29-91	120
Sagar	051		60	40	10-08-91	10-15-91	40
Manaktela	051		60	40	10-08-91	11-05-91	160

							440
WP Flr. Module	052	Computer module to estimate waste package failure	50	0	11-05-91	11-05-91	
Chang	052		50	0	11-05-91	11-05-91	

							0
Integrt. Modules	053	Integrate the component source term modules	60	10	01-31-92	02-13-92	
Sagar	053		60	10	01-31-92	02-06-92	20
Janetzke	053		60	10	01-31-92	02-13-92	20
Gureghian	053		60	10	01-31-92	02-07-92	40

							80
ST Module	054	Complete source term computational module	50	0	02-13-92	02-13-92	
Write Task 4 WD	055	Write Task 4, Source Term, Working Draft	60	20	02-13-92	03-12-92	
Chang	055		60	20	02-13-92	03-06-92	120
Nair	055		60	20	02-13-92	02-27-92	40
Codell	055		60	20	02-13-92	02-28-92	80
Gureghian	055		60	20	02-13-92	02-28-92	80
Sagar	055		60	20	02-13-92	02-21-92	40
Manaktela	055		60	20	02-13-92	03-12-92	80
Bradbury	055		60	20	02-13-92	02-26-92	69

							509
Task4 Wrkng. Dr.	056	Completed Working Draft for Task 4	50	0	03-12-92	03-12-92	
Manaktela	056		50	0	03-12-92	03-12-92	

							0
Rev.&Mod. T4 WD	057	Review and Modify Task 4 Working Draft into Rough Draft	60	10	03-12-92	03-26-92	
Dancer	057		60	10	03-12-92	03-25-92	40
Chang	057		60	10	03-12-92	03-26-92	60

Task Name / Resource Name	Task ID	Task Description	Pr	Dur	Schd Start	Schd Finish	Total Hours
Gureghian	057		60	10	03-12-92	03-19-92	40
Codell	057		60	10	03-12-92	03-16-92	20
Sagar	057		60	10	03-12-92	03-16-92	16
Manaktela	057		60	10	03-12-92	03-19-92	40

							216
Task4 Rough Dr.	058	Task 4 Rough Draft - contribution to Phase 2 Rough Draft	55	0	03-26-92	03-26-92	
Manaktela	058		55	0	03-26-92	03-26-92	

							0
WF Dissol. Model	059	Develop model for waste form dissolution	60	40	12-06-91	01-31-92	
Manaktela	059		60	40	12-06-91	01-06-92	160
Codell	059		60	40	12-06-91	01-07-92	167
Bradbury	059		60	40	12-06-91	01-31-92	300
Janetzke	059		60	40	12-06-91	12-11-91	32
Murphy	059		60	40	12-06-91	12-26-91	108
Sagar	059		60	40	12-06-91	12-12-91	40

							807
WF Dissl. Module	060	Completed Waste Form Dissolution Module	50	0	01-31-92	01-31-92	
Manaktela	060		50	0	01-31-92	01-31-92	

							0
ST Transport Mdl	061	Develop model for transport of radionuclides from source	60	40	11-06-91	12-05-91	
Sagar	061		60	40	11-06-91	11-13-91	40
Manaktela	061		60	40	11-06-91	12-05-91	160
Chang	061		60	40	11-06-91	11-13-91	40
Gureghian	061		60	40	11-06-91	12-05-91	160

							400
ST Trnpt. Module	062	Completed module to calculate transport from source	50	0	12-05-91	12-05-91	
Sagar	062		50	0	12-05-91	12-05-91	

							0
Restart Task 5	063	Initiate Restructured Task 5 - Disruptive Consequences	50	0	10-01-91	10-01-91	
Margulies	063		50	0	10-01-91	10-01-91	

							0
Volcanism Model	064	Develop models to describe consequences of volcanism	55	80	10-01-91	01-21-92	
Margulies	064		55	80	10-01-91	01-21-92	600
Park	064		55	80	10-01-91	11-25-91	300
Trapp	064		55	80	10-01-91	11-06-91	208
Kovach	064		55	80	10-01-91	10-07-91	40
Eisenberg	064		55	80	10-01-91	11-05-91	200
Ibrahim	064		55	80	10-01-91	10-09-91	52

							1400

Task Name / Resource Name	Task ID	Task Description	Pr	Dur	Schd Start	Schd Finish	Total Hours
Volcanism Module	065	Completed computational module for volcanism consequence	55	0	01-21-92	01-21-92	
Margulies	065		55	0	01-21-92	01-21-92	

							0
Write Task 5 WD	066	Write Task 5 Working Draft	45	10	04-14-92	05-01-92	
Park	066		45	10	04-14-92	04-22-92	51
Eisenberg	066		45	10	04-14-92	04-14-92	6
Margulies	066		45	10	04-14-92	04-14-92	6
Eisenberg	066		45	10	04-21-92	04-30-92	58
Margulies	066		45	10	04-21-92	05-01-92	66

							187
Task 5 Wrkg. Dr.	067	Task 5 Working Draft	45	0	05-01-92	05-01-92	
Margulies	067		45	0	05-01-92	05-01-92	

							0
Rev.&Mod. T5 WD	068	Review and modify Task 5 Working Draft into Rough Draft	45	10	05-01-92	05-15-92	
Eisenberg	068		45	10	05-01-92	05-08-92	40
Margulies	068		45	10	05-01-92	05-15-92	80
Park	068		45	10	05-01-92	05-14-92	72

							192
Task 5 Rough Dr.	069	Task 5 Rough Draft	45	0	05-15-92	05-15-92	
Margulies	069		45	0	05-15-92	05-15-92	

							0
Restart Task 6	070	Initiate Restructured Task 6 - Sensitivity & Uncertainty	50	0	10-01-91	10-01-91	
Codell	070		50	0	10-01-91	10-01-91	

							0
Write Meth. Sect	071	Write part of Task 6 Wrkng Dr. describing methods for SU	50	20	02-12-92	04-13-92	
Codell	071		50	20	03-31-92	04-01-92	13
Codell	071		50	20	02-12-92	02-12-92	7
Gureghian	071		50	20	02-12-92	02-12-92	7
Gureghian	071		50	20	03-20-92	04-13-92	133

							160
Prepare Methods	072	Prepare sensitivity and uncertainty analysis methods	50	20	01-07-92	02-12-92	
Codell	072		50	20	01-07-92	01-08-92	8
Gureghian	072		50	20	01-07-92	01-30-92	129
Gureghian	072		50	20	02-07-92	02-12-92	21

							158
Perform S&U Anal	073	Perform sensitivity & uncertainty analysis on prod. runs	50	10	04-21-92	05-04-92	
Gureghian	073		50	10	04-21-92	05-04-92	72
Codell	073		50	10	04-21-92	05-04-92	72
Janetzke	073		50	10	04-21-92	04-28-92	40

Task Name / Resource Name	Task ID	Task Description	Pr	Dur	Schd Start	Schd Finish	Total Hours
							---
							184
Complete S&U An.	074	Completed sens. & uncert. analysis on Phase 2 output	50	0	05-04-92	05-04-92	
Codell	074		50	0	05-04-92	05-04-92	

							0
Write Task 6 WD	075	Write Task 6 Working Draft, including sens. & uncert.	50	10	05-04-92	05-18-92	
Codell	075		50	10	05-04-92	05-15-92	72
Gureghian	075		50	10	05-04-92	05-18-92	80

							152
Task 6 Wrkg. Dr.	076	Completed Task 6 Working Draft	50	0	05-18-92	05-18-92	
Codell	076		50	0	05-18-92	05-18-92	

							0
Rev.&Mod. T6 WD	077	Review and modify Task 6 Working Draft	50	10	05-18-92	06-02-92	
Codell	077		50	10	05-18-92	06-01-92	72
Gureghian	077		50	10	05-18-92	06-02-92	80

							152
Task 6 Rough Dr.	078	Task 6 Contribution to Phase 2 Rough Draft	50	0	06-02-92	06-02-92	
Codell	078		50	0	06-02-92	06-02-92	

							0
Assemble Tot. RD	079	Assemble Complete Rough Draft	50	1	06-02-92	06-03-92	
Delligatti	079		50	1	06-03-92	06-03-92	8
Park	079		50	1	06-02-92	06-03-92	7
Garcia	079		50	1	06-02-92	06-03-92	8
Jensen	079		50	1	06-02-92	06-03-92	8
Delligatti	079		50	1	06-02-92	06-02-92	4

							35
Rev.&Mod. Tot.RD	080	Review and Modify Total Rough Draft	50	10	06-04-92	06-17-92	
Eisenberg	080		50	10	06-04-92	06-16-92	72
Sagar	080		50	10	06-04-92	06-16-92	60
McCartin	080		50	10	06-04-92	06-16-92	72
Manaktela	080		50	10	06-04-92	06-16-92	72
Margulies	080		50	10	06-04-92	06-17-92	80
Codell	080		50	10	06-04-92	06-16-92	72
Park	080		50	10	06-04-92	06-16-92	72
Garcia	080		50	10	06-04-92	06-17-92	80
Delligatti	080		50	10	06-04-92	06-17-92	40

							620
Issue First Dr.	081	Issue First Draft of Phase 2 Report to Management	50	5	06-18-92	06-24-92	
Delligatti	081		50	5	06-18-92	06-24-92	40
Jensen	081		50	5	06-18-92	06-24-92	40

