



TRW Environmental  
Safety Systems Inc.

# Viability Assessment Design and Review Plan

## Civilian Radioactive Waste Management System

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### Management & Operating Contractor

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**Civilian Radioactive Waste Management System  
Management and Operating Contractor**

**Viability Assessment Design and Review Plan**

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**(SCPB: N/A)**

**August 11, 1997**

Prepared for:

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## Viability Assessment Design and Review Plan

### CHANGE HISTORY

REV	ICN	DATE	DESCRIPTION
00		12/19/96	Initial Issue
01		3/14/97	Revised Subsection 3.3 to clarify the expected design progress toward the VA milestone. Revised Appendix B to expand and clarify all Issue Resolution Plans. Modified Appendix G to clarify the expected accomplishments for the Phase I Design. Added program interfaces to Section 6.0 and Appendix L.
01	1	5/22/97	Corrected errors in Issue Resolution Plan numbers 4 and 10.
01	2	08/11/97	Update the Resolution Plan for Issue #10, contained in Appendix B, to reflect the interim DOE guidance of July 14, 1997, on the Repository performance standard.

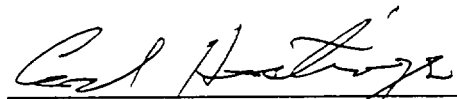
**Civilian Radioactive Waste Management System  
Management and Operating Contractor**

**Viability Assessment Design and Review Plan**

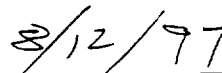
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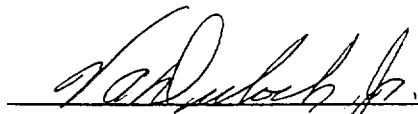


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Date

Approved by:



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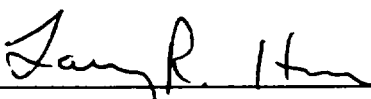
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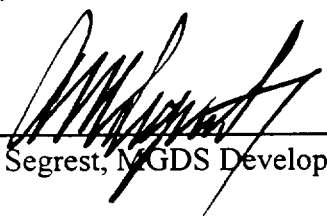
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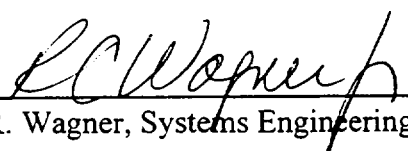
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# 1. INTRODUCTION

## 1.1 PURPOSE

This Viability Assessment (VA) Design and Review Plan (Plan) will identify and discuss the organizations and tools (schedules, processes, plans, etc.) that will be used to direct, control, and monitor progress toward the timely and successful development of design and systems engineering components of the VA package. It will address the activities and products of the Civilian Radioactive Waste Management System Management and Operating (M&O) Contractor's Engineering and Integration (E&I) Operations area, which has responsibility for the design and systems engineering of the repository and engineered barrier system, and for interfacing with other M&O Operations areas. The creation of this Plan will facilitate the identification and organization of the E&I activities and products required to support the VA milestone.

## 1.2 SCOPE

As required by the fiscal year (FY) 1997 Energy and Water Appropriations Act, the VA package will include four components:

- “(1) the preliminary design concept for the critical elements for the repository and waste package;
- (2) a total system performance assessment, based upon the design concept and the scientific data and analysis available by September 30, 1998, describing the probable behavior of the repository in the Yucca Mountain geological setting relative to the overall system performance standards;
- (3) a plan and cost estimate for the remaining work required to complete a license application; and
- (4) an estimate of the costs to construct and operate the repository in accordance with the design concept.”

This Plan will address the scope of the Design and Systems Engineering activities and products required to support the development of these four components. The VA milestone support addressed in this Plan will focus on those aspects of waste package and repository design that are important to post-closure criticality control, and to post-closure waste containment and isolation performance. The Design and Systems Engineering activities will both support and be supported by the total system performance assessment for the VA milestone. This Plan will also address those aspects of repository surface and subsurface operations, and of waste package and repository design required to support the cost estimates and License Application (LA) planning. The results of these activities will be documented in a VA package to be developed in accordance with the *Viability Assessment Monitoring Plan* (VA Monitoring Plan) (in development).

Those Design and Systems Engineering activities and products required to support the VA milestone are a subset of the total set of activities to be performed in FY 97/98. For example, FY 97/98

activities and products that will not be included in this Plan or in the VA package are those related to planning, the National Environmental Protection Act (NEPA), operational safety, construction methods, maintenance, and operations not affecting the repository performance.

### **1.3 OBJECTIVES**

Many of the objectives of this Plan will be accomplished by the act of creating and delivering the Plan. That is, it is the forcing function for organizing the E&I activities required to support the VA milestone and for developing the management tools required to direct, control, and monitor those activities. An additional objective is to provide a general understanding of the relationship between the E&I activities and products and the VA management tools. This Plan will provide guidance on remaining current on the revisions and evolution of VA management tools, and information on how to access those tools to obtain the current status of the E&I activities and planning which support the VA milestone.

Because the VA management tools exist as "living" entities outside of this Plan, there is no intention of updating this Plan once it has been delivered. One of the primary VA management tools will be the VA Monitoring Plan, which is described in Subsection 1.2. In addition, there will be a sequel to this Plan which will address those Design and Systems Engineering related topics and issues that are important to the Site Recommendation (SR) milestone and to the preparation of an LA. This draft LA Plan is scheduled to be delivered in September of 1997.

## 2. BACKGROUND

### 2.1 ACTIVITIES LEADING TO LA

In response to Congressional guidance from the 1996 fiscal year appropriation, and the additional policy decisions made by the U.S. Department of Energy (DOE) during development of the President's 1997 fiscal year budget request, the path forward for completing the Yucca Mountain Site Characterization Project (YMP) has been revised. This revision rescheduled the completion of major YMP milestones of the Environmental Impact Statement (EIS), SR, and LA to maintain the DOE's long-term objective of beginning repository operations in the year 2010. This revised YMP schedule was provided in the *Civilian Radioactive Waste Management Program Plan*, Revision 1, dated May 1996.

Based on the knowledge the DOE has gained through scientific investigations and engineering design activities conducted to date, as well as streamlining and focusing both technical and regulatory elements of the YMP, the Yucca Mountain Site Characterization Office (YMSCO) has defined the following three near-term objectives:

- 1) complete an update to the YMP regulatory framework (DOE's siting guidelines in 10 CFR 960, *General Guidelines for the Recommendation of Sites for Nuclear Waste Repositories*.) in 1997;
- 2) complete the VA milestone in 1998;
- 3) complete the remaining statutory milestones to issue an EIS in 2000, recommend the repository site to the President in 2001, and submit an LA to the Nuclear Regulatory Commission (NRC) in 2002.

This Plan addresses the E&I activities and products which support the near-term VA milestone objective.

### 2.2 COMPONENTS OF THE VA MILESTONE

The four components of the VA package, as identified in Subsection 1.2, address the design, total system performance assessment (TSPA), LA planning, and the Mined Geologic Disposal System (MGDS) cost estimate.

The first component of the VA package will address those design elements that are critical to determining the feasibility and performance of the repository and the engineered barrier system. This effort will evaluate the technological feasibility of the designs but will not yet contain the detail needed for licensing. The designs will build on existing design work documented in the *1996 MGDS Advanced Conceptual Design Report*, with emphasis placed on the key technical questions that affect licenseability, criticality control, waste containment and isolation, handling and packaging of waste, performance, and cost. These questions revolve around design of waste packages, surface and subsurface facilities, thermal management of the waste-generated heat, corrosion of waste packages, the role of supplemental engineered barriers, degradation of waste forms, and transport of

radionuclides. In addition, the effort will address concepts for waste retrieval operations, performance confirmation requirements, safety systems, and other factors that could significantly affect repository costs.

The second component of the VA package will be a TSPA based on an updated design and the analyses of available site and engineering data. The primary objective of the TSPA is to evaluate the probable behavior of the potential repository. An additional objective is to further refine the evaluations of repository performance under a range of normal conditions and an initial evaluation under a selected set of conditions imposed by potentially disruptive events, such as tectonic movements along geologic faults. The TSPA will also evaluate the possible change in performance as a consequence of the uncertainty in key factors such as groundwater flow, thermal effects, and corrosion.

The third component of the VA package is the LA Plan, which, among other functions, will identify the remaining scientific investigations, engineering information, and estimated costs required to complete an LA. The preparation of the LA Plan will provide an opportunity to assess the adequacy of the revised approach to site characterization and design, and the effectiveness of updates to the Office of Civilian Radioactive Waste Management (OCRWM) Program's regulatory framework.

The fourth component of the VA package provides cost estimates for the repository system. The cost estimates are not for the total system life-cycle costs (TSLCC), but will address all relevant costs for the MGDS. It will provide information for policy decisions regarding the feasibility and rationale for continuing with licensing and construction of a geologic repository at Yucca Mountain.

## **2.3 DESIGN AND SYSTEMS ENGINEERING ROLE**

The E&I Operations area of the M&O is responsible for the Design and Systems Engineering organizations' activities which will directly support the first and fourth VA package components on design and cost estimates. The E&I Operations area will also be responsible for providing accurate and timely information required to develop the second and third VA package components on TSPA and LA planning. This Plan will discuss the role of the E&I organization and its activities and products. Other organizations, activities and products that are dependent on the products of the E&I Operations area, and which support the VA milestones, are discussed in the VA Monitoring Plan.

## **2.4 QUALITY ASSURANCE (QA)**

Based on an evaluation in accordance with QAP-2-0, *Conduct of Activities*, this Plan was determined to be a non-Q product.

The quality affecting aspects of the Design and Systems Engineering products required to support the VA milestone will be determined in accordance with applicable procedures.

### **3. ENGINEERING ACTIVITIES**

#### **3.1 VA CONCERNS**

A list of the Design and Systems Engineering related concerns important to the VA milestone has been developed and is provided in Appendix A. These concerns are areas of work with relatively higher risk. Consequently, the concerns list will be used to focus the planning and performance of activities leading to the VA milestone.

#### **3.2 VA ISSUES**

A list of the Design and Systems Engineering related issues important to the VA milestone has been developed and is provided in Appendix B. These issues are related to trade-offs or decisions with significant, potential impacts for the OCRWM Program. Consequently, the planning for issue resolution will help provide timely answers to significant questions and will help manage risk leading to the VA milestone. The method for resolving the issues and keeping the list current is also provided in the appendix.

#### **3.3 VA DESIGN AND SYSTEMS ENGINEERING PRODUCTS**

The Design and Systems Engineering products developed in preparation for the VA milestone are of two basic types. Some consist of information passed along to other YMP organizations to support their activities leading to the VA milestone (see Section 6 for a detailed discussion of YMP integration). Other products consist of the components which make up the MGDS design. Examples of such components are requirements documents, analysis documents, drawings, technical reports, etc. The current lists of the specific E&I products are provided in the following appendices:

- Waste Package Development and Materials Products (Appendix C)
- Repository Surface and Subsurface Products (Appendix D)
- Systems Engineering Products (Appendix E)

Descriptions for these products are provided in the M&O earned value guidelines documents that have been developed by the E&I Operations Area and coordinated with the DOE. These descriptions provide the standards for the stages of completion for each type of document. The FY97/98 schedules (Appendices I, J and K) identify when the products are expected to be completed. By comparing the contents and timing of each product with the stage of completion standards contained in the earned value documents and the timing standards contained in the schedules, management is able to evaluate the progress accomplished toward the VA milestone. Engineering documents will represent the most important systems, structures, and components as determined by the binning process. Those systems which are most important to licensing and capital cost are being given priority in the planning. Studies, reports, and requirements documents, when delivered in compliance with the earned value guidelines and the planning schedules, will illustrate that timely decisions are being made on important issues, and that assumptions are being made as necessary to facilitate progress in completing engineering for the MGDS.



## 4. DESIGN REVIEWS

The products to support the VA milestone need not be completed to a level suitable for construction release. The level of completion for each product will be as required to support defined objectives of the VA milestone in accordance with the VA Monitoring Plan..

The process for reviewing the design throughout its development has been proposed by the M&O to include the following:

- 1) reviews of each product or deliverable during the design process and in accordance with applicable QA procedures;
- 2) informal, in-process product status reviews;
- 3) formal administrative status reviews of cost, schedule, earned value, and deliverables; and
- 4) formal high-level management system design reviews.

Together, these reviews provide a comprehensive means for assessing progress and ensuring customer confidence throughout the design development.

### 4.1 QA REVIEWS

When each design product (drawings, analyses, specifications, reports) has been developed to a point suitable to support the VA milestone, it will be released. The product will be reviewed and released in accordance with the appropriate M&O QA procedures. The following are examples of some of those procedures:

*QAP-3-5, Development of Technical Documents*  
*QAP-3-8, Specifications*  
*QAP-3-9, Design Analysis*  
*QAP-3-10, Engineering Drawings*

At this stage of the preliminary design, nearly all the engineering documents will present concepts that will be carried forward to LA design. These documents represent decisions affecting layout of the Yucca Mountain Site and the various facilities, design of the most important systems, structures and components, and plans for design at a more detailed level. As such, all of these engineering documents will be distributed to the DOE for review. Documents prepared in accordance with QA procedures will be submitted during the design review process, thus giving the DOE an opportunity to comment. Documents that are *not* prepared in accordance with QA procedures will be provided to the DOE concurrent with the M&O internal review process. This phase of the design will establish the direction for all subsequent phases of design development. For this reason, the DOE must be given the opportunity to participate in the process. A copy of all products both before and after the M&O review, will be distributed to the DOE.

## **4.2 IN-PROCESS REVIEWS**

In-process status reviews are key to maintaining an on-going communication between the M&O engineers and their DOE counterparts throughout the development process. This ongoing interaction is typically informal, but is frequent and regular. Several forums have been established to facilitate these interactions in which the progress on products or product sets, or briefings for upcoming reviews, are discussed. The reviews which address Work Breakdown Structure (WBS) unique topics are facilitated and controlled by the DOE and M&O WBS Managers. The reviews which address topics common to two or more WBS areas are facilitated by the M&O's MGDS Project Engineering Office.

## **4.3 ADMINISTRATIVE STATUS REVIEWS**

A less frequent but regularly scheduled review of cost, schedules, earned value, and deliverable status has also been established. This more formal, higher level management review provides an assessment of how efficiently and timely the design is being developed and provides an opportunity to identify problems or to pursue specific issues. This review is controlled by the E&I Manager and DOE counterparts, and is facilitated by the M&O's MGDS Project Engineering Office.

## **4.4 MANAGEMENT REVIEWS**

The purpose of the management reviews is to provide a high-level review of how all elements of the design work together to complete the overall mission of safely disposing radioactive waste. During these reviews, design information provided to other YMP organizations is validated, course corrections are made, and an assessment performed on the soundness of the overall design. A series of three management reviews are planned en route to the VA milestone: the June Design Review, the Phase I Design Review, and the MGDS VA Review. These reviews will be structured, where appropriate, to also meet the VA monitoring requirements as identified in the VA Monitoring Plan.

### **4.4.1 June Design Review**

The purpose of this June 1997 review is to assess the overall engineering approach and obtain high-level management concurrence. It will address the major issues, topics, risks, concerns and progress within the E&I area of responsibility. It will not get into a review of the design details nor the contents of the information being provided to the other YMP organizations to support their VA milestone activities. These topics will be covered in the Phase I Design Review. A discussion of this review and a description of the planning for this review are provided in Appendix F.

### **4.4.2 Phase I Design Review**

The purpose of the Phase I Design Review is two-fold. The first purpose is to review all the information exchanged between Design and Systems Engineering and the interface organizations such as Performance Assessment (PA), Site, NEPA, etc., to ensure completion. The second purpose is to compare those activities completed to date, with the planned progress of activities in order to identify and refocus efforts toward a successful VA milestone. It will be a review of the design and operational concepts at a more detailed level than covered at the June Design Review. A discussion

of the Phase I Design Review and a description of the planning for this review are provided in Appendix G.

#### **4.4.3 MGDS VA Review**

The focus of the MGDS VA Review is to ensure that all relevant design information has been completed and summarized in VA supporting documentation or in the Project Integrated Safety Assessment. A discussion of this review and a description of the planning for this review are provided in Appendix H.

## 5. SCHEDULES

The FY 97/98 schedules are being developed as part of the current planning activity. Planning is continuing and the schedules are expected to be completed in March 1997. The current versions of the E&I schedules are:

- Systems Engineering Schedule (Appendix I)
- Waste Package Development and Materials Schedule (Appendix J)
- Repository Surface and Subsurface Schedule (Appendix K)

All activities identified in the schedules support the VA milestone except those that are completely outside the scope of the VA package (see Subsection 1.2). These schedules are used with the other management tools identified in this Plan to allocate resources and monitor progress toward the VA milestone.

## 6. INTERFACES

The interfaces of the Design and Systems Engineering organizations with other YMP and OCRWM areas involve both data needs (input) and data deliveries (products). These data needs and deliveries and their associated dates are captured in the schedules listed in Section 5. These schedules were used to create a point of departure checklist of the interactions and exchanges of information planned between the E&I Operations area and other YMP and Program areas both within the M&O and external to it. This checklist is provided in Appendix L. Some anticipated interfaces are not yet funded and included in the planning; however, it is expected that when funding and guidance is provided, the planning will address these Program level interfaces. Specifically, these Program interfaces will include DOE/EM for the DOE-SNF and other waste, RSAs for waste receipt characteristics, and potential interfaces for co-located, government directed, federal receiving facilities. Additionally, there are plans for various organizations to provide support to E&I activities, with budget provided for that support. These interactions with other organizations are captured within the Basis of Estimates for these specific activities. Numerous organizations are invited to participate during review of E&I documents. Some participation is required by procedures, but most of the participation is administratively controlled in the review process.

The design organization will request qualified input in accordance with the QA process. When qualified input is not available, unqualified input will be used and will be labeled as such.

Design and engineering products (i.e., functional and design analyses, drawings, specifications, etc.) that address major features and parameters of the developed design and operations will be provided to support the TSPA-VA and the planning to the LA. Some of this output may be preliminary or be considered a work in progress (i.e., some products may not be fully reviewed and approved). Such engineering products will be identified as preliminary and released for a specific purpose.

## 7. SUMMARY OF M&O VA MANAGEMENT TOOLS

The M&O VA management tools identified and discussed in this Plan are summarized in the following Table. A brief description is provided, along with a reference to the corresponding Appendix which provides a version of the tool that was available at the time this Plan was developed. These tools are kept current and controlled by the individuals identified in the Table.

**Summary Table - M&O VA Management Tools**

<b>Title</b>	<b>Description</b>	<b>M&amp;O Controller</b>	<b>M&amp;O Keeper</b>	<b>Appendix</b>
VA Concerns	A list of concerns used to focus the planning and performance of activities leading to the VA milestone.	J. Bailey	C. Hastings	A
VA Issues	Issues are identified and the plans to resolve them are provided. The resolutions of these issues are used to provide direction and manage risk leading to the VA milestone.	J. Bailey	C. Hastings	B
Waste Package Development and Materials Products	A list of products to be developed by the Waste Package Development and Materials group in FY 97.	A. Segrest	C. Chagnon	C
Repository Surface and Subsurface Products	A list of products to be developed by the Repository Surface and Subsurface group in FY 97.	A. Segrest	B. Stanley	D
Systems Engineering Products	A list of products to be developed by the Systems Engineering group in FY 97.	A. Segrest	F. VanDerLaan	E
June Design Review	Description and planning for the June Review used to integrate the E&I activities required to support the review.	R. Snell	M. Sellers	F
Phase I Design Review	Description and planning for the Phase I Review used to integrate the E&I activities required to support the review.	R. Snell	J. Clouet	G

<b>Title</b>	<b>Description</b>	<b>M&amp;O Controller</b>	<b>M&amp;O Keeper</b>	<b>Appendix</b>
MGDS VA Review	Description and planning for the MGDS VA Review used to integrate the E&I activities required to support the review.	R. Snell	J. Clouet	H
Systems Engineering Schedule	FY 97/98 schedule of Systems Engineering tasks and milestones used to monitor and control its activities and products.	R. Wagner	F. VanDerLaan	I
Waste Package Development and Materials Schedule	FY 97/98 schedule of Waste Package Development and Materials tasks and milestones used to monitor and control its activities and products.	A. Segrest	C. Chagnon	J
Repository Surface and Subsurface Schedule	FY 97/98 schedule of Repository Surface and Subsurface tasks and milestones used to monitor and control its activities and products.	A. Segrest	B. Stanley	K
E&I Interfaces	A point of departure checklist of the FY 97/98 Planning summary accounts which involve interfaces with other YMP and Program areas.	R. Wagner	M. Sellers	L

## **APPENDIX A**

### **VA CONCERNS**

The data contained in this appendix reflects the status of the Yucca Mountain Site Characterization Project as of 12/16/96. Because of the evolving conditions of the Yucca Mountain Site Characterization Project, data in this appendix is changed or updated as necessary. However, this VA Design and Review Plan will not be revised or reissued as a result of data updates. For a current status of the data in this appendix and/or a copy of the current version, contact C. Hastings. For suggested changes to the contents, contact J. Bailey.



## **VA CONCERNS**

A list of concerns has been developed to help focus the planning and performance of the E&I activities leading to a successful VA milestone. The list includes a title and the organization that is primarily responsible for addressing the concern in their planning. Sometimes, a short description of the concern is provided with the title.

## **APPENDIX B**

### **VA ISSUES**

The data contained in this appendix reflects the status of the Yucca Mountain Site Characterization Project as of 3/7/97. Because of the evolving conditions of the Yucca Mountain Site Characterization Project, data in this appendix is changed or updated as necessary. However, this VA Design and Review Plan will not be revised or reissued as a result of data updates. For a current status of the data in this appendix and/or a copy of the current version, contact C. Hastings. For suggested changes to the contents, contact J. Bailey.

Viability Assessment Design Concerns

Concern No	Concern Title	E&I Org. of Primary Responsibility
C-1	Waste package emplacement concept for thermal management (point load vs line load)	MGDS PE
C-2	Subsurface ventilation concept, feasibility & operation (continuous emplacement drift, preclosure ventilation vs during emplacement only) (concepts for dust control); Includes subsurface ventilation redundancy.	Repository Design
C-3	Waste package materials	Waste Package Development
C-4	Waste stream characteristics and throughput requirements from receipt to emplacement	Systems Engineering
C-5	Lag storage capacity requirements and concept	Systems Engineering
C-6	Updated Q-list	Systems Engineering
C-7	Closure & decommissioning concepts for equipment, facilities & operations procedures	Repository Design
C-8	Remote welding and NDE of loaded disposal containers	Repository Design
C-9	Determine the appropriate and necessary levels of geologic fault characterization	Repository Design
C-10	Identify constraints (standards) from EPA & NRC on waste package loading relative to normal and off-normal operations	Repository Design
C-11	List of prohibited and limited use materials	Systems Engineering
C-12	Waste package fabrication method	Waste Package Development
C-13	LA strategy for DOE SNF	Waste Package Development
C-14	Design basis waste characteristics	Waste Package Development
C-15	Safeguards and security requirements and concepts; Includes IAEA inspection requirements and concepts.	Systems Engineering
C-16	SNF burnup measurement requirements and concepts	Waste Package Development
C-17	Surface facilities requirements and concepts	Repository Design
C-18	Restricted area requirements and concepts	Systems Engineering
C-19	Seismic design requirements	Repository Design
C-20	Subsurface fault standoff requirements	Repository Design
C-21	OSHA and MSHA code compliance requirements	Systems Engineering
C-22	Design basis rock fall characteristics - Post Closure	Repository Design
C-23	Waste package containment requirements	Waste Package Development
C-24	Near field environment design basis	Repository Design
C-25	Nevada transportation routes and modes	System Engineering
C-26	Off site utility requirements and concepts	Repository Design
C-27	Subsurface drainage requirements and concepts	Repository Design
C-28	Number of HLW glass canisters per disposal container	Waste Package Development
C-29	Design development of engineered features that demonstrate licensability of unprecedented systems, structures, components or activities (SSCA)	MGDS Development
C-30	Design development of engineered features that while using existing technology are unique to the MGDS operations and have little or no design precedence	MGDS Development
C-31	Design development of engineered features that have significant impact on cost and schedule estimates for MGDS construction, operation, and closure	MGDS Development

## VA ISSUES

A list of key VA issues has been developed, the resolution of which will provide direction and reduce risk to the Program. The following steps will be used to track progress of resolving the issues and for updating the list as required:

- An M&O and a DOE Responsible Individual (RI) is identified for each key VA issue as given in the table below.
- For each key VA issue, the M&O RI will prepare a resolution plan in accordance with the guidance given in attachment 1.
- Each resolution plan will be coordinated within M&O and DOE.
- Each resolution plan will be implemented and tracked to the conclusion of the key VA issue.
- On a regular basis, the list of key VA issues and the resolution plans will be reviewed and updated as required.

The latest version of these resolution plans are provided in Attachment 2. Status of activities addressed in these resolution plans will be monitored in accordance with the VA Monitoring Plan. E&I management will direct remedial actions and provide necessary resources if progress toward resolution is not in accordance with the resolution plan.

## **Attachment 1 - Resolution Plan Form and Instructions**

# Viability Assessment Design Issues

Issue No	Issue Title	VA Issue POC - DOE	VA Issue POC - M&O
1	Thermal loading range (high, medium, low) (reference values)	Harrington	Blink
2	EBS performance enhancements (backfill, drip shields, etc.)	Haught	Balady
3	Criticality control: NRC strategy (probabilistic vs. deterministic) and concepts (filler, control rods, partially filled WP, use of DU) (assuming burn up credit)	Russell	Benton
4	Emplacement drift ground support concept (steel vs cast in place concrete vs precast concrete)	Gonzalez	Nolling
5	Performance Confirmation concept (monitoring system, sampling approach, sampling rate, etc.)	Boyle	Memory
6	Retrievability concept (Instant & continuous vs develop when required)	Harrington	Saunders
7	Confirmation of high volume and long period waste handling capability and DBE consequences (dry vs pool)	Verna	Meyers
8	Disposal of site generated waste (on site vs off site)	Verna	Memory
9	Strategy for mapping repository subsurface	Boyle	Memory
10	Post closure performance standards	Van Luik	Kalla
11	Viability of underground, remote control concepts	Harrington	McAfee
12	Burnup credit limits (none vs principal isotopes)	Russell	P. Hastings
13	Repository seals requirements and concepts	Harrington	Memory

8. Describe the steps in a process that the project will use to bring closure on this issue

No.	Title	Description	Summary Account #
1	Assign Tasks		
2	Gather Data		
3	Document Resolution		
4	Report Conclusions		

9. Provide a rough schedule of when this issue will be resolved for VA

			----- FY97 -----												----- FY98 -----											
No.	POC (Name/Phone)	Date	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S
1	John/x55555	10/1/96	X																							
2	Joe/x66666	11/12/96 - 4/30/98		X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X						
3	John/55555	8/1/98 - 9/1/98																							X	X
4	John/x55555	9/30/98																								X

10. Describe a process that will be used to measure performance towards closure. Performance will be measured in accordance with the process documented in the VA Monitoring Plan.

11. Describe how status will be reported during the process of closing this issue. Status will be reported in accordance with the process documented in the VA Monitoring Plan.