Task Name / Resource Name	Task ID	Task Description	Pr	Dur	Schd Start	Schd Finish	Total Hours
Garcia	081		50	5	06-18-92	06-24-92	40
							120
P2 First Draft	082	Phase 2 First Draft	50	0	06-24-92	06-24-92	
Task 2 Wrkg. Dr.	084	Completed Task 2 Working Draft	50	0	03-27-92	03-27-92	
Eisenberg	084		50	0	03-27-92	03-27-92	
							0
C-14 Analysis	085	Geochemical analysis of C-14 transport	50	5	12-02-91	01-15-92	
Codell	085		50	5	01-14-92	01-15-92	3
Codell	085		50	5	12-02-91	12-05-91	29
Murphy	085		50	5	12-02-91	12-05-91	29
Murphy	085		50	5	12-26-91	12-27-91	7
							68
Document C-14	086	Document the C-14 Analysis	50	5	01-15-92	01-22-92	
Murphy	086		50	5	01-15-92	01-22-92	36
Codell	086		50	5	01-15-92	01-22-92	32
							68
Regional Flow	087	2-D planar regional, saturated flow model	50	5	10-04-91	10-11-91	
Ahola	087		50	5	10-04-91	10-11-91	40
							40
Doc. Reg. Flow	088	Document regional, saturated flow model	50	5	10-11-91	10-21-91	
Ahola	088		50	5	10-11-91	10-21-91	40
							40
Restart Coord.	089	Initiate Restructured Task 0 - Coordination	50	0	10-01-91	10-01-91	
Eisenberg	089		50	0	10-01-91	10-01-91	
							0
Coordination	090	IPA Phase 2 Coordination	48	131	11-21-91	06-01-92	
Delligatti	090		48	131	11-21-91	06-01-92	420
D. Brooks	090		48	131	11-21-91	03-02-92	136
Justus	090		48	131	11-21-91	03-02-92	136
Weller	090		48	131	11-21-91	03-02-92	136
Coplan	090		48	131	11-21-91	04-02-92	272
Eisenberg	090		48	131	11-21-91	02-04-92	400
Sagar	090		48	131	11-21-91	12-05-91	20
McCartin	090		48	131	01-31-92	02-18-92	96
McCartin	090		48	131	04-10-92	04-15-92	8
Sagar	090		48	131	12-13-91	02-13-92	84
Sagar	090		48	131	02-21-92	02-28-92	12
McCartin	090		48	131	04-10-92	04-10-92	2
Sagar	090		48	131	03-11-92	03-12-92	4
Sagar	090		48	131	03-16-92	03-25-92	16
McCartin	090		48	131	04-13-92	04-13-92	6

Task Name / Resource Name	Task ID	Task Description	Pr	Dur	Schd Start	Schd Finish	Total Hours
McCartin	090		48	131	04-14-92	04-14-92	6
McCartin	090		48	131	04-21-92	04-22-92	6
McCartin	090		48	131	04-21-92	04-28-92	12

							1772
WP Env.Cond.Mdl.	094	Develop model for repository environment (Th., Ch., Hy.)	60	40	10-01-91	11-29-91	
Dancer	094		60	40	10-01-91	10-10-91	60
Manaktela	094		60	40	10-01-91	10-07-91	40
Codell	094		60	40	10-01-91	10-03-91	24
Codell	094		60	40	10-28-91	11-29-91	176

							300
WP E.Cnd. Module	095	Computer module to calculate repository environment	50	0	11-29-91	11-29-91	
Codell	095		50	0	11-29-91	11-29-91	

							0
							======
							14866

APPENDIX E

GANTT CHART FOR IPA PHASE 2 TASKS
(OCTOBER 1991 TO JUNE 1992)

Appendix E

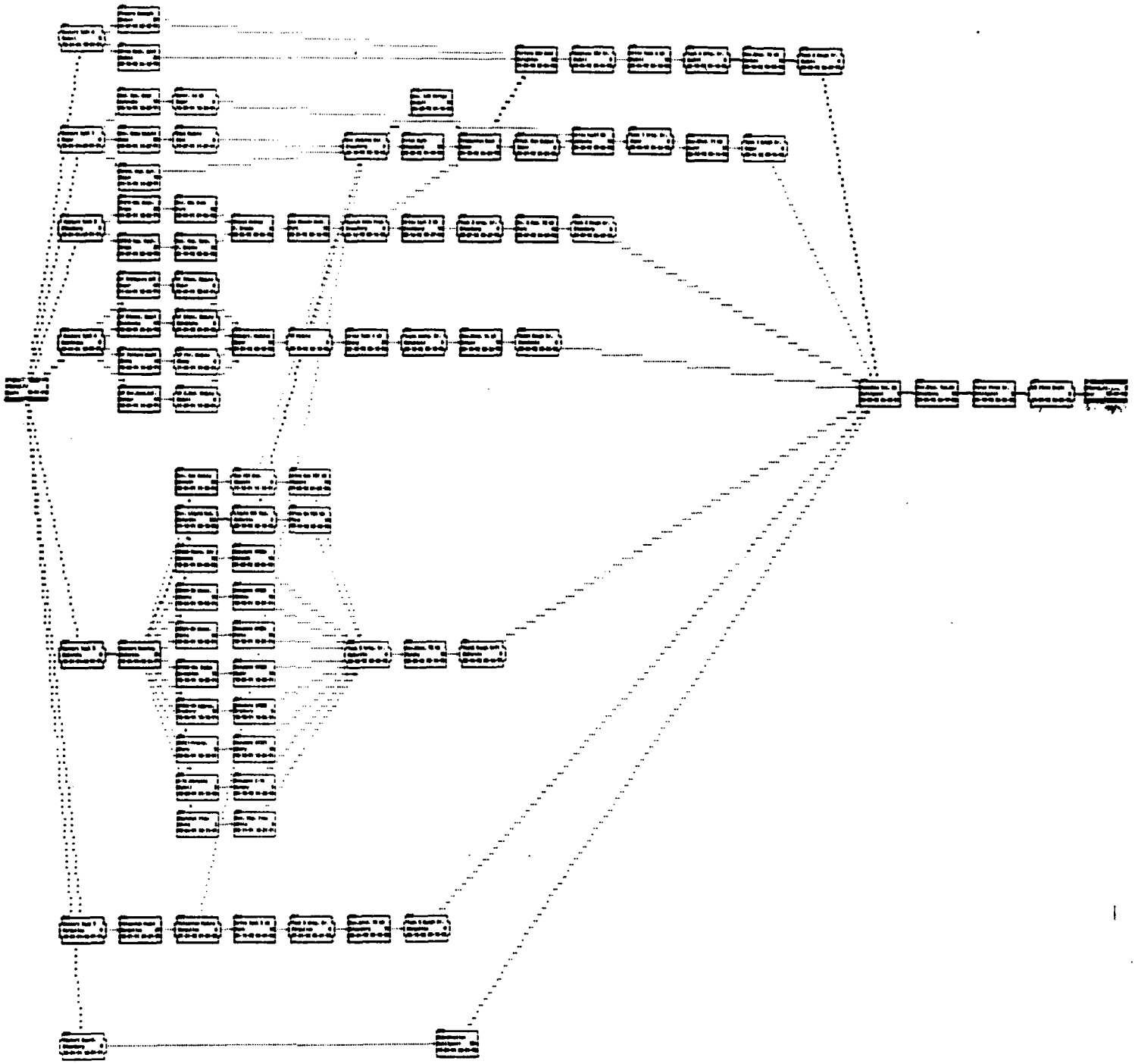
Gantt Chart

The Gantt Chart represents information about the 95 tasks for the Phase 2 IPA in a graphical format. The non-graphical part of the Gantt Chart list in columnar form the following information:

Column	Heading	Meaning
1	Heading/Task	task name, same as on PERT chart
2	Task ID	task number, same as on PERT chart
3	Pr	priority, higher numbers indicate a higher priority task
4	Dur	task duration in days, same as on PERT chart
5	Schd Start	scheduled start date
6	Schd Finish	scheduled finish date
7	Total Hours	total number of person-hours required to complete this task; this is resource time, not elapsed time
8	Task Description	a short description of the task or milestone

Following this tabular information the Gantt Chart graphically represents on a time line for each task: the scheduled start, scheduled finish, and duration. In addition, special symbols are used to denote tasks on the critical path, and to indicate, as appropriate, the float, free float, and milestones for tasks. Since this information is presented for each task, the Gantt Chart provides a convenient way to represent and compare the schedule for various tasks and how they might overlap in time.