Coordination:

DOE RI: \_\_\_\_\_

M&O RI: \_\_\_\_\_

DOE Manager: \_\_\_\_\_

M&O Manager: \_\_\_\_\_

## Key VA Issue Resolution Plan

1. Issue Title: \_\_\_\_\_ Date: \_\_\_\_\_ Rev. # \_\_\_\_\_
2. Issue Description: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
3. Responsible Individuals:    DOE: \_\_\_\_\_ Phone: \_\_\_\_\_  
   M&O: \_\_\_\_\_ Phone: \_\_\_\_\_
4. Describe the current status and the significance of the issue. \_\_\_\_\_  
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\_\_\_\_\_
5. Indicate its importance and what effects it will have on a VA. \_\_\_\_\_  
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\_\_\_\_\_
6. Describe how the issue ties to the TSPA, MGDS cost estimate, and LA planning. \_\_\_\_\_  
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\_\_\_\_\_  
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7. Describe the strategy and criteria for achieving a degree of closure sufficient for VA. \_\_\_\_\_  
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\_\_\_\_\_  
\_\_\_\_\_

(Continued on next page)



**Key VA Issue  
Resolution Plan**

**Continuation Page for Paragraph 8**

<b>No.</b>	<b>Title</b>	<b>Description</b>	<b>Summary Account #</b>

**Key VA Issue  
Resolution Plan**

**Continuation Page for Paragraphs 4 through 7**

**Continuation for Paragraph Number \_\_\_\_:**

# Key VA Issue Resolution Plan

## Guidance

**Issue Title:** Taken from list of Key VA Issues.

**Date:** Date the form was completed sans the coordination signatures.

**Rev. #:** 1st version submitted for coordination signature is Rev. # 00.  
After all coordination signatures on Rev. # 00, the 1st modified version submitted for coordination signatures is Rev. # 01. Etc. for other modified versions.

**Issue Description:** A description of the issue including scope, constraints and specific examples.

**Responsible Individuals:** Taken from list of Key VA Issues.

**For Paragraphs 4 - 7, confine oration to the space provided on the form. However, if additional space is necessary to communicate the full extent of the planning, use the appropriate continuation page.**

**Paragraph 4:** Address what has been done and what is currently being done. Describe the work scope(s) that it is a part of. Identify groups outside of E&I that are key players. Discuss why it is significant for the OCRWM Program.

**Paragraph 5:** Address the importance to VA design of resolving this issue. Identify the impact if it is not resolved by VA.

**Paragraph 6:** Describe the products and their contents (if any) that will be used to communicate the resolution of this issue to those working on TSPA-VA, VA cost estimate, and/or LA planning.

**Paragraph 7:** Describe the VA closure criteria for this issue and the general strategy for achieving closure.

**Paragraph 8:** Identify and describe the major tasks required to resolve the issue. Type over the examples given in the form. Try to confine the description to the space provided on the form. Use the appropriate continuation page for additional space for the major tasks and for any sub-tasks.

**Paragraph 9:** For each of the major tasks of paragraph 8, provide the point of contact (POC), dates and schedule notation. Type over the examples given in the form. Use the appropriate continuation page for additional space for major tasks and for any sub-tasks.

**Continuation Page for Paragraph 9**

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## **Attachment 2 - Resolution Plans for Key VA Issues**

**The following resolution plans for the VA issues have been reviewed by E&I management, but have not yet been coordinated with the DOE. The M&O is currently working to complete the coordination with the DOE.**

The resolution plans will be updated as necessary during progress toward the VA milestone. C. Hastings is responsible for maintaining the plans based on input from the DOE and M&O Responsible Individuals. J. Bailey is responsible for controlling the content of the plans. Any changes to the plans will require rolling the "Rev" number and obtaining the appropriate DOE and M&O coordination signatures.

## **Key VA Issue Resolution Plan**

### **Plan Coordination Procedure**

The M&O RI shall complete the plan and obtain the required coordination signatures in accordance with the following procedure:

1. Complete Paragraphs 1 through 7.
2. Submit the partially completed form to your supervisor for a verbal concurrence and direction to proceed with completing the form. Continue to rework these paragraphs as necessary until verbal direction is received.
3. Complete Paragraphs 8 and 9, and sign the form as the M&O RI.
4. Submit the draft form to your supervisor for a verbal concurrence from your supervisor, E&I OM signature, and direction to proceed with the DOE coordination process. Continue to rework the form as necessary until the M&O Manager's signature is obtained.
5. Review the contents of the form with your DOE RI counterpart, and obtain his coordination signature. Continue to rework the form as necessary until the DOE RI counterpart signature is received. If non-editorial, technical changes are required, repeat step 4 before obtaining the DOE RI signature.
6. Request assistance from your DOE RI counterpart in obtaining the appropriate DOE Manager's signature. Continue to rework the form as necessary until the DOE Manager's signature is received. If non-editorial, technical changes are required, repeat steps 4 and 5 before obtaining the DOE Manager's signature.
7. Insure that copies of the completed form have been delivered to the following distribution:
  - Your Supervisor
  - E&I OM
  - DOE RI
  - DOE Coordinating Manager
  - E&I Assistant Manager
  - MGDS PE Office Manager
  - M&O Systems Engineering Manager
  - M&O Design Engineering Manager
  - Others as Appropriate

**Key VA Issue  
Resolution Plan**

1. **Issue #1: Thermal Management**

March 10, 1997

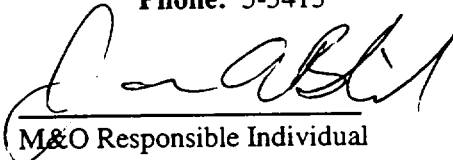
Rev. #01

2. **Assigned to:**      **M&O Responsible Individual:** Jim Blink  
                         **DOE Contact:** Paul Harrington

**Phone:** 5-4371

**Phone:** 5-5415

  
M&O Manager

  
M&O Responsible Individual

3. **Issue Description:**

Determine thermal management techniques that will be used for VA design (and others that will be reconsidered for LA design), and then develop design solutions to implement them. Candidate techniques include overall areal mass loading, line vs. point loading, edge loading, active ventilation, passive ventilation, the use of backfill or other EBS components, WP sequencing within the repository, SNF assembly sequencing within individual WPs, and the degree of lag storage required to implement WP or SNF assembly sequencing. Evaluations to select thermal management techniques will use as criteria the existing thermal goals stated in the CDA for protection of cladding, limiting the drift wall mechanical loading, protection of zeolites, limitation of surface temperature rise and uplift, and shear of the TS<sub>w</sub>/PT<sub>n</sub> interface. The evaluations will also consider additional goal(s) to limit the exposure of WPs to moisture and high humidity (for high AML), to limit temperature-dependent corrosion for low AML, and to allow drainage of mobilized water through the repository pillars (for high and low AML). Performance assessment types of criteria, including WP failure history, EBS radionuclide release rate, and accessible environment dose rate will also be used. This issue is related to issues 2 (EBS Performance Enhancements), 3 & 12 (Criticality), and 7 (Surface Facility Waste Handling); resolution of these five issues will require coordination and integration. This issue is also related to issue 18 (Design Basis Modeling) and will be a subset of the design options modeled in that issue.

4. **Describe the current status and the significance of the issue:**

The VA design will use a specific AML within the 80-100 MTU/acre range. The VA design is currently using point loading at 83 MTU/acre, but may adjust the AML during VA design. The FY96 Thermal Systems Study recommended reducing the upper bound to 90 MTU/acre, but that recommendation was not accepted by management because of insufficient evidence, and certainty of the evidence, to support making a change in requirements. Point loading will be used as the reference case for VA design, but line loading will continue to be evaluated as a PA sensitivity analysis during VA. Edge loading, active and passive ventilation, and the use of backfill will not be considered for the VA design, but may be reconsidered for the LA design. The current design does not consider WP or SNF assembly sequencing, but that situation may need to change, depending on the additional thermal goal(s). The current design is limited by the zeolite temperature goal, with the drift wall temperature goal and the cladding temperature goal being nearly limiting for some of the WPs. The current design (point loading, no WP or SNF assembly sequencing) may not meet the additional goal(s) to limit exposure of WPs to moisture and high humidity. Ultimately, the overall design will be evaluated to regulatory requirements (substantially complete containment, controlled release from the EBS, releases to the accessible environment, criticality control, etc.). TSPA will be the tool to

make such evaluations, and aspects of the TSPA tool will be refined using process model improvements and data from ongoing laboratory and field testing of thermal processes. If the TSPA evaluations show the current design does not meet the regulatory requirements, the design organization is retaining flexibility to go toward a low AML as an alternative. Interfaces for this issue are Subsurface Design, Surface Design, WPD, WP Materials, Systems, PA, SPO, and the EIS process.

5. **Indicate its importance and what effects it will have on a VA:**

The performance of the repository and its cost are dependent on thermal management decisions and associated design solutions. Not making the appropriate design decisions for VA could lead to an unacceptable performance in the TSPA for VA. To date, the TSPA calculations have not had enough fidelity to be used as a tool to easily select thermal management options; the ability of PA to make such sensitivity analyses has improved considerably in the past few years and is expected to improve much more as part of the TSPA-VA abstraction process.

6. **Describe how the issue ties to the TSPA, MGDS cost estimate, and LA planning:**

The products of resolving this issue will be decisions on thermal management options to be implemented in the VA and LA designs, and the design solutions implementing these decisions. The design solutions will be incorporated in cost estimates and the TSPA. It will be important for the TSPA abstraction process to include the selected thermal options. For thermal management techniques not used in the VA design, we will need to plan how to evaluate them, and decide whether to incorporate them, in the LA design; this planning will need to be part of the LA planning which is one of the four components of the VA.

7. **Describe the strategy and criteria for achieving a degree of closure sufficient for VA:**

The near term focus will be on the line vs. point loading issue and determining the overall AML. For the intermediate time frame, the additional thermal goal(s) will be formulated and applied to the VA design; this should be of use to the PA effort as well. It is anticipated that the new thermal goal(s) will result in some constraints on the WP and SNF assembly sequencing, and thus on the design and operational concept.

Closure of this issue will be documented by inclusion of the selected thermal design techniques in the Controlled Design Assumptions document. Closure for VA will be for a limited subset of thermal management techniques; the issue will not be fully resolved for VA.



8. Describe the steps in a process that the project will use to bring closure on this issue:

No.	Title	Description	Summary Account #
1	Line Load Evaluation	<p>Phase 1: Follow up to 96 Thermal Loading Study; reconcile three analysts' results; plan VA activity in area. (2/18 - 5/19/97)</p> <p>Phase 2: Use temperature &amp; humidity histories in WP degradation PA models, predict WP failure time distribution for LL vs. PL and for AMLs in the 80-100 MTU/acre range (5/20 - 6/23/97).</p> <p>Phase 3: Use WP failure time distribution &amp; NF water flux to predict total system performance (6/24 - 7/21/97) ( provide feedback to management).</p> <p>Phase 4: Compare point and line load from Engineering, SCC, and TSPA perspectives; evaluate margin and uncertainty; develop T/RH goals to gain margin and reduce uncertainty (7/22 - 10/13/97).</p> <p>Phase 5: Apply T/RH goals to simulations of various WP sequences; develop WP sequence operational rules (10/1 - 12/5/97).</p> <p>Phase 6: Add T/RH goals and WP sequence operational rules to CDA (12/6/97 - 4/3/98).</p>	<p>TR11FB2</p> <p>TR11FB2</p> <p>TR11FB2</p> <p>TR11FB2</p> <p>TR11FB2</p> <p>TR11FB2, TR12FB2</p>
2	TSPA-VA	<p>VA scenario development</p> <p>TSPA-VA (PISA Chapter 8), total system calculations</p> <p>Peer review, and process model improvement due to the review</p> <p>TSPA abstraction process. Four of the ten workshops have a strong link to thermal issues. They are:</p> <p>WP Degradation (workshop Jan 8-10, 1997) (also, expert elicitation)</p> <p>Thermal Hydrology (workshop Jan 21-23, 1997) (also, expert elicitation)</p> <p>Waste Form Degradation/Mobilization (workshop Feb 19-21, 1997) (also, expert elicitation)</p> <p>Near Field Environment (workshop Mar 5-7, 1997)</p>	<p>TR541FB1; SL105AM3, 9/30/97; SL105E12, 1/28/98 TR541FB3; SL230GM3, 1/30/98; SL230KM3, 6/12/98; SL230M3, 8/20/98 TR541FB8, TR57FB3, TR57GB3, TR57GB5, TR57GB6, TR57GB7, TR57GB8; SLSR500M, 6/20/97</p> <p>TR542FB2, TR57FB4; SL208DM, 2/24/97; SL5X4E1M, 6/30/97; SL208J9, 1/30/98 TR543FB3, TR543GB2, TR57FB2; SLX09M, 3/18/97; SL5X41CM, 9/30/97; SLX09M3, 1/30/98; SLX10M3, 4/14/99 TR542FB1, TR542FB3, TR542GB1, TR57GB1; SL210DM, 5/15/97; SL204FX, 6/30/97; SL204S3, 12/19/97; SL210M3, 2/27/98; SL206M3, 5/10/99 TR543FB2, TR543GB1; SLX07MM, 6/30/97; SLX07M3, 4/2/98, SLX08M3, 7/19/99</p>

No.	Title	Description	Summary Account #
3	Corrosion Testing and Modeling	<p>Tests and models to determine the critical humidity for candidate materials and possible conditions (such as salt on surface). Tests to determine corrosion rates as a function of environment.</p> <p>Model development, and abstraction for TSPA</p> <p>Long term corrosion tests (large tanks with multiple samples)</p> <p>Short term thermogravimetric apparatus tests</p> <p>Long term relative humidity chamber corrosion tests</p> <p>Crack growth tests</p> <p>MIC tests: 2 abiotic and 4 biotic MIC tests, CR: 3/31/97.</p> <p>Screening electrochemical potential tests</p> <p>Long-term controlled electrochemical potential tests</p> <p>Short term electrochemical tests of galvanic corrosion</p> <p>Long term galvanic corrosion tests</p> <p>Thermal stability (aging) measurements</p> <p>Issue EMCR, Rev. 1.</p> <p>Ceramic testing and modeling</p>	<p>TR251FBE, TR251FA2</p> <p>TR251FBG; WB 60116, 7/8/97; WP 60118, 7/8/97 (don't know why 2A and 2B tanks have same date)</p> <p>TR251FB5</p> <p>TR251FBH; WP61607, 1/13/97</p> <p>TR251FBC; WP60703A, 1/16/97</p> <p>TR251FB1; WP26708, 1/16/97</p> <p>TR251FB4</p> <p>TR251FBA; WP26402, 2/10/97</p> <p>TR251FB7</p> <p>TR251FBB; WP60801A, 2/28/97 (7/30/97 in 97AP); WP60121, 9/11/97</p> <p>TR251FBK</p> <p>TR251FB9; WP015A3, 2/28/97</p> <p>TR256FB1, TR256FB2; WP60315A, 6/13/97</p>
4	Waste Isolation Requirements Study	Analyses to determine importance of features and components to waste isolation. Includes resolution of locations of zeolites and performance allocation. Performance allocation will be addressed. This study will follow up on the FY96 evaluation of backfill and other engineered barrier components such as drip shields. These components influence thermal performance.	TR15FB1, TR541FA3; SE440M3, 3/31/97 (4/1 in 97AP?)
5	Performance Confirmation Follow-on Work	Analyses to determine performance confirmation methodology and consequent requirements imposed on design. The deliverable report will include drafts of the PC baseline and PC program plan.	TR15FB1; SE050BM3, 9/30/97
6	WP Size Study	This study will develop the rationale for the WP size used in VA and LA design. WP size is a key factor in thermal performance. The current rationale is based on an MPC baseline.	TR15FB1; SE460M3, 9/30/97

No.	Title	Description	Summary Account #
7	Waste Quantity, Mix, & Throughput Study	This study will add definition to expected waste streams and surface facility requirements. Its results will be used to develop WP and SFA sequencing scenarios for thermal analyses. Its deliverable will recommend a consistent approach for utilization of the waste stream, for use in surface, subsurface, and WP design. Will address temporary storage requirements driven by thermal loading and/or surges in shipment rate.	TR15FB2; SE200M3, 3/31/97
8	Retrievability Study	Analyses to determine constraints placed on design by the regulatory retrievability design. This could influence thermal performance, depending on the constraints.	TR15FB3; SE502M3, 4/30/97
9	MGDS CONOPS	Develop CONOPS in support of VA. Document in PISA Chapter 11. The milestone is a review draft	TR12FB3; TR142GB1, TR12GB5; SE400BM3, 9/30/97
10	Test & Evaluation Plan	Develop the Test and Evaluation Plan (T&EP) to support the VA to integrate Project testing. Emphasis will be on developing test requirements; identifying test architecture; and allocating requirements to the identified tests.	TR13FB1; SE418M3, 9/30/97
11	MGDS RD	MGDS Requirements Document, Rev. 3; includes "in-situ environment requirements" and "operational requirements"	TR12FB2, TR541FA4, TR12GB2; SE422M3, 3/3/97

No.	Title	Description	Summary Account #
12	Subsurface EBS Design	<p>Subsurface design is key to thermal performance. The AML will be determined by evaluating (using ANSYS with initial water vaporization energy included) temperature at the surface, drift wall, and zeolite layer (170 m below the repository horizon). The zeolite temperature is thought to be controlling. Without backfill, the drift wall temperature is more controlling than the cladding temperature.</p> <p>Support requirements development Prepare VA and LA Design and Review plans</p> <p>Support system studies (activities 4-8, 10) SDD Development Evaluate NFE impacts on Subsurface Design Drift stability design Subsurface layout</p> <p>Emplacement system design Radiological design Ventilation design Retrieval design Backfill, invert, and WP support design Performance Confirmation design</p>	<p>TR42FA3 TR42FA6; RP120MG1, 12/31/96; RP120MG2, 9/30/97 TR42FB4 TR42FB5; RP120M3H, 9/30/97 TR47FB2 TR47FB3; RP120M3C, 9/30/97 TR47FB5; RP120M3, 7/31/97; RP120M3A, 7/31/97; RP120M3B, 9/30/97 TR47FB6; RP502M3, 9/30/97 TR47FB7 TR47FB9; RP120M3D, 9/30/97 TR47FBA; RP504M3, 8/29/97 TR47FB1; RP120M3E, 3/31/97 TR47FBJ; RP120M3F, 4/1/97</p>
13	Surface Design	<p>General arrangements and operating concept of the surface facilities. The first deliverable is the establishment of the number of operating trains and capacity of in-process staging areas for waste handling operations. The second is waste handling and cask flow diagrams. The third are the general arrangements. Two other deliverables (not listed) concern HVAC and secondary waste.</p> <p>Radiological safety design</p>	<p>TR46FB2, TR46FB5; RP243AMA, 1/30/97; RP243AMB, 5/30/97; RP243AME, 9/30/97; RP243CM, 9/30/97</p> <p>TR46FB3; RP242AM, 9/30/97</p>
14	WP Design	<p>Develop waste stream scenarios to define the Design Basis WP. Evaluate internal WP temp. for various WP sequencing scenarios. Evaluate criticality (flooded WP, flooded degraded WP, and external) to develop design basis WP constraints. Evaluate NFE impacts on WP performance Evaluate DOE-Owned SNF impacts on WP design Analyze additional Engineered Barriers such as drip shields</p>	<p>TR231FA1 TR233FB7 TR233FBE, TR233FB2; WP233755, 09/16/97 TR22FB5 TR233FA1 TR233FB5</p>

No.	Title	Description	Summary Account #
15	Site Characterization	<p>3-D Mineralogy Model, including locations of zeolitic zones  Mineralogic &amp; Hydrologic Characteristics of the PTn  Coupling Between Mineralogic &amp; Hydro. Char. of the PTn  Thermal Properties of Repository Horizon samples  Percolation Flux at the Repository Horizon  Unsaturated Zone Synthesis &amp; Modeling, incl UZ site flow model  Modeling the influence of heat on UZ Hydrologic Flow  3-D Integ Site Model Ver 2.0</p> <p>Mineral changes &amp; formation of flow barriers in the Altered Zone  Near-field geochemistry and hydrology</p> <p>Near-field thermal-mechanical behavior  Effects of introduced materials on the chemical composition of water  contacting WPs &amp; Waste  Near Field and Altered Zone Report, Vol. 1; and summary reports on models  and processes</p> <p>Large Block Test</p> <p>Single Heater Test</p> <p>Drift Scale Test</p>	<p>TR32111FBB  TR32112FB4  TR32112FB5  TR32711FB1  TR33124FB8  TR33129FBG; SP24BM3, 6/16/97  TR33129FBH  TR395FA1, TR395FB1; SP23BM3,  2/28/97  TR3A1FB1, TR3A2FB2, TR3A2FB6  TR3C1FB1, TR3C2FB2, TR3C2FB3,  TR3C2FB4, TR3C2FB5, TR3C2FB6,  TR3C2FB7, TR3C2FBC  TR3C3FB8  TR3C5FBB</p> <p>TR3C5FB54, TR3C5FB9, TR3C5FBA4;  SP3000M3, 8/19/97; SP3005M3, 8/29/97;  SP3100M3, 11/17/97  TR3E1FB1, TR3E1FB2, TR3E1FB3;  SP9901C3, 1/27/97; SP9903M3, 8/29/97  TR3E2FB1, TR3E2FB2, TR3E2FB3,  TR3E2FB4; SP9200M3, 5/23/97;  SP23RM3, 8/29/97  TR3E2FB13, TR3E2FB23, TR3E2FB33,  TR3E2FB43; SP3305M3, 7/16/97;  SP3308M3, 8/4/9  8/4/97; SP3320C3, 12/8/97</p>

9. Provide a rough schedule of when this issue will be resolved for VA:

			-----FY97-----												-----FY98-----											
No	POC (Name/Phone)	Date	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S
1	Jim Blink/5-4371	02/18/97 - 04/13/98																								
2	Bob Andrews/5-5549	10/01/96 - 99+																								
3	Dave Stahl/5-4383	10/01/96 - 99+																								
4	Steve Saterlie/5-4026	10/01/96 - 04/01/97																								
5	Brent Thomson/5-4060	10/01/96 - 09/30/97																								
6	Ovadia Lev/5-4029	04/01/97 - 09/30/97																								
7	Rick Memory/5-3938	10/01/96 - 03/31/97																								
8	Rick Memory/5-3938	10/01/96 - 04/30/97																								
9	Richard Wagner/5-3935	10/01/96 - 09/30/98																								
10	Mark Balady/5-4032	10/01/96 - 09/30/97																								
11	Sam Rindskopf/5-3943	10/01/96 - 01/04/99																								
12	Dan McKenzie/5-4393	10/01/96 - 99+																								
13	Steve Meyers/5-4392	10/01/96 - 99+																								
14	Hugh Benton/5-4389	10/01/96 - 99+																								
15	Larry Hayes/5-5152	10/01/96 - 99+																								

10. **Describe a process that will be used to measure performance towards closure:**  
Performance will be measured in accordance with the process documented in the VA Monitoring Plan.
11. **Describe how status will be reported during the process of closing this issue.**  
Status will be reported in accordance with the process documented in the VA Monitoring Plan.

**Key VA Issue  
Resolution Plan**

1. **Issue #2:** EBS Performance Enhancements  
(Backfill, Drip Shields, etc.)

February 3, 1997

Rev. #01A

2. **Assigned to:** M&O Responsible Individual: Mark Balady  
DOE Contact: David Haught

Phone: 5-4032

Phone: 4-5474

  
M&O Manager

  
M&O Responsible Individual

3. **Issue Description:**

The long-term performance of the potential repository must be calculated to be compliant with a long-term performance standard. Given the possibility that the Performance Assessment "reference case" results scheduled to be completed in 1/98 may demonstrate that the potential repository modeled without EBS performance enhancements has insufficient performance margin, what EBS performance-related work should have already been conducted and subsequently incorporated into the MGDS design to support VA? Also, given the possibility that the 1/98 PA results will show sufficient calculated compliance with the performance standard, what EBS performance-related work should nevertheless have been conducted in support of VA?

4. **Describe the current status and the significance of the issue:**

A FY 1996 system study entitled "Engineered Barrier System Performance Requirements Systems Study" was conducted and determined that, based on the information available at the time of the study, there is no need to impose a requirement to use backfill, drip shields, or any other EBS performance enhancements outside the waste package. However, since this assessment was based on, among other things, an assumed post-closure performance standard and an infiltration rate to the repository horizon that may be of significantly less magnitude than we currently believe to be the case, the study concluded that we should not preclude the option to backfill at a later time if deemed necessary. Currently, work is ongoing in Subsurface Design (Summary Account TR47FBI, "Subsurface EB Segment Design") to establish that the emplacement system design can accommodate the use of emplacement drift backfill. This is scheduled to be completed by 4/97. The issue of postclosure performance standards (Issue #10) has also been identified as a Key VA design issue, and must be tracked by this issue.

**Interfaces:**

The Performance Assessment department is a key interface because it is their assessment of total system performance compared against the assumed performance standard that serves as the technical basis for stating the current lack of need for additional EBS performance barriers. Scientific Program Operations is also a key interface since it will be their ongoing characterization of the mountain, and corresponding abstractions by Performance Assessment, that may cause us to re-evaluate the need for additional EBS performance barriers. Also important will be any further modeling of the near-field environment, especially regarding flow and transport through and around the emplacement drifts as well as through emplacement drift backfill and the invert. Finally, Regulatory Operations is a key



interface as their support will be required to develop a regulatory compliance strategy for this issue as part of the overall license strategy conducted in support of VA.

5. **Indicate its importance and what effects it will have on a VA:**

If we find in the 1/98 time frame that the calculated long-term performance of the potential repository modeled without any EBS performance enhancements has insufficient performance margin relative to a long-term performance standard, then not resolving this issue will result in a VA that reflects insufficient long-term repository performance. This could result in a determination that the site is not viable.

6. **Describe how the issue ties to the TSPA, MGDS cost estimate, and LA planning:**

Resolution of this issue is only possible with input from TSPA. An assessment of whether additional EBS performance barriers are required will be possible only when the performance assessment results of 1/98 are produced. Given the short time remaining to VA once the PA results are available, it is clear that the TSPA should include long-term performance sensitivities that reflect the use of emplacement drift backfill and/or a chemically conditioned invert, if appropriate. If it is determined that these additional EBS performance enhancements are necessary, then there will be an impact to the MGDS cost estimate. For this reason, cost estimates for emplacement drift backfill and/or a chemically conditioned invert (if appropriate) should be included as contingencies in the MGDS cost estimate. With regard to LA planning, it must be emphasized that even if the PA results of 1/98 reflect satisfactory long-term repository performance without the use of EBS performance enhancements, there is still the possibility that information obtained subsequent to VA (i.e., during the performance confirmation period) may require a reassessment of repository performance. For this reason a regulatory compliance strategy for this issue should be adopted in support of LA planning.

7. **Describe the strategy and criteria for achieving a degree of closure sufficient for VA:**

The overall goal of this strategy is to achieve the performance required from the EBS such that the repository is calculated to meet long-term performance requirements. An integral element of this strategy is to identify those key assumptions that must be made in order that this issue can be resolved. Once identified, these key assumptions should be placed into the Controlled Design Assumptions document. In support of VA, a part of this strategy is to determine no later than 1/98 whether EBS performance enhancements are required to achieve the long-term performance criteria. A table depicting the performance enhancements, their calculated benefit to total system performance, and their associated costs, will be employed to aid in determining which enhancements, if any, should be incorporated into the VA design.