Phase 2 Iterative Performance Assessment



Phase 2 Iterative Performance Assessment

6 Days Per Symbol Heading/Task	Task ID	Pr	Dur	Schd Start	Schd Finish	Total Hours	Task Description
P2IPA3.PJ	P1		164	10-01-91<	06-26-92	14666	Phase 2 Iterative Performance Assessment
aRestart Task 1	001	30	0	10-01-91<	10-01-91	0	Initiate restructured Task 1 = System Code
aDev. Dose Module	002	30	30	10-03-91	11-07-91	262	Develop computational module to calculate doses
aTask 1 Rough Dr.	003	30	0	05-14-92	05-14-92	0	Task 1 - System Code. Rough Draft Input to Final Rept.
aRev.&Mod. T1 WD	004	30	10	05-06-92	05-14-92	110	Review and Modify Task 1 Working Draft
aTask 1 Wrkg. Dr.	005	30	0	05-06-92	05-06-92	0	Task 1 Working Draft for revision into Rough Draft
aWrite Task1 WD	006	30	10	04-28-92	05-06-92	120	Write Task 1 Working Draft
aProd. Run Output	007	30	0	04-21-92	04-21-92	0	Computer output from production runs of system code
aProduction Runs	008	30	5	04-15-92	04-21-92	210	Production runs of system code for Phase 2 scenarios
aTrial Runs	009	35	30	02-28-92	04-08-92	721	Trial runs of system code with all modules
aDev. LHS Strtgy	010	30	10	04-08-92	04-15-92	148	Determine variables and their distributions for LHS
aAll Modules Del.	011	30	0	02-18-92	02-18-92	0	All computational consequence modules delivered
aCoord. Mod. Dev.	012	30	10	11-14-91	11-28-91	48	Coordinate consequence module development w/other tasks
aDose Module	013	30	0	11-07-91	11-07-91	0	Computational module for individual & population dose
aMod. Sys. Code	014	30	10	10-16-91	10-29-91	40	Modify System Code and Documentation for it
aContr. to WD	015	30	5	10-29-91	10-29-91	0	Description of modifications to system code
a Restart Task 2	016	30	0	10-01-91<	10-01-91	0	Initiate Restructured Task 2 - Scenario Analysis
aST212-Imp. Meth.	017	45	30	11-07-91	02-10-92	384	Develop an improved scenario analysis method
aDoc. Imp. Scen.	018	30	10	02-10-92	02-24-92	165	Document improved scenario method
aChoose Method	019	30	2	02-24-92	02-26-92	38	Select one scenario analysis method from alts. for anal.
aUse Chosen Meth.	020	30	10	02-26-92	03-16-92	282	Use scenario analysis method to define scenarios & probs
aSystem Code Prob	021	30	0	03-16-92	03-16-92	0	Probabilities of scenarios for use in Phase 2 analysis
aWrite Task 2 WD	022	30	10	03-16-92	03-27-92	144	Write Task 2 Working Draft - Team 2 Activities & Results
aRev. & Mod. T2 WD	023	30	10	03-27-92	04-09-92	136	Review and Modify Task 2 Working Draft to Task 2 RD
aTask 2 Rough Dr.	024	30	0	04-09-92	04-09-92	0	Task 2 Rough Draft - Team 2 Contribution to P2 RD
aST211-SNL Meth.	025	45	30	11-25-91	12-20-91	384	Evaluate SNL scenario methodology
aDoc. SNL Eval.	026	30	10	12-20-91	01-06-92	172	Document evaluation of SNL scenario methodology
aRestart Task 3	027	30	0	10-01-91<	10-01-91	0	Initiate Restructure Task 3 - Flow and Transport
aRestart Meeting	028	75	2h	10-04-91<	10-04-91	30	Meeting to discuss completion of Task 3
aDev. Liquid Mod.	029	70	100	11-12-91	02-18-92	1515	Develop model for groundwater flow and transport
aLiquid F&T Mod.	030	30	0	02-18-92	02-18-92	0	Developed flow and transport model for liquid phase
aWrite GW F&T WD	031	70	10	02-19-92	03-02-92	142	Write up model for groundwater flow and transport
aTask 3 Wrkg. Dr.	032	30	0	03-02-92	03-02-92	0	Working Draft for Task 3
aRev.&Mod. T3 WD	033	70	10	03-02-92	03-16-92	548	Review and modify Task 3 Working Draft into Rough Dr.
aTask3 Rough Drft	034	30	0	03-16-92	03-16-92	0	Task 3 Contribution to Phase 2 IPA Rough Draft
aDev. Gas Module	035	70	30	10-04-91	11-12-91	388	Develop module for gas transport of radionuclides-C-14
aGas F&T Mod.	036	30	0	11-12-91	11-12-91	0	Computer module to calculate gas transport of radionuclid
aWrite Gas F&T WD	037	30	10	01-08-92	01-22-92	184	Write up gaseous radionuclide flow and transport model
aST321-Precip.	038	40	5	10-04-91	10-10-91	36	Auxiliary analysis for infiltration from precipitation
aDocument ST321	039	40	10	10-10-91	10-24-91	72	Document the auxiliary analysis on precipitation
aST322-HD Approx.	040	40	10	10-04-91	10-18-91	72	Evaluate how well HD's estimate radionuclide transport
aDocument ST322	041	40	5	10-18-91	10-24-91	36	Document auxiliary analysis evaluating HD's
aST323-Rm. Codes	042	40	10	10-18-91	10-25-91	100	Partial evaluation of SNL tuff flow and transport codes
aDocument ST323	043	40	10	10-25-91	12-06-91	130	Document auxiliary analysis of SNL tuff code evaluation
aST324-2D Unsat.	044	40	10	10-04-91	10-18-91	72	Auxiliary analysis of 2D partially saturated flow at YM
aDocument ST324	045	40	10	10-18-91	10-31-91	72	Document auxiliary analysis of 2D partially sat. flow
aST325-3D Unsat.	046	40	10	10-04-91	10-18-91	72	Auxiliary analysis of 3D partially saturated flow at YM
aDocument ST325	047	40	10	10-18-91	10-31-91	72	Document auxiliary analysis of 3D unsaturated flow at YM
aST326-Therm. Air	048	40	10	12-26-91	01-08-92	74	Scoping, literature survey of gas flow at Yucca Mt.
aDocument ST326	049	40	10	01-22-92	02-04-92	72	Document auxiliary analysis of therm. & barom. gas flow
a Restart Task 4	050	20	0	10-01-91	10-01-91	0	Initiate Restructured Task 4 - Source Term
aWP Flr. Module	052	30	0	11-05-91	11-05-91	0	Computer module to estimate waste package failure
aWP E.Cnd. Module	095	30	0	11-20-91	11-20-91	0	Computer module to calculate repository environment
aIntegrt. Modules	053	40	10	01-31-92	02-13-92	80	Integrate the component source term modules
ST Module	054	30	0	02-13-92	02-13-92	0	Complete source term computational module
aWrite Task 4 WD	053	40	20	02-13-92	03-12-92	309	Write Task 4, Source Term, Working Draft
aTask4 Wrkg. Dr.	054	30	0	03-12-92	03-12-92	0	Completed Working Draft for Task 4
aRev.&Mod. T4 WD	057	40	10	03-12-92	03-26-92	216	Review and Modify Task 4 Working Draft into Rough Draft
aTask4 Rough Dr.	058	35	0	03-26-92	03-26-92	0	Task 4 Rough Draft - contribution to Phase 2 Rough Draft
aWF Dissol. Model	059	40	40	12-06-91	01-31-92	807	Develop model for waste form dissolution
aWF Dissl. Module	060	30	0	01-31-92	01-31-92	0	Completed Waste Form Dissolution Module
aST Transport Mdl	061	40	40	11-06-91	12-05-91	405	Develop model for transport of radionuclides from source
aST Trnpt. Module	062	30	0	12-05-91	12-05-91	0	Completed module to calculate transport from source
aRestart Task 5	063	30	0	10-01-91<	10-01-91	0	Initiate Restructured Task 5 - Disruptive Consequences
aVolcanism Model	064	35	80	10-01-91	01-21-92	1608	Develop module to describe consequences of volcanism
aVolcanism Module	065	35	0	01-21-92	01-21-92	0	Completed computational module for volcanism consequence
aWrite Task 5 WD	066	45	10	04-14-92	05-01-92	187	Write Task 5 Working Draft
aTask 5 Wrkg. Dr.	067	45	0	05-01-92	05-01-92	0	Task 5 Working Draft
aRev.&Mod. T5 WD	068	45	10	05-01-92	05-15-92	192	Review and modify Task 5 Working Draft into Rough Draft
aTask 5 Rough Dr.	069	45	0	05-15-92	05-15-92	0	Task 5 Rough Draft
aRestart Task 6	070	30	0	10-01-91	10-01-91	0	Initiate Restructured Task 6 - Sensitivity & Uncertainty
aWrite Meth. Sect	071	30	80	02-12-92	04-13-92	144	Write part of Task 6 Wrkg Dr. describing methods for SU
aPrepare Methods	072	30	20	01-07-92	02-12-92	158	Prepare sensitivity and uncertainty analysis methods
aPerform S&U Anal	073	30	10	04-21-92	05-04-92	184	Perform sensitivity & uncertainty analysis on prod. runs
aComplete S&U An.	074	30	0	05-04-92	05-04-92	0	Completed sens. & uncert. analysis on Phase 2 output
aWrite Task 6 WD	075	30	10	05-04-92	05-18-92	152	Write Task 6 Working Draft, including sens. & uncert.
aTask 6 Wrkg. Dr.	076	30	0	05-18-92	05-18-92	0	Completed Task 6 Working Draft
aRev.&Mod. T6 WD	077	30	10	05-18-92	06-02-92	152	Review and modify Task 6 Working Draft
aTask 6 Rough Dr.	078	30	0	06-02-92	06-02-92	0	Task 6 Contribution to Phase 2 Rough Draft
aAssemble Tot. RD	079	30	1	06-02-92	06-03-92	35	Assemble Complete Rough Draft
aRev.&Mod. Tot.RD	080	30	10	06-04-92	06-17-92	420	Review and Modify Total Rough Draft
aIssue First Dr.	081	30	5	06-18-92	06-24-92	180	Issue First Draft of Phase 2 Report to Management
P2 First Draft	082	30	0	06-26-92	06-26-92	0	Phase 2 First Draft
aTask 2 Wrkg. Dr.	084	30	0	03-27-92	03-27-92	0	Completed Task 2 Working Draft
aC-14 Analysis	085	30	5	12-02-91	01-15-92	48	Geochemical analysis of C-14 transport
aDocument C-14	086	30	5	01-15-92	01-22-92	48	Document the C-14 Analysis
aRegional Flow	087	30	5	10-04-91	10-11-91	48	2-D planar regional, saturated flow model
aDoc. Reg. Flow	088	30	5	10-11-91	10-21-91	40	Document regional, saturated flow model
aRestart Coord.	089	30	0	10-01-91	10-01-91	0	Initiate Restructured Task 8 - Coordination
aCoordination	090	48	131	11-21-91	06-01-92	1772	IPA Phase 2 Coordination

Timeline columns: Oct 91, Nov, Dec, Jan 92, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec

Legend: Non Critical; Milestone; Float/Delay; Finish Delay; Interrupt; Critical; Critical MS; Free Float; Unassigned

APPENDIX F

RESOURCE SUMMARY REPORT

Appendix F
Resource Summary Report

This report lists:

Column	Heading	Meaning
1	Resource Name	staff person name
2	Std day	standard day (CWS is not accounted for, but on a two-week schedule this is not very important)
3	Cldr Var	calendar variance (total hours beyond normal workday)
4	Un	number of resource units for this resource (this is unity for our resources, since they are individuals, not teams or groups, and cannot be divided).
5	Total Hours	total time scheduled for IPA for this person
6	Ovr Hours	Overscheduled hours, the amount of hours scheduled outside the person's normal workday

The key items in this list are the resource names and the total hours scheduled for that person for IPA Phase 2.