Closure sufficient for VA will be achieved when the following criteria are satisfied for each potential EBS enhancement being addressed:

a preliminary assessment of the total system performance benefits of the EBS enhancement is determined

design concept is developed that depicts incorporation of the EBS enhancement into the repository design

a cost estimate is developed for the potential EBS enhancement concept

8. Describe the steps in a process that the project will use to bring closure on this issue:

No.	Title	Description	Summary Account #
1	Repository Performance Assessment	Determine whether the reference case long-term repository performance assessment shows sufficient performance margin without additional EBS barriers	TR541FB3
2	Infiltration rate determination	Determine the net infiltration rate to be used for the TSPA - VA	TR543FB2
3	Backfill Thermohydrology	Determine the thermohydrological benefits of backfill at fluxes higher than those examined in TSPA-1995	TR47FB1
4	Viability of Backfilling	Establish the viability of backfilling emplacement drifts given the current emplacement drift envelope	TR255FB1, TR255FB2
5	Material Interaction of Backfill	Determine the long-range material interaction effects of backfill on waste packages	TR255FB1, TR255FB2
6	EBS Enhancements Study	Conduct a study that addresses the total system performance benefits of EBS enhancements (backfill, chemically treated invert) at higher fluxes	TR15GB4
7	EBS Enhancements Decision	Use the previous activity as part of the basis for deciding whether additional EBS performance barriers should be incorporated in the VA Design	milestone associated with previous activity
8	Incorporation of EBS Enhancements	Incorporate the recommended additional EBS enhancements, if any, into the VA Design	TR47GBD, TR46FB5
9	Regulatory Compliance Strategy	Develop a regulatory compliance strategy for this issue as part of the overall license strategy conducted in support of VA	TR524FB5, TR524GA5
10	Integration and Facilitation of Key VA Design Issue	Status individual activities identified to help resolve this issue; identify with a plan to resolve any developing problems that may endanger resolution of this issue	preliminary unfunded
11	Waste Isolation System Study	As part of this study, establish the feasibility of conditioning the emplacement drift invert with sedimentary apatite ore by determining the amount necessary under a waste package to sorb the <sup>237</sup> Np in a waste package	TR15FB1
12	Key Assumptions Identification	Develop and document those key assumptions that must be made in order for this issue to be resolved	preliminary unfunded
13	Waste Package Support/Invert Design	Address the possibility of chemical additives (sedimentary apatite or) in the invert	TR233FB6, TR233GB1

9. Provide a rough schedule of when this issue will be resolved for VA:

No	POC (Name/Phone)	Date	-----FY97-----												-----FY98-----											
			O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S
1	R. Andrews/5-5549	10/01/96 - 01/30/98																								
2	M. Pendleton/5-5550	12/01/96 - 05/30/97																								
3	R. Andrews/5-5549	10/01/96 - 01/30/98																								
4	D. McKenzie/4-1863	10/01/96 - 03/31/97																								
5	D. Stahl/4-7778	10/01/96- 08/29/97																								
6	R. Memory/4-7247	10/01/97 - 04/30/98																								
7	DOE/M&O Management	02/27/98																								
8	A. Segrest/4-1924	10/01/96 - 09/30/98																								
9	K. Ashc/5-5563	10/01/96 - 09/29/97 02/03/98 - 08/12/98																								
10	M. Balady/5-4032	10/01/96 - 09/30/98																								
11	S. Saterlie/5-4026	10/01/96 - 04/01/97																								
12	M. Balady/5-4032	10/01/96 - 03/17/97																								
13	T. Doering/5-4382	10/01/96 - 08/15/98																								

10. **Describe a process that will be used to measure performance towards closure:**  
Performance will be measured in accordance with the process documented in the VA Monitoring Plan.
11. **Describe how status will be reported during the process of closing this issue.**  
Status will be reported in accordance with the process documented in the VA Monitoring Plan.

**Key VA Issue  
Resolution Plan**

1. **Issue #3: Criticality Control**

February, 13, 1997

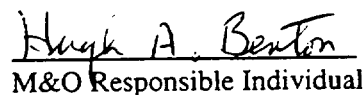
Rev. # 01A

2. **Assigned to:** **M&O Responsible Individual:** Hugh Benton  
**DOE Contact:** Paige Russell

**Phone:** 5-4389

**Phone:** 4-1315

  
M&O Manager

  
M&O Responsible Individual

3. **Issue Description:**

Demonstrating to the satisfaction of the NRC that criticality will be controlled during pre- and postclosure over the time period of regulatory concern (assumed to be at least 10,000 years) is one of the most important issues in the development of a viable MGDS design. The current 10 CFR 60.131(H) regulation does not recognize a probabilistic risk methodology.

4. **Describe the current status and the significance of the issue:**

Criticality control has a major impact on waste package and engineered barrier segment designs and their licensing. Criticality considerations govern many aspects of design including waste package capacity for some fuels, basket design, and amount and type of neutron absorbing material. The methods of validating the codes and models used in predicting long-term performance as it impacts the probabilities of criticality involve major interdisciplinary effort. Interfaces include: Scientific Programs, for the environmental conditions; LLNL, for the material confirmation tests; Performance Assessment, for the consequence evaluation process; Scientific studies, for the data reduction of the environment. Validating and justifying the amount of credit for burnup of the commercial spent fuel is an integral part of the overall development and documentation of criticality analysis methodology. Information on the methodology and the probabilistic approach have been presented to the NRC staff in the Disposal Criticality Analysis Methodology Technical Report along with examples of the design controls. Changes to the current deterministic regulations have been proposed, but not yet incorporated by the NRC.

5. **Indicate its importance and what effects it will have on a VA:**

The means of providing and demonstrating disposal criticality control will have important impacts on the engineered barrier segment and repository designs. The "Disposal Criticality Analysis Methodology" is being developed to be submitted to the NRC for review in late 1998. In support of VA, the methodology used for analysis of PWR and BWR SNF needs to be developed sufficiently to provide an understanding of the general and detailed processes that make up the methodology, including: PWR and BWR Commercial Reactor Criticals; available chemical assay data evaluation; risk based processes. This methodology will be used to show the applicability of the waste packages/engineered barrier segment design concepts.

6. **Describe how the issue ties to the TSPA, MGDS cost estimate, and LA planning:**

Demonstrating the validity of the criticality control measures incorporated into the designs and the probabilistic approach will make the MGDS cost estimate significantly lower than it would be otherwise. Although the issue cannot be fully resolved prior to VA, proceeding as far as time and budget will allow will reduce the uncertainties attendant to the license application. Evaluations to date indicate that a small number of criticality events over extended time periods will have little impact on TSPA. The Disposal Criticality Analysis Methodology Technical and Topical Reports will

be used to communicate the status of the disposal criticality analysis methodology. Evaluations using the methodology will provide the status of the design and control features.

7. **Describe the strategy and criteria for achieving a degree of closure sufficient for VA:**

Complete the draft Topical Report by the time of the viability assessment. Resolution of this issue also requires meeting with the NRC staff to discuss the important details of the methodology and the design features that are planned to provide criticality control. Specifically:

- 1) Keeping the NRC staff informed about the planned disposal criticality analysis methodology,
- 2) Seeking feedback from the NRC staff on the acceptability of the methodology
- 3) Showing the NRC staff preliminary results using the methodology to analyze the designs.

The specific criteria for determining the sufficiency of the methodology for viability assessment is:

- 1) NRC staff has not identified any major technical topic that would preclude acceptance of the methodology, including risk-based approach.
- 2) NRC does not indicate that burnup credit is infeasible.

8. Describe the steps in a process that the project will use to bring closure on this issue:

No.	Title	Description	Summary Account #
1	Meetings with NRC staff	Technical exchanges and Appendix 7 meetings are being planned to discuss the issue	TR233FB9
2	Technical Report, Rev. 1	Disposal Criticality Analysis Methodology Technical Report, Revision 1	TR233FB9
3	Criticality Analyses	Ongoing analytical work demonstrating the disposal criticality control work with the analysis methodology	TR233FB2, TR233EB005, TR233FBE
4	Topical Report	Disposal Criticality Analysis Methodology Draft Topical Report	TR233GBD
5	Topical Report, SER	Safety Analysis Report for the Disposal Criticality Analysis Methodology Topical report from the NRC	TR233GB8
6	Criticality Design for LA	Criticality control design to be licensed evaluated using the disposal criticality analysis methodology	TR233(TBD)

9. Provide a rough schedule of when this issue will be resolved for VA:

No	POC (Name/Phone)	Date	-----FY97-----												-----FY98-----											
			O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S
1	Mike Scott/5-4885	11/01/96 - 10/01/98																								
2	Hugh Benton/4-1891	10/01/96 - 09/04/97																								
3	Hugh Benton/4-1891	10/01/96 - 2000+																								
4	Hugh Benton/4-1891	10/01/97 - 09/30/98																								
5	Hugh Benton/4-1891	2000+																								
6	Hugh Benton/4-1891	2000 +																								




10. **Describe a process that will be used to measure performance towards closure:**  
Performance will be measured in accordance with the process documented in the VA Monitoring Plan.
11. **Describe how status will be reported during the process of closing this issue:**  
Status will be reported in accordance with the process documented in the VA Monitoring Plan.

**Key VA Issue  
Resolution Plan**

1. **Issue #4:** Emplacement Drift Ground Support Concept      April 21, 1997      Rev. # 02

2. **Assigned to:**      **M&O Responsible Individual:** Richard Nolting      **Phone:** 5-4450  
                         **DOE Contact:** Jaime Gonzalez      **Phone:** 5-5454

  
M&O Manager

  
M&O Responsible Individual

3. **Issue Description:**

At issue are the stability and maintenance of emplacement drifts. Constraints on the issue are:

- Construction materials for ground support must be compatible with post-closure performance.
- The ground support method must be compatible with performance confirmation requirements and the construction method.
- Drifts must be safely useable for a long operational life including a potential retrieval period.
- Emplaced waste packages producing heat and radiation will make access difficult for drift maintenance.

4. **Describe the current status and the significance of the issue:**

- A preliminary analysis of emplacement drift stability and support methods is in progress to support VA and will be completed by 9/30/97. Linings are being designed to be durable and capable of accommodating thermally-imposed rock deformation, because a robust, long-lived structure is needed to provide for performance confirmation and for possible retrieval.
- A preliminary assessment has been made of an appropriate pH and mix design for concrete. Work continues on a concrete formulation suitable for repository construction.
- A strategy is being developed for geologic mapping of the emplacement area which will largely determine the permissible method of lining construction. For example, the currently preferred support method using rapid installation of precast segments does not easily accommodate mapping.
- As currently planned, drift maintenance will be accomplished by removal of waste packages to temporary storage drifts to allow access without a radiation hazard.

Significance includes:

- The analysis and design of a robust lining system will increase the safety of preclosure operations and closure, and support the viability of retrieval, and backfill, if needed.
- Determination of a concrete formulation that meets PA approval for postclosure performance is needed to support the use of concrete as the most important repository construction material.

- The emplacement drift support system must meet performance confirmation requirements, be compatible with construction methods, and achieve efficient installation.
5. **Indicate its importance and what effects it will have on a VA:**  
The issue affects the following significant aspects of repository design: the ground support system, the repository layout, and retrievability. Until all aspects of the issue are resolved, alternative, but viable, methods of ground support will be developed for VA. This approach should not significantly affect VA if longevity and maintenance aspects are acceptable.
  6. **Describe how the issue ties to the TSPA, MGDS cost estimate, and LA planning:**
    - Selection of materials suitable for postclosure (e.g., an acceptable concrete formulation) will be provided to PA for use in the TSPA.
    - MGDS cost estimate - determination of types and quantities of construction materials, associated costs of fabrication, and erection and efficiency of overall construction methods.
    - LA planning - resolution of the issue forms the design basis for long-term, maintainable drift design.
  7. **Describe the strategy and criteria for achieving a degree of closure sufficient for VA:**  
The strategy for VA is to present designs for three ground support options (CDA, DCSS 034). These options, which will bound the possible range of alternative criteria, are as follows:

Option 1: Precast concrete segmental lining - This is the preferred option because it can be rapidly installed and can be fabricated under controlled conditions to enhance quality. Assumptions: (1) concrete allowed by PA (CDA, DCSS 027), (2) geologic mapping strategy based on mapping selected non-emplacement drifts prior to emplacement drift lining (this is an alternative to be used with CDA, Key 061, 10a.).

Option 2: Cast-in-place concrete lining - This is the second preference and requires initial installation of support such as rockbolts. Assumptions: (1) concrete allowed by PA (CDA, DCSS 027), (2) geologic mapping strategy based on mapping all emplacement drifts (this is an alternative to be used with CDA, Key 061, 10a.).

Option 3: Steel sets with steel lagging - This is the third preference and allows steel lagging to be installed in stages at different times. Assumptions: (1) concrete use restricted or not allowed by PA (this is an alternative to CDA, DCSS 027), (2) geologic mapping strategy can be either mapping of all emplacement drifts or selected mapping of other drifts to meet CDA, Key 061, 10a.).

Completion of current design analyses and drawings will establish the three alternative ground support options for VA, thus giving sufficient flexibility to accommodate changes in important aspects of the issue such as acceptance of the ground support material by PA and the method of support construction by the performance confirmation group. The alternative ground support methods also demonstrate that stability and maintenance can be achieved using different materials. Development of a geologic mapping strategy is necessary to define the final ground support method and develop a position which is licensable. A reference ground support method will be selected for TSPA based on resolution of the geologic mapping strategy (late FY97) and the use of cementitious materials (early FY98).

In summary, closure for VA will be achieved in one of the following three ways:

- (1) If concrete is found to be acceptable for postclosure use and the acceptable geologic mapping strategy is to map nonemplacement drifts, then the reference ground support for VA will be Option 1 - precast concrete segments.
- (2) If concrete is found to be acceptable for postclosure use but the only acceptable geologic mapping strategy is to map all emplacement drifts, then of the remaining available options, Option 2 - cast-in-place concrete would become the reference ground support for VA.
- (3) If concrete is found to be unacceptable for postclosure use, then Option 3 - steel sets and steel lagging - would be the reference ground support for VA, regardless of the geologic mapping strategy.

**APPENDIX H**  
**MGDS VA REVIEW**  
**Preliminary**

The data contained in this appendix reflects the status of the Yucca Mountain Site Characterization Project as of 12/16/96. Because of the evolving conditions of the Yucca Mountain Site Characterization Project, data in this appendix is changed or updated as necessary. However, this VA Design and Review Plan will not be revised or reissued as a result of data updates. For a current status of the data in this appendix and/or a copy of the current version, contact J. Clouet. For suggested changes to the contents, contact R. Snell.

**MGDS VA REVIEW**  
**Preliminary**  
**E&I Section**

## **1.0 PROPOSED CONCEPT**

The proposed concept for the MGDS VA Review will be focused on the YMP. The lead for this review will be the Regulatory group. The review will cover the four VA products; VA MGDS Cost Estimate, TSPA-VA, VA Design, and the LA Plan, and will concentrate on the progress that has been made in the four product areas.

The review will be presented to the Director of the OCRWM with presentations provided by both YMSCO and M&O Management leads. The target audience will be the OCRWM and M&O Management.