Resource Name	Std day	Cldr Var	Un	Total Hours	Ovr Hours
Neel	8		1	340	
Eisenberg	8		1	1224	
Sagar	8		1	673	
McCartin	8		1	1020	
Manaktela	8		1	854	
Margulies	8		1	1020	
Codell	8		1	1224	
Park	8		1	1020	
Garcia	8		1	128	
Jensen	8		1	48	
Gureghian	8		1	1020	
Janetzke	8		1	292	
Trapp	8		1	340	
Kovach	8		1	40	
Murphy	8		1	204	
Ahola	8		1	80	
P. Brooks	8		1	298	
Ford	8		1	680	
Nicholson	8		1	113	
Wescott	8		1	680	
Pohle	8		1	340	
Bradbury	8		1	680	
Chery	8		1	272	
Ababou	8		1	144	
Chang	8		1	340	
Dancer	8		1	100	
Nair	8		1	160	
Delligatti	8		1	512	
Ibrahim	8		1	340	
D. Brooks	8		1	136	
Justus	8		1	136	
Weller	8		1	136	
Coplan	8		1	272	
				======	=====
				14866	0

APPENDIX G

RESOURCE DETAIL REPORT

Appendix G
Resource Detail Report

This appendix lists each individual working on IPA Phase 2. Below each individual's name are listed the names of the tasks that individual is scheduled to work on and the total hours the individual is scheduled to work on that task. Because of the assumptions used in generating this plan, the overscheduled hours (Ovr Hours) are zero for all staff.

Resource Task/Subproject	Total Hours	Ovr Hours
Neel		
Dev. Dose Module	200	
Dose Module Trial Runs	40	
Write Task1 WD	50	
Rev.&Mod. T1 WD	50	
	340	0
Eisenberg		
Volcanism Model	200	
Restart Coord.		
Restart Task 2		
ST212-Imp. Meth.	32	
Coord. Mod. Dev.	20	
ST212-Imp. Meth.	20	
Coordination	400	
ST212-Imp. Meth.	28	
Doc. Imp. Scen.	54	
All Modules Del.		
Choose Method	10	
Use Chosen Meth.	14	
Trial Runs	60	
Use Chosen Meth.	26	
Write Task 2 WD	72	
System Code Prob		
Rv. & Mod. T2 WD	64	
Task 2 Wrkg. Dr.		
Dev. LHS Strtgy	16	
Task 2 Rough Dr.		
Write Task 5 WD	6	
Production Runs	32	
Write Task 5 WD	58	
Rev.&Mod. T5 WD	40	
Rev.&Mod. Tot.RD	72	
	1224	0
Sagar		
Restart Task 1		
Dev. Dose Module	12	
Restart Meeting	3	
WP Failure Model	40	
Mod. Sys. Code	20	
ST323-SNL Codes	40	
Document ST323	20	
Contr. to WD		
ST Transport Mdl	40	
Coord. Mod. Dev.	40	
Coordination	20	
ST Trnpt. Module		
WF Dissol. Model	40	
Coordination	84	
Integrt. Modules	20	
Write Task 4 WD	40	

Resource Task/Subproject	Total Hours	Ovr Hours
Coordination	12	
Trial Runs	60	
Coordination	4	
Rev.&Mod. T4 WD	16	
Coordination	16	
Dev. LHS Strtgy	16	
Production Runs	20	
Prod. Run Output		
Write Task1 WD	30	
Rev.&Mod. T1 WD	20	
Task 1 Wrkg. Dr.		
Task 1 Rough Dr.		
Rev.&Mod. Tot.RD	60	
	---	---
	673	0
McCartin		
Restart Task 3		
Restart Meeting	3	
ST323-SNL Codes	20	
Document ST323	40	
Dev. Liquid Mod.	429	
Coordination	96	
Liquid F&T Mod.		
Write GW F&T WD	50	
Trial Runs	12	
Task 3 Wrkg. Dr.		
Rev.&Mod. T3 WD	64	
Trial Runs	148	
Task3 Rough Drft		
Dev. LHS Strtgy	16	
Coordination	8	
Coordination	2	
Coordination	6	
Coordination	6	
Production Runs	30	
Coordination	12	
Coordination	6	
Rev.&Mod. Tot.RD	72	
	---	---
	1020	0
Manaktela		
WP Env.Cond.Mdl.	40	
Restart Task 4		
WP Failure Model	160	
ST Transport Mdl	160	
WF Dissol. Model	160	
WF Dissl. Module		
Write Task 4 WD	80	
Trial Runs	4	
Trial Runs	4	
Trial Runs	4	
Trial Runs	4	
Trial Runs	4	

Resource Task/Subproject	Total Hours	Ovr Hours
Trial Runs	4	
Trial Runs	4	
Trial Runs	4	
Trial Runs	4	
Rev.&Mod. T4 WD	40	
Task4 Wrkng. Dr.		
Trial Runs	44	
Task4 Rough Dr.		
Dev. LHS Strtgy	30	
Production Runs	32	
Rev.&Mod. Tot.RD	72	
	---	---
	854	0
Margulies		
Volcanism Model	600	
Restart Task 5		
Volcanism Module		
Trial Runs	126	
Dev. LHS Strtgy	30	
Write Task 5 WD	6	
Production Runs	32	
Write Task 5 WD	66	
Rev.&Mod. T5 WD	80	
Task 5 Wrkg. Dr.		
Task 5 Rough Dr.		
Rev.&Mod. Tot.RD	80	
	---	---
	1020	0
Codell		
WP Env.Cond.Mdl.	24	
Restart Task 6		
Restart Meeting	3	
Dev. Gas Module	120	
WP Env.Cond.Mdl.	176	
WP E.Cnd. Module		
C-14 Analysis	29	
WF Dissol. Model	167	
Prepare Methods	8	
Write Gas F&T WD	32	
C-14 Analysis	3	
Document C-14	32	
Write Meth. Sect	7	
Write Task 4 WD	80	
Trial Runs	12	
Rev.&Mod. T3 WD	30	
Trial Runs	26	
Rev.&Mod. T4 WD	20	
Trial Runs	82	
Write Meth. Sect	13	
Dev. LHS Strtgy	40	
Production Runs	32	
Perform S&U Anal	72	
Write Task 6 WD	72	

Resource Task/Subproject	Total Hours	Ovr Hours
Complete S&U An.		
Rev.&Mod. T6 WD	72	
Task 6 Wrkg. Dr.		
Task 6 Rough Dr.		
Rev.&Mod. Tot.RD	72	
	---	---
	1224	0
Park		
Volcanism Model	300	
ST211-SNL Meth.	144	
Doc. SNL Eval.	72	
Doc. Imp. Scen.	72	
Choose Method	14	
Use Chosen Meth.	72	
Write Task 2 WD	72	
Rv. & Mod. T2 WD	72	
Write Task 5 WD	51	
Rev.&Mod. T5 WD	72	
Assemble Tot. RD	7	
Rev.&Mod. Tot.RD	72	
	---	---
	1020	0
Garcia		
Assemble Tot. RD	8	
Rev.&Mod. Tot.RD	80	
Issue First Dr.	40	
	---	---
	128	0
Jensen		
Assemble Tot. RD	8	
Issue First Dr.	40	
	---	---
	48	0
Gureghian		
Restart Meeting	3	
ST323-SNL Codes	40	
Document ST323	58	
ST Transport Mdl	160	
Document ST323	2	
Prepare Methods	129	
Integrt. Modules	40	
Prepare Methods	21	
Write Meth. Sect	7	
Write Task 4 WD	80	
Trial Runs	68	
Rev.&Mod. T4 WD	40	
Trial Runs	7	
Write Meth. Sect	133	
Perform S&U Anal	72	
Write Task 6 WD	80	
Rev.&Mod. T6 WD	80	

Resource Task/Subproject	Total Hours	Ovr Hours
	1020	0
Janetzke		
Dev. Dose Module	48	
Mod. Sys. Code	40	
WF Dissol. Model	32	
Integrt. Modules	20	
Production Runs	32	
Perform S&U Anal	40	
Write Task1 WD	40	
Rev.&Mod. T1 WD	40	
	292	0
Trapp		
Volcanism Model	208	
ST212-Imp. Meth.	40	
ST211-SNL Meth.	40	
Doc. SNL Eval.	8	
Choose Method	8	
Use Chosen Meth.	36	
	340	0
Kovach		
Volcanism Model	40	
	40	0
Murphy		
C-14 Analysis	29	
WF Dissol. Model	108	
C-14 Analysis	7	
Document C-14	36	
Rev.&Mod. T3 WD	24	
	204	0
Ahola		
Regional Flow	40	
Doc. Reg. Flow	40	
	80	0
P. Brooks		
ST211-SNL Meth.	120	
Doc. SNL Eval.	72	
Doc. Imp. Scen.	20	
Choose Method	14	
Use Chosen Meth.	72	
	298	0
Ford		