This MGDS VA Review covers the documentation, support and presentations that will be provided by E&I on the MGDS VA Design and Cost Estimate.

## **2.0 QUALITY ASSURANCE**

Based on an evaluation in accordance with QAP-2-0, *Conduct of Activities*, the MGDS VA Review was determined to be a non-QA review.

## **3.0 PRESENTATION OF E&I VA PRODUCTS**

### **3.1 VA MGDS Cost Estimate**

Details describing cost estimate are to be provided at a later date.

### **3.2 VA Design**

The MGDS Design to support the VA milestone will focus on Systems, Structures and Components which are important to radiological safety, and have no licensing precedence with the NRC.

The Design Products listed in Appendices C, D and E of the VA Design and Review Plan will define the MGDS VA design and will be described in the Engineering chapters of the Project Integrated Safety Assessment. The Design Products include:

- Chapter 3 - Design of Systems, Structures and Components
- Chapter 4 - Repository Design
- Chapter 5 - Waste Package Design
- Chapter 6 - Engineered Barrier System Design
- Chapter 11 - Conduct of Operations

The Project Integrated Safety Assessment chapters will be summarized into a VA Design Summary, which will be similar to the Director's Summary.

The presentation of the MGDS Design for VA will be based on the VA Design Summary and will describe how the system design balances the overall facility. The presentation will also describe what potential solutions have been developed to resolve unprecedented regulatory designs with specific emphasis on the key design issues that have been identified as important to the VA milestone.

The format and flow of the Design Summary will include the concept of operations for the repository from receipt of waste through emplacement and repository closure or, if necessary, waste retrieval. The focus of the descriptions will be based on repository operations, surface, subsurface, waste package design, and waste form testing. Critical design features will be described as well as the binning methodology related to their selection. The rationale for selection of the reference design will be summarized. Reference to the Project Integrated Safety Assessment design chapters will be made to identify supporting design documentation. The additional work to be performed in each area to support the LA will be summarized. The document will make liberal use of graphics and illustrations to describe, explain, and emphasize focus areas.

#### **4.0 REVIEW LOGISTICS**

A pre-review package consisting of the Design Summary and the Engineering chapters of the Project Integrated Safety Assessment will be provided to a selected audience after June 30, 1998.

Comments generated from the MGDS VA Review will be applied toward the next phase of LA design.

The MGDS Cost Estimate will have been published in March of 1998, and updated before its submittal as a VA product. Any comments generated against the MGDS Cost Estimate will be included in the next cost estimate cycle.

## **5.0 SCHEDULE**

The MGDS VA Review will be held July 31, 1998. The key Engineering milestones that lead to this date are:

- MGDS VA Cost Estimate - June 1998
- Phase I Design Review - September 1997
- Engineering Chapters of the Project Integrated Safety Assessment complete - June 30, 1998
- VA Design Summary - June 30, 1998

## **6.0 VA DESIGN REVIEW CHECKLIST**

The intent of the VA Design Review Checklist is to provide a methodical listing of items to be evaluated against expectations at the conclusion of the design effort intended to support the VA milestone. Currently, this point is expected to occur during the initial stages of the Phase II Design, but prior to the VA milestone itself. The checklist includes a list of engineering products and their expected level of completion, a list of critical interfaces, expected progress on issue resolution, expected progress on selected topics and/or items requiring decisions, and an assessment of cost and schedule variances.



## **APPENDIX I**

### **SYSTEMS ENGINEERING SCHEDULE**

The data contained in this appendix reflects the status of the Yucca Mountain Site Characterization Project as of 12/16/96. Because of the evolving conditions of the Yucca Mountain Site Characterization Project, data in this appendix is changed or updated as necessary. However, this VA Design and Review Plan will not be revised or reissued as a result of data updates. For a current status of the data in this appendix and/or a copy of the current version, contact F. VanDerLaan. For suggested changes to the contents, contact R. Wagner.

## **SYSTEMS ENGINEERING SCHEDULE**

The Systems Engineering (WBS 1.2.1) schedule for FY 97/98 is provided. This schedule reflects the current status of the FY 98 planning activity. All of the Systems Engineering activities are tied to the VA milestone.

Activity ID	Activity Description	OD	Early Start	Early Finish	MILE	FY96	FY97	FY98	Y9
YP1XPP006: PPkg - IN06X - ESF Construction Suppo									
SE806	Update ESF Con-Ops	251	02FEB98*	01FEB99					
SE824	DIE FY'99	251	01OCT98*	30SEP99					
YP1XPP007: PPkg - LA200 - Prepare Project Integr									
SE708A	Provide PISA Development Support	161	01OCT97	22MAY98					
YP1XPP008: PPkg - LA355 - Write PISA Ch. 1, Intr									
SE708	Provide PISA Development Support - Chapter 1	110	31OCT97	10APR98					
YP1XPP011: PPkg - MG010M2 - PISA Chapters 2,3,4,									
MG010M2	PISA Chapters 2,3,4,5,6,9,11 Design/Ops/Site	0		30JUN98*	X2				
YP1XPP032: PPkg - SE124M2 - Submit MGDS Cost Est									
SE124M2	Submit MGDS Cost Estimate to OCRWM	0		25AUG98*	M2				
YP1XPP033: PPkg - SE125A - MGDS Design SRA - Ph									
SE310B	DBA/DBE Definition & Analysis - Ph 2	204	02DEC96*	19SEP97					
YP1XPP034: PPkg - SE126 - MGDS Design SRA - 3									
SE800A	Support ESF Operations	855	01OCT97	01MAR01					
YP1XPP037: PPkg - SE306M2 - Complete Chapter 11									
SE306M2	Complete Chapter 11 PISA	0		03APR98	M2				
YP1XPP040: PPkg - SE322 - Classification Analysi									
SE322A	Classification Analysis/Q-List Update - 2	204	01OCT98	26JUL99					
YP1XPP043: PPkg - SEGHIM2 - Complete Waste Qty,									
SEGHIM2	Complete Waste Qty, Mix, and Throughput Study	0		11APR97*	M2				
YP1XPP047: PPkg - SERSTM2 - Complete Retrieval									
SERSTM2	Complete Retrieval Study - VA	0		12MAY97*	M2				
YP1XPP049: PPkg - SEUVM2 - Complete Safeguards									
SEUVM2	Complete Safeguards & Security Reqms Study	0		29OCT97*	X2				
YP1XPP051: PPkg - SEXYZM2 - Complete Regional Tr									
SEXYZM2	Complete Regional Transportation Data Collection	0		30SEP97*	X2				
TR11FA1: Systems Engineering Management									

Project Start 01OCT95

Project Finish 01OCT02

Date Date 02DEC96

Plot Date 16DEC96

Legend

Early

Progress Bar

Critical Activity

YUCCA MOUNTAIN PROJECT PLAN

WBS 1.2.1 - SYSTEMS ENGINEERING

LONG RANGE PLAN (FY96-FY98)

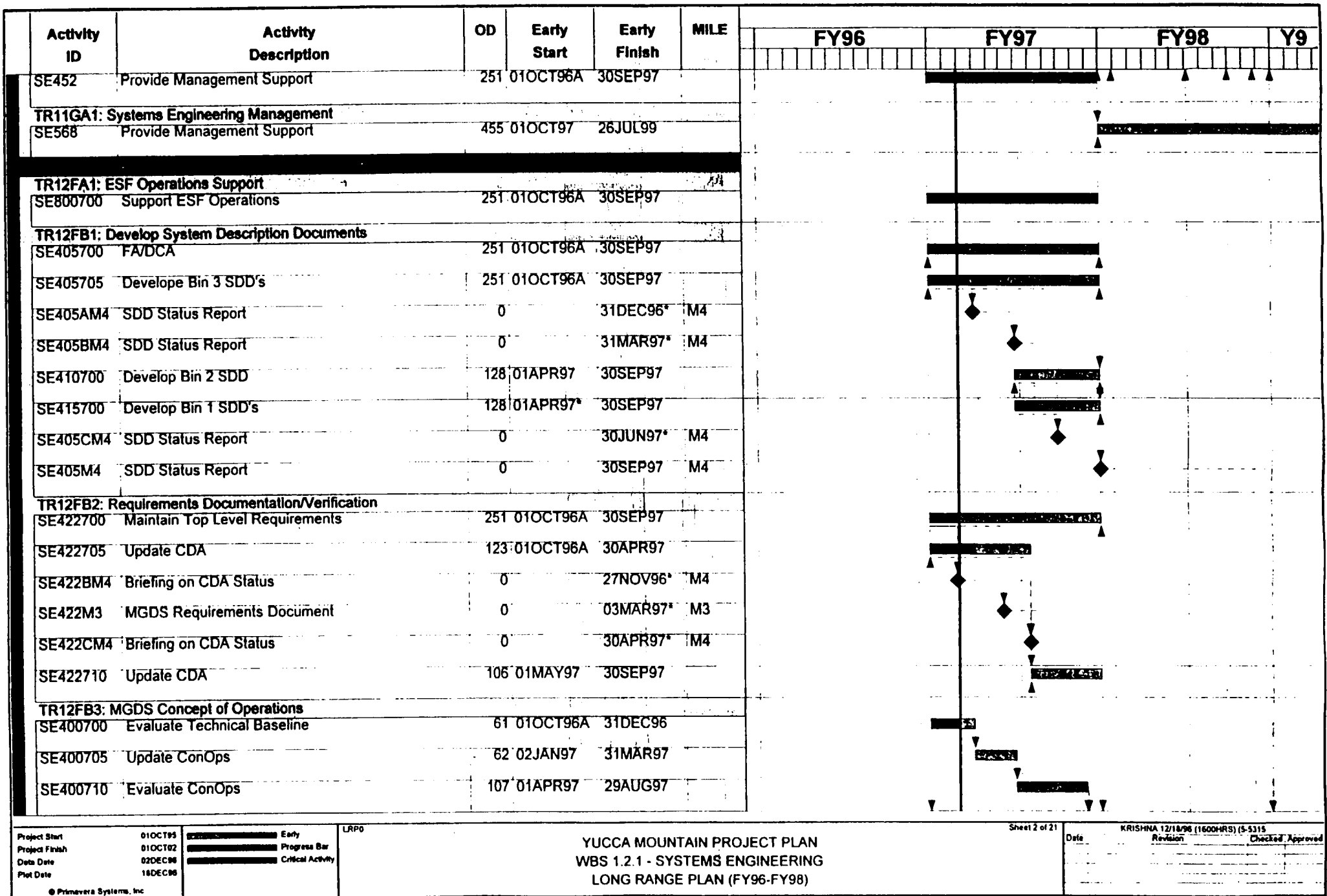
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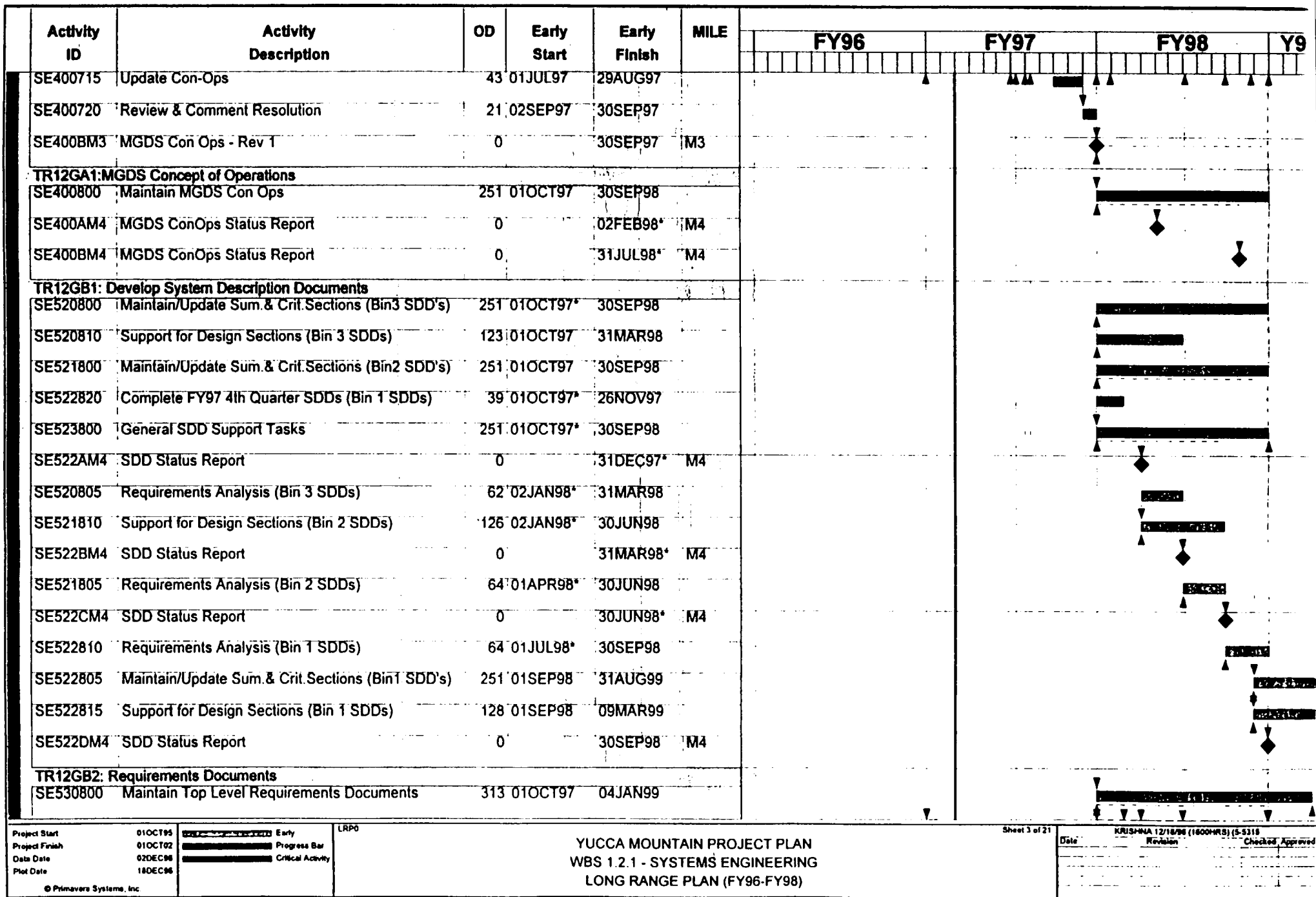
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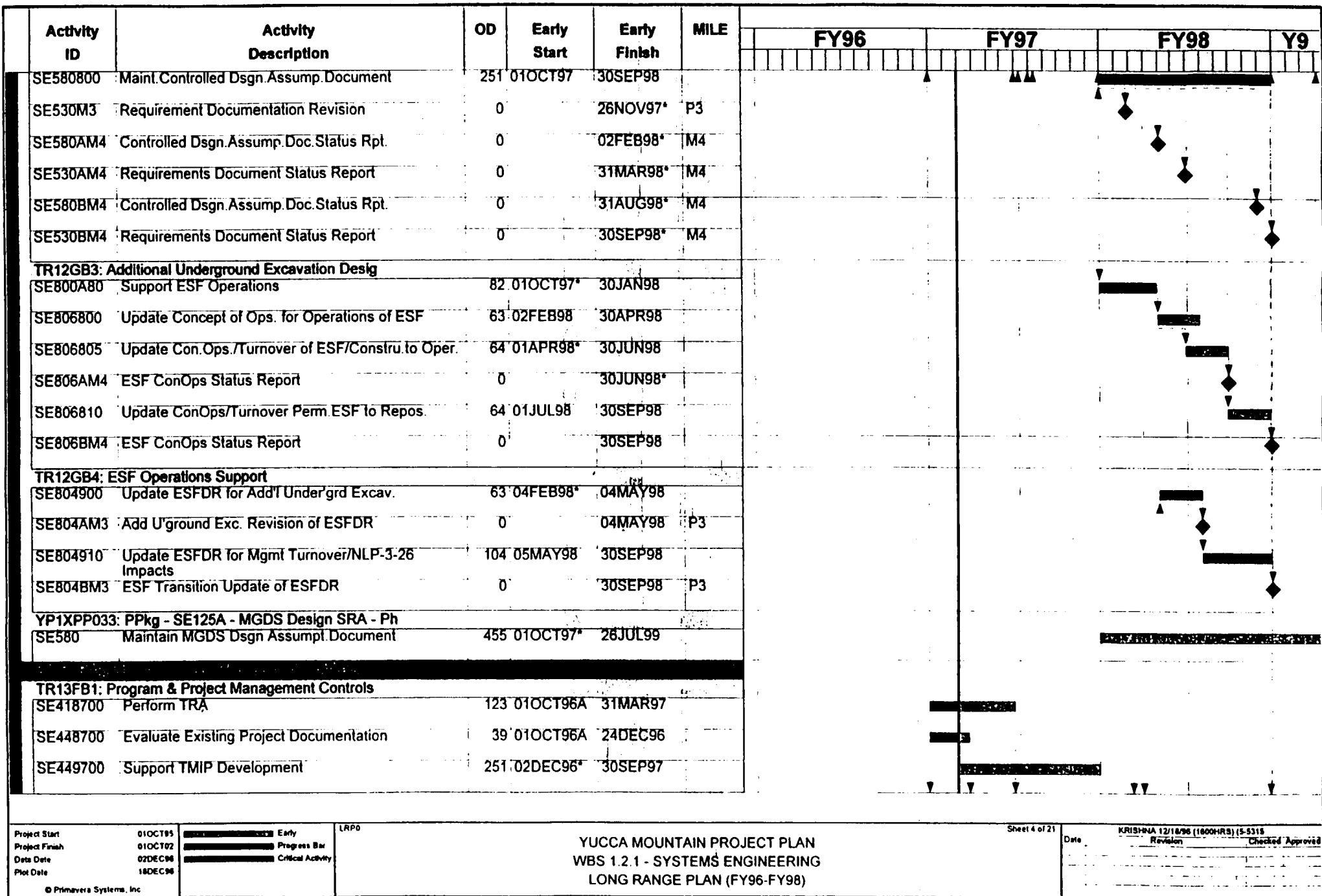
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Project Start 01OCT95  
 Project Finish 01OCT97  
 Data Date 02DEC96  
 Plot Date 18DEC96

Early  
 Progress Bar  
 Critical Activity

LRP0

YUCCA MOUNTAIN PROJECT PLAN  
 WBS 1.2.1 - SYSTEMS ENGINEERING  
 LONG RANGE PLAN (FY96-FY98)

Sheet 4 of 21

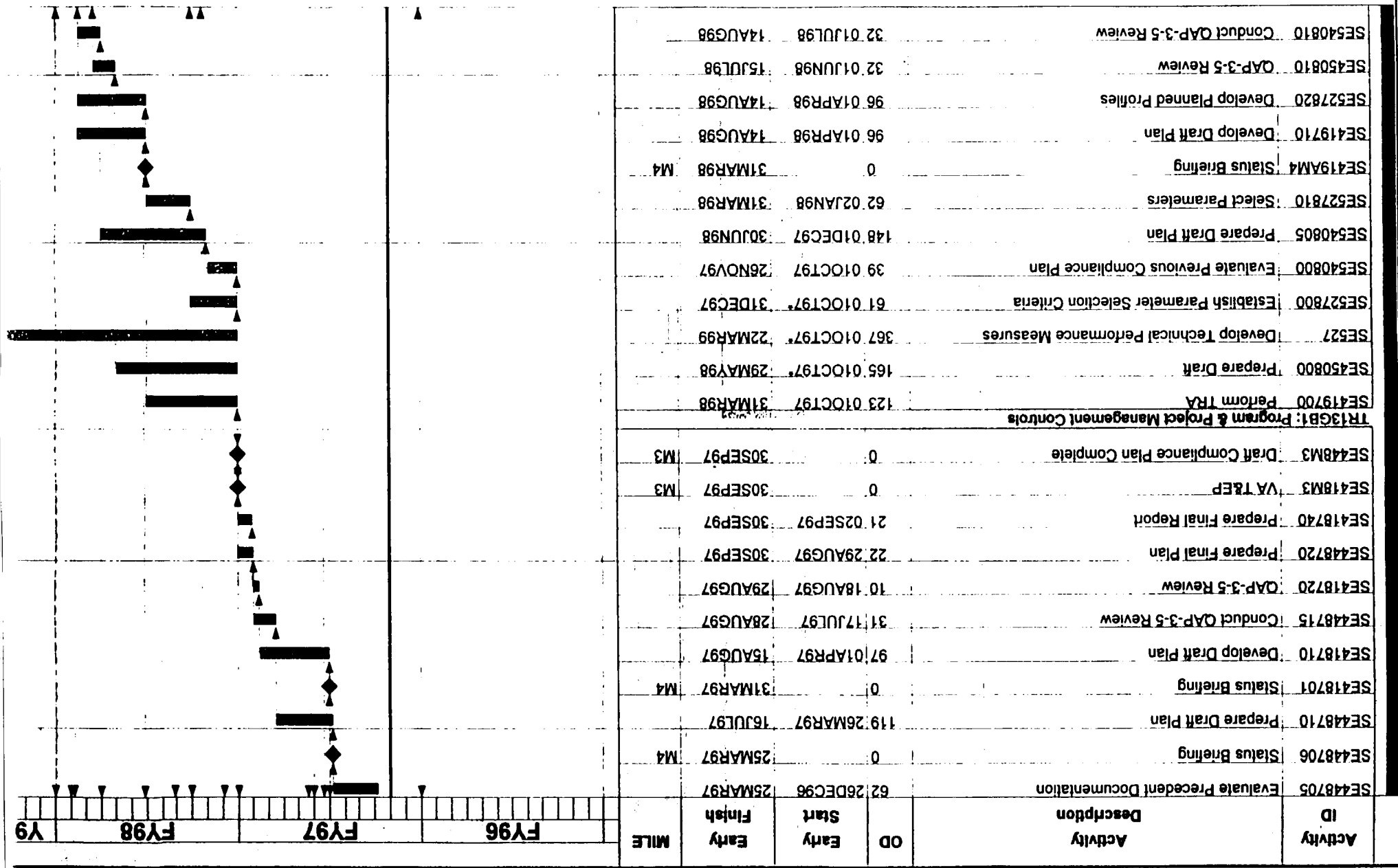
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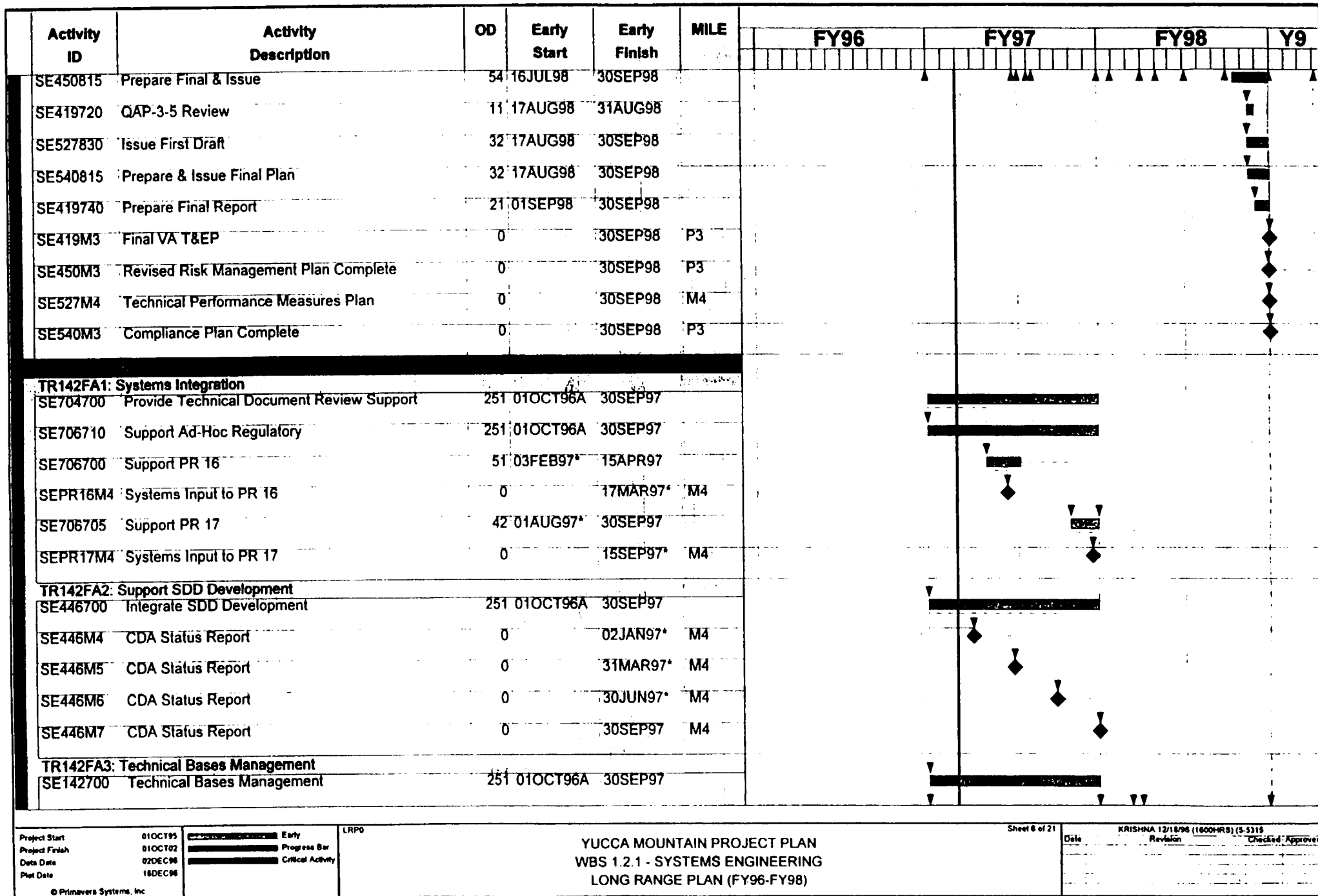
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Project Start 01OCT95  
Project Finish 01OCT02  
Data Date 02DEC98  
Project Status  
Critical Activity  
Program Bar  
Early  
LRP0