Resource Task/Subproject	Total Hours	Ovr Hours
Restart Meeting	3	
Dev. Liquid Mod.	525	
Write GW F&T WD	72	
Rev.&Mod. T3 WD	80	
	680	0
Nicholson		
Restart Meeting	3	
Dev. Liquid Mod.	80	
Rev.&Mod. T3 WD	30	
	113	0
Wescott		
Restart Meeting	3	
Dev. Gas Module	200	
Dev. Liquid Mod.	159	
Gas F&T Mod.		
ST326-Therm. Air	74	
Write Gas F&T WD	72	
Document ST326	72	
Write GW F&T WD	20	
Rev.&Mod. T3 WD	80	
	680	0
Pohle		
Restart Meeting	3	
ST324-2D Unsat.	72	
Document ST324	72	
Dev. Liquid Mod.	113	
Rev.&Mod. T3 WD	80	
	340	0
Bradbury		
Restart Meeting	3	
ST322-KD Approx.	72	
Document ST322	36	
Dev. Liquid Mod.	120	
WF Dissol. Model	300	
Write Task 4 WD	69	
Rev.&Mod. T3 WD	80	
	680	0
Chery		
Restart Meeting	3	
ST321-Precip.	36	
Document ST321	72	
Dev. Liquid Mod.	89	
Rev.&Mod. T3 WD	72	
	272	0

Resource Task/Subproject	Total Hours	Ovr Hours
Ababou		
ST325-3D Unsat.	72	
Document ST325	72	
	144	0
Chang		
WP Failure Model	120	
WP Flr. Module		
ST Transport Mdl	40	
Write Task 4 WD	120	
Rev.&Mod. T4 WD	60	
	340	0
Dancer		
WP Env.Cond.Mdl.	60	
Rev.&Mod. T4 WD	40	
	100	0
Nair		
WP Failure Model	120	
Write Task 4 WD	40	
	160	0
Delligatti		
Coordination	420	
Assemble Tot. RD	4	
Assemble Tot. RD	8	
Rev.&Mod. Tot.RD	40	
Issue First Dr.	40	
	512	0
Ibrahim		
Volcanism Model	52	
ST212-Imp. Meth.	84	
ST211-SNL Meth.	2	
ST211-SNL Meth.	2	
ST211-SNL Meth.	76	
Doc. SNL Eval.	20	
Doc. Imp. Scen.	20	
Choose Method	12	
Use Chosen Meth.	72	
	340	0
D. Brooks		
Coordination	136	
	136	0
Justus		

Resource Task/Subproject	Total Hours	Ovr Hours
Coordination	136	
	136	0
Weller		
Coordination	136	
	136	0
Coplan		
Coordination	272	
	272	0
	14866	0

APPENDIX H

IPA PHASE 2 SUBTASK DESCRIPTIONS

IPA PHASE 2 SUBTASK DESCRIPTIONS

Task 0 -- IPA Coordination

Subtask 001 -- NMSS IPA Coordinator, N. Eisenberg
RES IPA Coordinator, T. McCartin
CNWRA IPA Coordinator, B. Sagar
NMSS Project Manager, M. Lee

The three coordinators will propose plans for technical work to the NRC Management Board, monitor and report on technical progress and promote communication within and among NMSS, RES, and CNWRA.

Subtask 011 -- Code Maintenance

The purpose of this subtask is to assure that an adequate system is in place and is used for the archiving, development, modification, and use of computer codes used in performance assessment. This system, which will have many of the attributes of a configuration management system, will be put in place and maintained mainly by the CNWRA; however, both NRC and CNWRA staff will use the system for maintenance of performance assessment computer codes and for all computer work performed as part of this iterative performance assessment activity. This system will keep track of modifications to computer codes, assure that archival versions of codes are not modified, and will record the data sets, operating environment, and computer code used to obtain key output. The system will be documented in a final code maintenance procedures plan.

Task 1 -- System Code Development and Integration

The purpose of Task 1 is to assemble the computational tools to enable calculation of the performance measures for the repository at Yucca Mountain. Activities under this task will include: (1) the digitization of parametric distributions and other data bases, including information related to scenarios; (2) the testing of codes to calculate consequences; and (3) the coding of an executive program to exercise the consequence models with the appropriate data bases.

Subtask 101 -- System code coordination (B. Sagar)

The experience with Phase 1 indicated that activities within a major Task was better coordinated by a Leader for that Task. Because the Task Leader is closer to the details of the technical work than the overall coordinators, technical coordination appears to be better executed at this level. Since Phase 2 is expected to involve more staff and more disciplines than Phase 1, the need for this level of coordination is even greater. This level of coordination will be accomplished by communication between the Task Leader and (1) the staff working on the Task and (2) the three Coordinators. The Task Leader will monitor technical progress, give notice of any problems, provide

senior technical advice and leadership on the ongoing activities, and provide for coordination of the various subtasks within the Task. It is anticipated that the Task Leader will hold periodic meetings with the technical staff participating in the Task. The Task Leader will also participate in the periodic management meetings. Task 1 activities will be coordinated with those of the other teams and with the IPA coordinators.

Subtask 111 -- Develop an internal mode system code

For the Phase 1 effort, the consequence modules for the various release pathways were run separately from the system code and the resulting output files were accessed and the data manipulated by the system code to generate the total system CCDF. An alternate approach would be to incorporate the consequence modules as subroutines into a total system code. The purpose of this subtask is to test the system code running the consequence codes as subroutines to the system code. Work performed under this subtask will ensure that the system code and the source term, the flow and transport, and the statistical driver modules are developed or modified in such a way that they are compatible with the system code and each other. This will include input and output interfaces, as well as acceptability of the codes in terms of run times and completeness. This attempt will indicate the practicality of executing the consequence modules as subroutines within a total system code and will provide an important insight into the direction for further development of the NRC independent performance assessment capability.

Subtask 112 -- Add a graphics capability to the system code

In the Phase 1 effort, the generation of graphical output (i.e., CCDFs) involved tedious and potentially inaccurate manual operations separate from the operation of the system code. Incorporating a graphical interface, e.g., DISSPLA graphics, directly into the system code would improve efficiency and reduce the possibility of error. Work in this subtask will seek to add to the system code a graphics module, which will contain routines for the quick reduction of the system code output to generate CCDF curves and graphical output of selected consequence modules.

Subtask 113 -- Add dose assessment capability to the system code

Phase 1 did not look directly at the effects of releases of radionuclides from the repository on individuals or populations. Instead, the analysis considered only compliance with the EPA cumulative release criteria for 10,000 years. Phase 2 will consider the doses to individuals and populations resulting from releases of radionuclides. The purpose of this subtask is to produce individual and population dose estimates for 10,000 years or longer, in order to compare the efficacy of the EPA limits within the context of a repository in unsaturated tuff. The staff will initially consider doses to individuals through the drinking water pathway for wells drilled at the boundary of the

controlled area. The analyses will be expanded as time permits to include the following phenomena:

- Gaseous release pathways, particularly C-14 and possibly I-129, to individuals living close to the site.
- Population doses for plausible population and water-use patterns.
- Individual and population doses from pathways other than directly from drinking water, such as irrigated crops, milk and meat, and particle resuspension from irrigated soils.

The expected product of this subtask will be a dose evaluation module to be incorporated into the system code.

Subtask 121 -- Investigate the impact of the NRC subsystem requirements upon total system performance

Activities in this subtask will investigate the effects of compliance with the subsystem requirements of 10 CFR 60.113 on total system performance. Total system performance measures include those used to determine compliance with the EPA cumulative release standard, 40 CFR Part 191, and other performance measures such as dose to individuals and populations. One approach to this investigation would be to sample input parameters constrained by physics and site data, but not constrained by compliance with the NRC subsystem requirements. Comparisons of the CCDF comprised from all of the unconstrained samples to CCDFs obtained from subsamples complying with one or more of the NRC subsystem requirements would provide some indication of the effectiveness of the NRC requirements. Another approach would be to compare performance of a repository not designed to meet the NRC subsystem requirements to that of one designed to meet them. Other approaches may be appropriate, especially to be in keeping with the concept of multiple barriers and the redundancy they may provide. This subtask will investigate this subject and provide a discussion of the direction taken for the Phase 2 report.

Although desireable, this activity probably will not be performed in Phase 2.

Subtask 122 -- Evaluate FPPA and other importance sampling methods for the total system CCDF

The Fast Probabilistic Performance Assessment (FPPA) method may be a useful complement to the Latin Hypercube Sampling (LHS) method used in Phase 1 for parameter selection in sensitivity analyses. This subtask will explore this possibility by attempting to add an FPPA module to the system program and determining its effect on parameter selection. This subtask will produce a discussion describing: (1) a driver based on the FPPA methodology; (2) the efficiency of an FPPA driver versus that of the LHS driver already part of the system program; and (3) when FPPA should be used and when LHS should be used.

This activity will be completed in Phase 2, if time and resources permit.

Task 2 -- Scenario Analysis

The purpose of Task 2 is to provide the scenario analysis needed to perform the Phase 2 performance assessment. Components of the scenario analysis include: (1) identification and enumeration of scenarios that are relevant to this particular repository; (2) screening of scenarios to make the analysis more tractable, but still sufficiently complete; and (3) estimation of the probabilities of scenarios retained in the analysis. Additional work may need to be devoted to an evaluation of scenario analysis methods and possibly to the development of improved methodologies (using methods that are more mathematically robust).

Subtask 201 -- Scenario analysis coordination (N. Eisenberg)

The experience with Phase 1 indicated that activities within a major Task was better coordinated by a Leader for that Task. Because the Task Leader is closer to the details of the technical work than the overall coordinators, technical coordination appears to be better executed at this level. Since Phase 2 is expected to involve more staff and more disciplines than Phase 1, the need for this level of coordination is even greater. This level of coordination will be accomplished by communication between the Task Leader and (1) the staff working on the Task and (2) the three Coordinators. The Task Leader will monitor technical progress, give notice of any problems, provide senior technical advice and leadership on the ongoing activities, and provide for coordination of the various subtasks within the Task. It is anticipated that the Task Leader will hold periodic meetings with the technical staff participating in the Task. The Task Leader will also participate in the periodic management meetings.

Subtask 211 -- Evaluate SNL scenario analysis methodology

In the Phase 1 study, the scenario analysis was left incomplete due to schedule and other resource limitations. Consequently, only four scenario classes were included in the CCDF. For Phase 2, the staff will attempt to expand on the number of scenarios considered in part by executing the SNL scenario analysis procedure, including scenario identification, screening, and probability determination. The SNL scenario methodology is documented in several reports. An interdisciplinary team is required to exercise the scenario methodology. A key step will be developing a description of the site system, with a special focus on ongoing geologic change. The products of this subtask will be a set of scenarios with corresponding probabilities for possible use in the Phase 2 total system performance assessment and an evaluation of the rigor and practicality of the SNL scenario analysis method.

The SNL scenario analysis methodology will be evaluated to limited extent.

Subtask 212 -- Develop an improved scenario analysis method

Development of an improved scenario analysis method is to be appropriate because existing scenario analysis methods appear to have certain deficiencies which include:

(1) A concern that the set of scenarios that result may not be mutually exclusive or cover the entire probability space;

(2) A concern that the scenario probabilities are not determined in a mathematically rigorous fashion, especially with regard to subsuming certain "screened out" scenarios into the "base case" scenario; and

(3) A concern that the definition of the system is vague, so that there is not a clear distinction between what events and processes are considered to make up the operating environment of the system and what events and processes make up the response of the system to this environment.

The objective of this task is to articulate an approach to scenario analysis which removes or reduces these problems and provides a more robust analytical framework. The methodology will be developed through the application of statistical and risk analysis techniques, in a rigorous fashion, to the problem of describing repository performance. This improved scenario analysis methodology, if produced, will be described and implemented in the Phase 2 iteration.

Subtask 213 -- Provide scenario specifications and probabilities for the total system performance assessment

As in Phase 1, Phase 2 will need a defined set of scenarios and their probabilities in order to calculate a CCDF. This subtask will implement the improved scenario analysis methodology developed in Subtask 212 to generate scenarios suitable for the Phase 2 effort. In addition, using available references, probabilities will be assigned to the scenarios. Scenario identification, screening, and probability estimation will require an interdisciplinary effort involving geoscientists, physical modelers, and performance assessment analysts. A key step will be developing a description of the site system, with a special focus on ongoing geologic change. The results of this subtask will then be compared to those from Subtask 211.

Subtask 221 -- Compare the scenario approach to environmental simulation

Environmental simulation is an approach which attempts to incorporate all identifiable uncertainties into a single repository system model. In this approach variables determining the occurrence or non-occurrence of various natural events (e.g., volcanism, glaciation, earthquake) are sampled from statistical distributions at each time step. In addition, parameters describing total system performance, such as hydraulic conductivity, are also

sampled from statistical distributions. Each individual total system simulation thus may yield a different result depending upon the type of events selected, their order of occurrence, and their timing relative to each other. Many simulations must be executed to obtain a set of consequences and probabilities representative of the repository. On the other hand, the scenario approach, derived from the risk context of PRA, assigns a particular set of events and order of their occurrence to an individual scenario. This was the direction taken in Phase 1 of the MOU. The developers of the environmental simulation approach claim that their method represents the probability space more completely, although proponents of the scenario approach say that their method is as fully capable. One approach to this issue would be to compare the performance estimates of the repository obtained from environmental simulation to those obtained from a performance assessment using a scenario-based approach. Because environmental simulation codes are not currently available to the staff and because such a comparison is likely to be very labor intensive, this type of comparison will not be attempted during Phase 2. Instead, to begin the comparison of the two approaches, the theoretical bases and methodological steps will be compared, to provide a theoretical, generic understanding of the differences. The product will be a report describing the findings.

Although desireable, this activity probably will not be performed in Phase 2.

Task 3 -- Flow and Transport

This task will develop and implement models for flow and transport in the far-field zone; i.e., the region beyond the engineered barrier where the effects of heat produced by the waste are not important. This task will consider flow of groundwater in the saturated and unsaturated zones in greater detail than those used in the Phase 1 analyses. Transport of radionuclides in the far field will consider phenomena such as sorption and matrix diffusion. Models for transport of radionuclides in the gaseous state, particularly C-14, will be incorporated into the overall systems model (C-14 gaseous transport was considered in Phase 1, but only as an auxiliary analysis).

Subtask 301 -- Flow and Transport Coordination (T. McCartin)

The experience with Phase 1 indicated that activities within a major Task was better coordinated by a Leader for that Task. Because the Task Leader is closer to the details of the technical work than the overall coordinators, technical coordination appears to be better executed at this level. Since Phase 2 is expected to involve more staff and more disciplines than Phase 1, the need for this level of coordination is even greater. This level of coordination will be accomplished by communication between the Task Leader and (1) the staff working on the Task and (2) the three Coordinators. The Task Leader will monitor technical progress, give notice of any problems, provide senior technical advice and leadership on the ongoing activities, and provide for coordination of the various subtasks within the Task. It is anticipated that the Task Leader will hold periodic meetings with the technical staff participating in the Task. The Task Leader will also participate in the

periodic management meetings. The purpose of this subtask is to coordinate these activities of the Flow and Transport team with those of other teams.

Subtask 311 -- Conduct a literature survey

This survey will expand on the Phase 1 literature review, and will determine the availability of: (1) additional data to use in determining an approach to modeling repository performance at an unsaturated site (e.g., from prior studies, etc.); (2) the computational methods and tools for modeling this performance; and (3) the site parameters data needed to model flow and transport in an unsaturated media. In addition, the survey will continue to increase the staff's familiarity with the modeling approaches used by others for the same or similar problems. The review, in particular, will seek information on such phenomena as the groundwater flow near fractures in an unsaturated porous media, the behavior of water, solute, water vapor, and gas near heat sources, and the geochemical nature of radionuclide transport in the media (e.g., colloid formation). This subtask will produce (1) a critical review on flow and transport phenomena in an unsaturated porous media and on the modeling of such phenomena and (2) a description of the site and repository for purposes of flow and transport modelling.

This activity will be completed in Phase 2, if time and resources permit.

Subtask 312 -- Develop a flow and radionuclide transport model for gaseous radionuclide release

In the Phase 1 demonstration, only the liquid and direct release (by exhumation of waste or contaminated rock) pathways were implemented; releases via the atmospheric pathway were treated separately in an auxiliary analysis. This analysis indicated that the release of C-14 and other radionuclides in the gas phase may be important. A more complete treatment of release pathways would include the gaseous release of these radionuclides in the estimate of total system performance. This treatment might involve the coupling of releases from the liquid and direct release pathways to those from the gaseous pathway in order to characterize correctly the interactions among the various pathways and to assure conservation of mass in the calculations. The purpose of this subtask is to develop or modify a model for the transport of gaseous C-14 (and possibly I-129) through the fractured porous media to the accessible environment, possibly following the lead of Amter, Behl and Ross (1988). This subtask will produce a computer code module for the system code that explicitly takes into account the transport of C-14.

Subtask 313 -- Develop a flow and radionuclide transport models for dissolved and colloidal radionuclides

The assumptions used in the Phase 1 effort greatly simplified the complexity, boundary conditions, and physical processes that should be considered when modeling flow and transport in an unsaturated media. Among the more

significant of these assumptions were: (1) one dimensional, steady-state flow vertically downwards; (2) a constant surface infiltration rate; (3) the initiation of fracture flow when the infiltration rate exceeded the matrix saturated hydraulic conductivity; (4) no matrix diffusion of radionuclides; (5) the transport of radionuclides governed by linear sorption, i.e., using an equilibrium coefficient, K_d; and (5) no credit taken for flow and transport through the saturated zone.

Work performed under this subtask will attempt to improve upon this approach. This could involve explicitly modeling flow through the matrix and fractures as well as the matrix/fracture coupling, and making the flow model two-dimensional and expanding on the Phase 1 auxiliary analysis which investigated the potential for non-vertical flow. Radionuclide transport modeling could be improved by incorporating more mechanistic models of phenomena such as matrix/fracture coupling and the behavior of colloids in the media, and more realistic sorption models. The model could also take credit for the potentially significant holdup in the saturated zone. The possible use of time-varying boundary conditions and fluxes should also be explored so that the steady-state assumption could be relaxed. This subtask does not necessarily involve the development of new codes, because existing codes, particularly those developed by Sandia National Laboratories (see subtask 323) might be suitable. The present subtask will rely on input from auxiliary analyses nos. 321 through 326. Products will consist of improved flow and transport modules for the groundwater release pathway to be incorporated into the systems code, and documentation of the model in the Phase 2 report.

Subtask 321 -- Analyze precipitation and infiltration estimates

The rate of water infiltration at Yucca Mountain's surface may be the key factor in determining the release of radionuclides from the engineered barrier and the rate at which they are transported to the accessible environment. The Phase 1 analysis used a wide range of infiltration rates because the only estimates available for the site were calculated values which varied considerably. More accurate estimates of infiltration rates would greatly reduce the uncertainty in the source, flow, and transport models. The purpose of this subtask is to analyze the currently available precipitation and infiltration rate data for the site and produce more defensible estimates of infiltration rate at Yucca Mountain with less variance.

Although desireable, this activity probably will not be performed in Phase 2.

Subtask 322 -- Investigate the use of the K_d approximation to model radionuclide retardation

Currently, most flow and transport models use the "retardation factor" or "K_d" approach.The Phase 1 study also used this approach. The purpose of this subtask is to establish an approach for modeling the retardation of radionuclides in the geologic media. The conditions under which this approach is acceptable for the current analysis should be determined, and alternatives

proposed for conditions when it is unacceptable. The expected product of this subtask is an estimate of the acceptability of the K_d approach in the radionuclide transport model.

Although desireable, this activity probably will not be performed in Phase 2.

Subtask 323 -- Preliminary evaluation of SNL flow and transport codes

Sandia National Laboratories has developed a series of computer codes as part of the tuff methodology. These codes need to be evaluated in a preliminary fashion. These code-evaluations will assess such aspects as: (1) run time efficiency; (2) transferability to different computer environments; (3) ability to execute benchmark problems; (4) accuracy in solving problems of various complexity; and (5) validity in modeling flow and transport in tuff. The purpose of this subtask is to test various aspects of the codes on a variety of problems, conducting comparisons between codes, and (to a limited extent) comparing code output to experimental results. The expected product of this subtask will be evaluations documented in the Phase 2 report.

Subtask 324 -- Develop a regional scale two-dimensional unsaturated flow model of the Yucca Mountain area

In the Phase 1 demonstration, the flow and transport model simulated, using simplified boundary conditions, groundwater and radionuclide movement on a local scale, i.e., confined to that area of unsaturated media from the hypothetical repository down to the water table. A regional scale two-dimensional flow model coupled to the local scale flow model would help to represent better the complexity involved and therefore provide a more precise and complete treatment of the hydrology at an unsaturated site. The purpose of this subtask is to develop a regional scale flow model which will supply more constrained boundary conditions to the flow models used to generate the total system CCDF. The expect product of this subtask will be an auxiliary analysis documented in the Phase 2 report.

This activity will be completed in Phase 2, if time and resources permit.

Subtask 325 -- Three dimensional unsaturated flow analysis

The Phase 1 study used a flow and transport model which was essentially a series of 4 one-dimensional tubes to express the predominantly vertical flow expected at the site. This model, while incorporating some three-dimensional detail about the thicknesses of the geohydrologic units, could not deal with flows other than vertical. Modeling the release of radionuclides from a potential repository and their subsequent movement away from the repository via any of the available pathways is truly a three-dimensional problem. This subtask will explore the phenomena involved in modeling groundwater flow on a regional scale in three dimensions. The results of this analysis will be

compared against the flow phenomena for one- and two-dimensional flow models, and documented in the Phase 2 report as an auxiliary analysis.

This activity will be completed in Phase 2, if time and resources permit.

Subtask 326 -- Evaluate the importance of thermally and barometrically driven air flow on repository performance at Yucca Mountain

In the Phase 1 demonstration the flow of groundwater was calculated using a simple, one-dimensional flow approximation which did not include interaction with fluids in the gaseous phase. The SCP, SCA, and other documents (including several reviewed as part of the Phase 1 effort) indicate that the barometrically and thermally driven flow of air and water vapor at Yucca Mountain may have a significant impact on the movement of groundwater and, thus on repository performance. This auxiliary analysis on the nature of such gas flows and their impact on the movement of groundwater could indicate whether such effects should be included explicitly in models of repository performance at Yucca Mountain. The analysis will be documented in the Phase 2 final report.

Although desireable, this activity probably will not be performed in Phase 2.

Task 4 -- Source Term

The source term module incorporated into the systems code will incorporate more-realistic assumptions about releases of radionuclides from the waste form. This module will consider mechanistic models of waste package failure, water/waste interaction, gaseous releases, and phenomena in the near-field of the engineered barrier.

Subtask 401 -- Source term coordination (H. Manaktala)

The experience with Phase 1 indicated that activities within a major Task was better coordinated by a Leader for that Task. Because the Task Leader is closer to the details of the technical work than the overall coordinators, technical coordination appears to be better executed at this level. Since Phase 2 is expected to involve more staff and more disciplines than Phase 1, the need for this level of coordination is even greater. This level of coordination will be accomplished by communication between the Task Leader and (1) the staff working on the Task and (2) the three Coordinators. The Task Leader will monitor technical progress, give notice of any problems, provide senior technical advice and leadership on the ongoing activities, and provide for coordination of the various subtasks within the Task. It is anticipated that the Task Leader will hold periodic meetings with the technical staff participating in the Task. The Task Leader will also participate in the periodic management meetings. The purpose of this subtask is to coordinate Team activities with those of the other teams and with the IPA coordinators.

Subtask 411 -- Conduct a literature review

This subtask will conduct a survey of the technical literature for information concerning the estimation of the rate of release of radionuclides from the waste package, waste form dissolution, and waste package degradation. This review will address, among other things, waste package corrosion, the near-field effects of heat, the behavior of plutonium with respect to release, and the release of gaseous radionuclides from the waste form. The product of this subtask will be (1) a critical review of the phenomena considered important in the estimation of the radionuclide release to the geosphere and (2) a description of the engineered barrier subsystem (based on available design and site information).

This activity will be completed in Phase 2, if time and resources permit.

Subtask 412 -- Develop a mechanistic model of waste package failure

In the Phase 1 effort, the processes by which waste packages fail were not modeled; instead, the entire inventory of radionuclides was instantly available for transport at a randomly chosen time. This model was non-mechanistic and oversimplifies the more realistic case of waste package failures distributed in time and space and therefore possibly underestimates the variance in radionuclide releases.

The purpose of this subtask is to develop or to use codes to simulate the mechanistic failure of waste packages within the engineered barrier. This failure model in turn will become part of a more complete source term model for predicting releases from the engineered barrier. This subtask should adapt a waste package corrosion model from those developed by the CNWRA and add to it models for failure by mechanisms other than corrosion, e.g., tectonic failures. This subtask will produce a model to predict failure rates for waste form canisters due to various mechanisms, which will be necessary input to determine the radionuclide release rate from the engineered barrier for the total system performance assessment.

Subtask 413 -- Develop a model for the interaction of water entering the waste package after failure, and waste form dissolution

Once water comes into contact with the waste form, it will begin to dissolve the soluble and miscible components, possibly carrying them beyond the engineered barrier. Dissolution of the waste form is a complicated process, and is likely to depend on such factors as the time of failure, the history of the waste form before and after canister failure, the chemistry of the water, and the form of the waste.

In the Phase 1 demonstration, the source term model assumed that water entering the canister interacted with the waste form to release radionuclides. The quantity of water and therefore the rate of release depended on a "contact fraction"; i.e., the fraction of water infiltrating the site that actually

comes into contact with the waste form. This contact fraction was not mechanistically based, but was chosen from a probability distribution for each simulation run.

A mechanistic model of water/waste-form interaction could incorporate parameters generally thought to influence the transfer of mass from the failed waste package to the groundwater. These parameters include: (1) the nature of groundwater flow near the repository (which involves the flow rate, the degree of matrix saturation, and the flow profile around the waste packages); (2) the degree of mixing induced by repository design; (3) the thermal conditions within the repository; and (4) the potential for thermally driven air flow. An even more direct approach would dispense with the concept of the fraction of groundwater contacting the waste and instead, would calculate mass transfer from the ensemble of waste packages to the geosphere based on the appropriate physical and geometrical parameters.

The purpose of this subtask is to develop a model for the dissolution of the radionuclides from the waste form within the canisters following canister failure and water entry, and the release from the canisters to the near-field environment. The expected product of this subtask will be a model for waste form dissolution to be incorporated into the source term module.

Subtask 414 -- Develop a near-field model for waste transport

Transport of water, dissolved waste and gaseous waste close to the waste packages will be quite different from flow and transport far from the engineered barrier. Near-field phenomena must take into account considerations such as heat-induced buoyancy, two-phase flow, evaporation and condensation, and temperature-dependent chemical effects. The purpose of this subtask is to develop a model for mass transfer in the region close to the waste packages. The expected product of this subtask are models to be incorporated into the overall source term model.

Subtask 415 -- Develop an overall source term model and program module for the total system performance assessment

The source term model employed in the Phase 1 demonstration was severely limited in its scope: the mechanisms of waste package failure, the spatial and temporal distribution of failures, and the complexity of the groundwater/waste contact process all were not addressed. This subtask will incorporate the developments made in Subtask nos. 412, 413, and 414 to produce a source term module for use in the Phase 2 effort.

Task 5 -- Disruptive Consequence Analysis

The Disruptive Consequence analyses will focus on investigating the staff's capability to model additional scenarios beyond the four modeled in the Phase 1

demonstration (a base case, a pluvial case, exploratory drilling under undisturbed conditions, and drilling under pluvial conditions).

Subtask 501 -- Disruptive consequence analysis coordination (T. Margulies)

The experience with Phase 1 indicated that activities within a major Task was better coordinated by a Leader for that Task. Because the Task Leader is closer to the details of the technical work than the overall coordinators, technical coordination appears to be better executed at this level. Since Phase 2 is expected to involve more staff and more disciplines than Phase 1, the need for this level of coordination is even greater. This level of coordination will be accomplished by communication between the Task Leader and (1) the staff working on the Task and (2) the three Coordinators. The Task Leader will monitor technical progress, give notice of any problems, provide senior technical advice and leadership on the ongoing activities, and provide for coordination of the various subtasks within the Task. It is anticipated that the Task Leader will hold periodic meetings with the technical staff participating in the Task. The Task Leader will also participate in the periodic management meetings. The purpose of this subtask is to coordinate Team activities with those of the other teams and with the IPA coordinators.

The purpose of this subtask is to provide coordination within the disruptive consequence analysis task and between this task and other tasks.

Subtask 511 -- Conduct a literature survey

The purpose of this subtask is to collect information about potential disruptive scenarios at Yucca Mountain, so that modeling can proceed based on a thorough knowledge of the geoscientific information available on the site and the important geologic processes. This survey will locate information on volcanism and other tectonic phenomena that could be used to improve the analysis of scenarios for the performance assessment. This subtask will produce a report, based on this literature review, on potential scenarios, which include volcanic and other tectonic events, and on the modeling of these alternative scenarios in performance assessments.

This activity will be completed in Phase 2, if time and resources permit.

Subtask 512 -- Improve the drilling model and code

For Phase 1, the staff developed a preliminary analysis for the direct release of radionuclides to the accessible environment due to human intrusion, i.e., drilling. The model did not correctly take into account several phenomena such as the production of radionuclides from chain decay and the removal of radionuclides via other pathways. Another concern is the assumption of uniform drilling rates over the repository, when such uniformity is unlikely. This subtask's purpose is to improve the model by addressing these and other

phenomena. These improvements will be reflected in an updated version of the drilling code for the total system performance assessment.

This activity will be completed in Phase 2, if time and resources permit.

Subtask 513 -- Provide the capability to model additional scenario classes

In the Phase 1 demonstration, the staff used the NEFTRAN computer code to model the release of radionuclides by the groundwater pathway, for both the "base case" (current climatic conditions) and the "pluvial case" (wetter conditions). In addition, a simple model and computer code were developed to treat the release of radionuclides directly to the environment through exploratory drilling. However, there did not appear to be any readily available models and computer codes to estimate consequences from volcanism, faulting, subsidence, uplift, and other tectonic events and processes, and from other types of scenarios. The consequences from these scenarios do not appear to be readily treatable by extensions of models currently in use (such as the way the pluvial case was treated by extending the base case treatment). Therefore, the capability for modeling the consequences of additional scenario classes must be added to the methodology. The focus is on how manifestations of geologic processes, i.e., events, influence primary site characteristics, properties, and processes and how such changes influence repository performance. Phase 2 models must be developed to handle scenarios in which the nature of the geologic medium is not stationary, e.g. due to uplift and/or subsidence. Therefore, special modules for source term, flow, and transport might have to be developed to treat these extreme conditions. This subtask will identify and plan the modification or development of source term, flow, and transport modules for the system model for extreme scenario classes, which include:

(1) volcanism;
(2) faulting;
(3) subsidence and uplift; and
(4) human intrusion.

Activities performed under Task 2 will identify those scenario classes and scenarios to be modeled, using, in part, information derived from Task 5 work. These models will be implemented in one or more modules to be included in the Phase 2 computer simulation.

Subtask 521 -- Prepare a geologic analysis of volcanism for the Yucca Mountain site

The objective of this task is to assemble existing geologic information, both generic and that specific to the Yucca Mountain site, that can be used to describe and quantify, to the extent possible, the frequency of occurrence and the physical manifestation (location, size, magnitude, etc.) of volcanism at Yucca Mountain. Results of this survey will be used in the development of scenarios and models dealing with volcanic activity. The modeling described in

Subtask 513 will be heavily reliant on the synthesis of data and analysis of potential scenarios to be performed in this Subtask. This Subtask will document a rationale for the modeling approaches used in Subtask 513. Probabilistic information will provide input to Task 2.

This activity will be completed in Phase 2, if time and resources permit.

Subtask 522 -- Prepare a geologic analysis of faulting for the Yucca Mountain site

This subtask will assemble existing generic and site specific geologic information, that can be used to describe and quantify, to the extent possible, the frequency of occurrence and the physical manifestation (location, size, magnitude, etc.) of faulting at Yucca Mountain. Findings will contribute to the development of those disruptive consequence models involving faulting and will be documented in the Phase 2 report. The modeling described in Subtask 513 will be heavily reliant on the synthesis of data and analysis of potential scenarios to be performed in this Subtask. This Subtask will document a rationale for the modeling approaches used in Subtask 513. Probabilistic information will provide input to Task 2.

Although desireable, this activity probably will not be performed in Phase 2.

Subtask 523 -- Prepare a geologic analysis of subsidence and uplift for the Yucca Mountain site

The purpose of this subtask is, to the extent possible, describe and quantify the frequency of occurrence and the physical manifestation (location, size, magnitude, etc.) of subsidence and uplift at Yucca Mountain using existing geologic information, both generic and site specific. This information will be used in the modification and development of total system code modules for extreme scenario classes involving subsidence and/or uplift. The modeling described in Subtask 513 will be heavily reliant on the synthesis of data and analysis of potential scenarios to be performed in this Subtask. This Subtask will document a rationale for the modeling approaches used in Subtask 513. Probabilistic information will provide input to Task 2.

Although desireable, this activity probably will not be performed in Phase 2.

Subtask 524 -- Prepare a geologic analysis of human intrusion for the Yucca Mountain site

The objective of this task is to assemble existing geologic information, both generic and that specific to the Yucca Mountain site, that can be used to describe and quantify, to the extent possible, the likely frequency of occurrence and the physical manifestation of human intrusion at Yucca Mountain. The results from this analysis will aid in the development and expansion of scenarios dealing with human intrusion. The modeling described in Subtask 513

will be heavily reliant on the synthesis of data and analysis of potential scenarios to be performed in this Subtask. This Subtask will document a rationale for the modeling approaches used in Subtask 513. Probabilistic information will provide input to Task 2.

Although desireable, this activity probably will not be performed in Phase 2.

Task 6 -- Sensitivity and Uncertainty Analyses

This task will assess the uncertainty and sensitivities for the Phase 2 modeling study. It will improve upon the Phase 1 analyses by using more sophisticated sensitivity and uncertainty methods, along with making more realistic assumptions about how input variables for the Monte Carlo analyses were sampled.

Subtask 601 -- Sensitivity and uncertainty analysis coordination (R. Codell)

The experience with Phase 1 indicated that activities within a major Task was better coordinated by a Leader for that Task. Because the Task Leader is closer to the details of the technical work than the overall coordinators, technical coordination appears to be better executed at this level. Since Phase 2 is expected to involve more staff and more disciplines than Phase 1, the need for this level of coordination is even greater. This level of coordination will be accomplished by communication between the Task Leader and (1) the staff working on the Task and (2) the three Coordinators. The Task Leader will monitor technical progress, give notice of any problems, provide senior technical advice and leadership on the ongoing activities, and provide for coordination of the various subtasks within the Task. It is anticipated that the Task Leader will hold periodic meetings with the technical staff participating in the Task. The Task Leader will also participate in the periodic management meetings. The purpose of this subtask is to coordinate Sensitivity and Uncertainty Team activities with those of the other teams and with the IPA coordinators.

Subtask 611 -- Reassess the Phase 1 sensitivity and uncertainty analysis

The Phase 1 sensitivity and uncertainty analyses included some weaknesses. In particular, (1) results from the direct release (i.e., drilling) pathway and those from the gaseous radionuclide release pathway were not included in the total system analysis, and (2) the pluvial scenarios were incomplete due to long run times and may have introduced spurious correlations into the analyses. The purpose of this subtask is to revisit the Phase 1 analyses in order to correct these weaknesses, primarily to determine whether any of the Phase 1 conclusions would be affected by such a reassessment. This subtask will produce a comparison between the Phase 1 analysis results and those from this reassessment, and will be documented in the Phase 2 report as an auxiliary analysis.

Although desireable, this activity probably will not be performed in Phase 2.

Subtask 612 -- Perform the Phase 2 sensitivity analysis

Sensitivity analyses on the Phase 2 total system performance results will be performed in this subtask. These analyses would be similar to those performed in Phase 1, but not restricted to the techniques used there. Results from the analyses will be documented in the Phase 2 report. Sensitivity analysis attempts to quantify the extent of changes in model output for a given change in model input. Typically model outputs are performance measures, such as cumulative releases of radionuclides, or intermediate results, such as radionuclide flux from the repository. Model inputs are typically parameters in the models, such as hydraulic conductivity, sorption coefficients, infiltration, but may also be assumptions in the conceptual or process models. Frequently the results of the sensitivity analysis are expressed in terms of a sensitivity coefficient, which is the fractional change in model output divided by the fractional change in model input producing the change in output. This activity will explore various methods of sensitivity analysis and will use one or more methods to describe model sensitivity.

Subtask 613 -- Perform the Phase 2 uncertainty analysis

Uncertainty analyses on the Phase 2 total system performance results will be performed in this subtask. These analyses would be similar to those performed in Phase 1, but not restricted to the techniques used there. Results from the analyses will be documented in the Phase 2 report. Uncertainty analysis attempts to quantify the uncertainty in model results and to relate those uncertainties to the uncertainties inherent in the process of generating the results. Uncertainty in results may be considered to derive from uncertainties in: (1) data; (2) modeling; and (3) future states-of-nature. Methods for quantifying modeling and future-states uncertainty are not well developed. Uncertainties in input data are typically described statistically, such as by the variance of the distribution of input data. Similarly the uncertainty in model results can usually be described by the variance of model output. Stepwise regression methods have been used to relate model output variance to input parameter variance. This activity will explore various methods of uncertainty analysis and will employ one or more methods to describe model uncertainty, at least as far as it represents data uncertainty.

Subtask 621 -- Evaluate alternative sensitivity and uncertainty analysis methods

The Phase 1 study relied on stepwise linear regression techniques and ad hoc studies to determine the sensitivities and uncertainties in the modeling results. There are a number of alternative techniques whose authors claim perform better than the ones chosen by the staff for the initial performance assessment effort. The purpose of this subtask will be to compare the results from sensitivity and uncertainty analyses conducted under Subtask 611 to those

from alternative methods. More specifically, this subtask will demonstrate the following techniques:

(1) adjoint sensitivity; and
(2) FAST analysis.

The expected product of this subtask will be an evaluation of alternative methods for sensitivity and uncertainty analyses to be documented in the Phase 2 report.