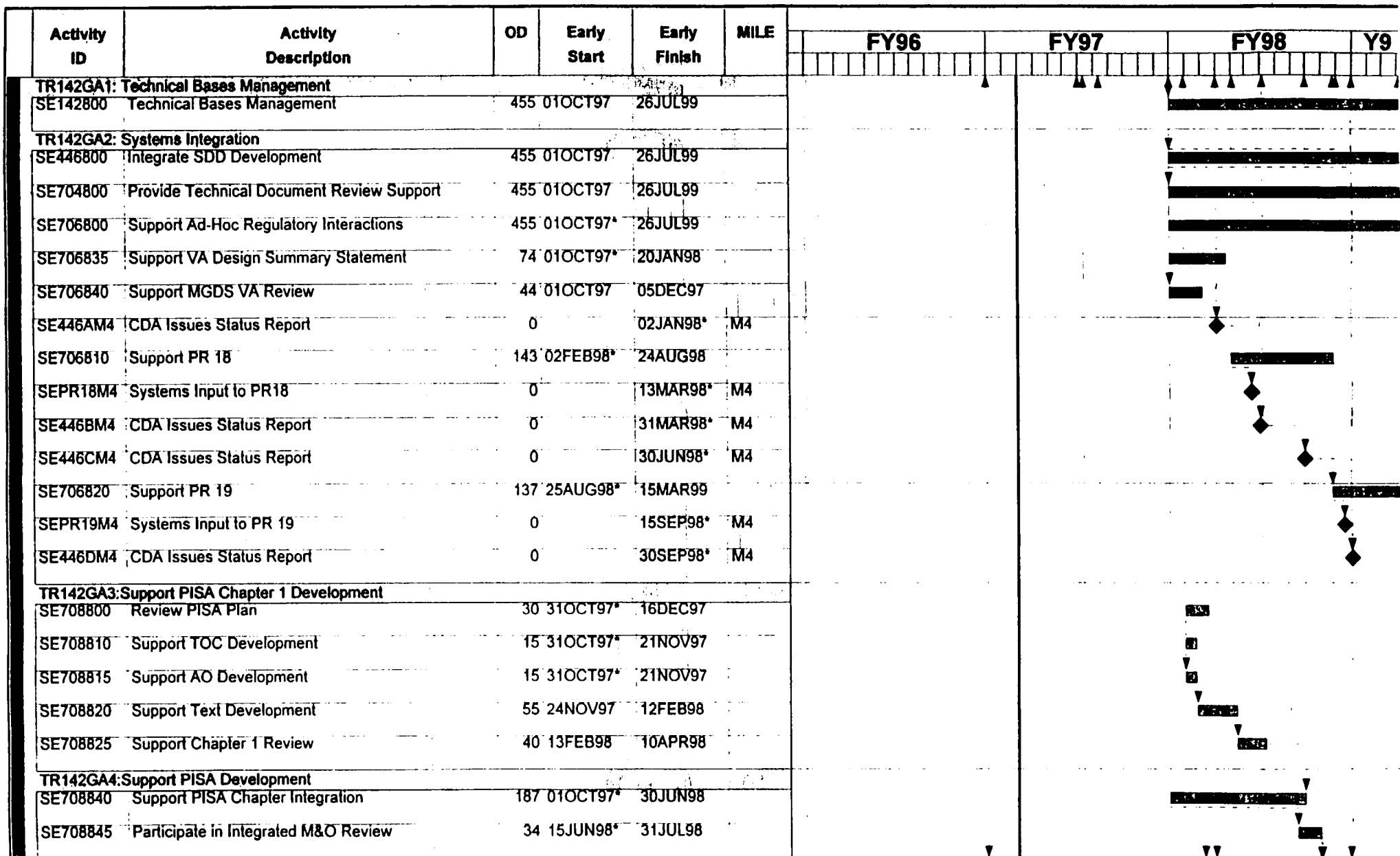
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WBS 1.2.1 - SYSTEMS ENGINEERING  
LONG RANGE PLAN (FY96-FY98)

Sheet 5 of 21  
Date  
Revision  
Checked/Approved  
KUSUMANA 12/18/98 (1600-MS) (S-5315)









Project Start 01OCT95  
 Project Finish 01OCT02  
 Data Date 02DEC96  
 Plot Date 18DEC96

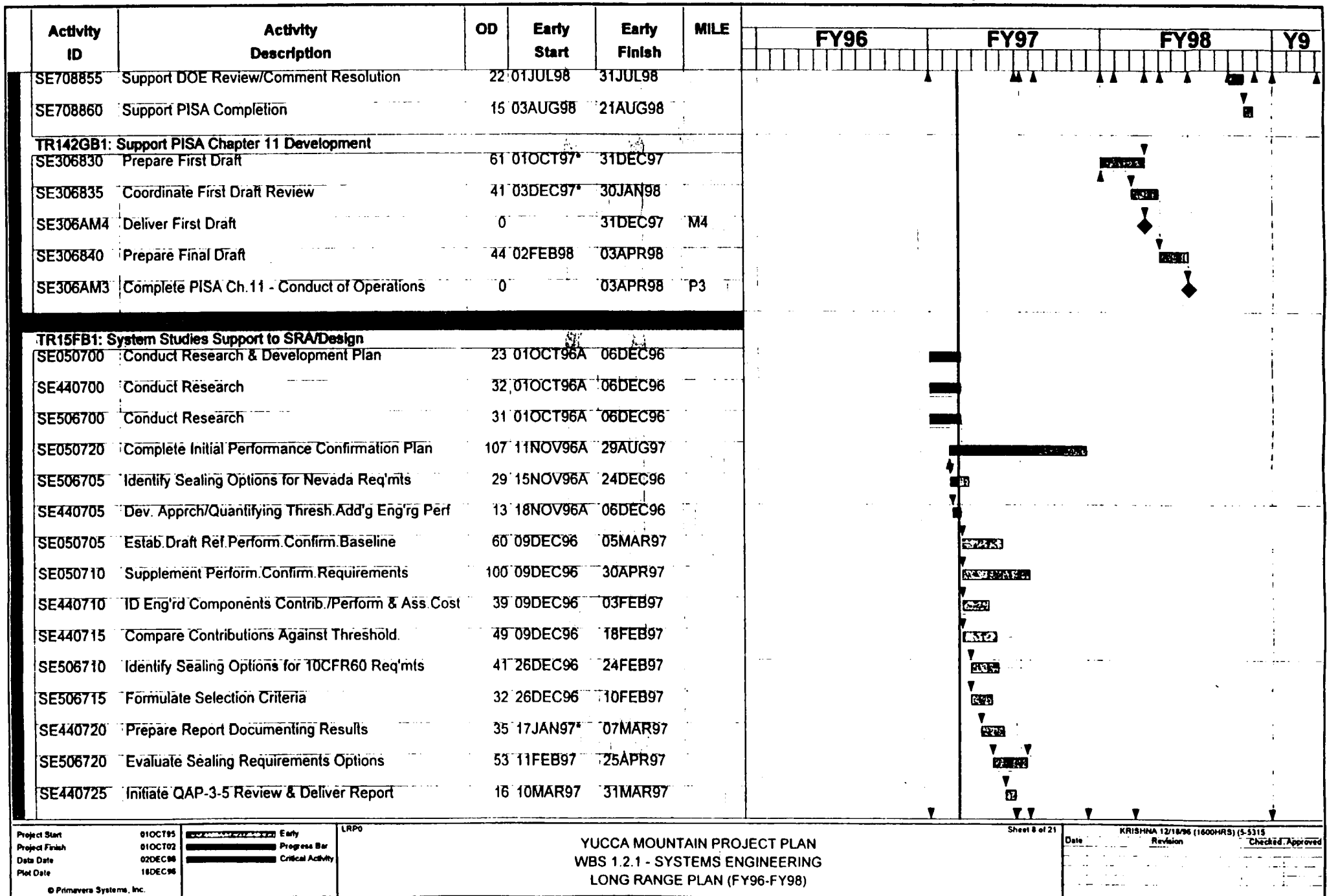
Early  
 Progress Bar  
 Critical Activity

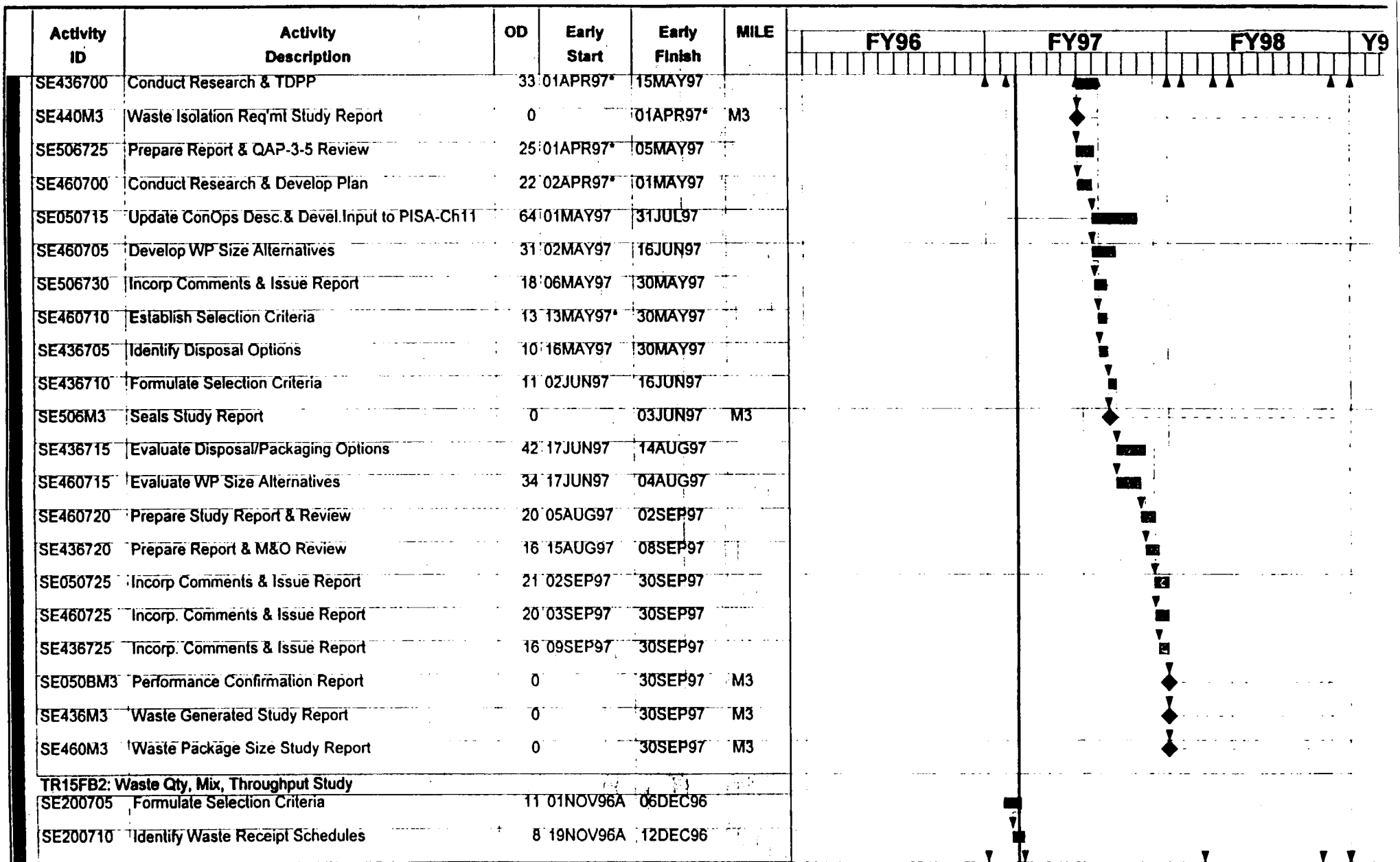
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YUCCA MOUNTAIN PROJECT PLAN  
 WBS 1.2.1 - SYSTEMS ENGINEERING  
 LONG RANGE PLAN (FY96-FY98)

Sheet 7 of 21

KRISHNA 12/18/96 (1600HRS) (5-5315)  
 Date Revision Checked Approved





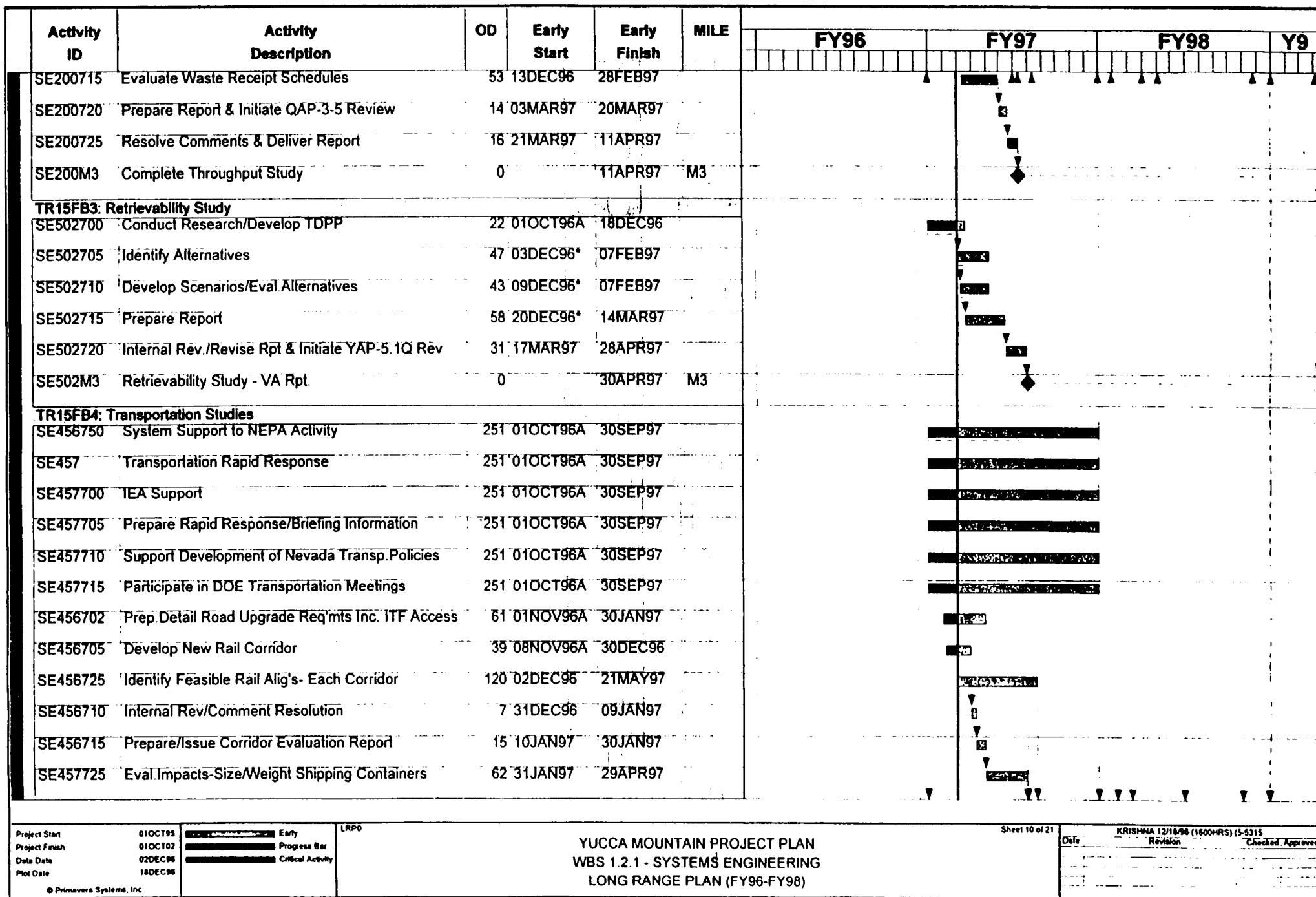
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 Project Finish 01OCT02  
 Data Date 02DEC96  
 Plot Date 18DEC96

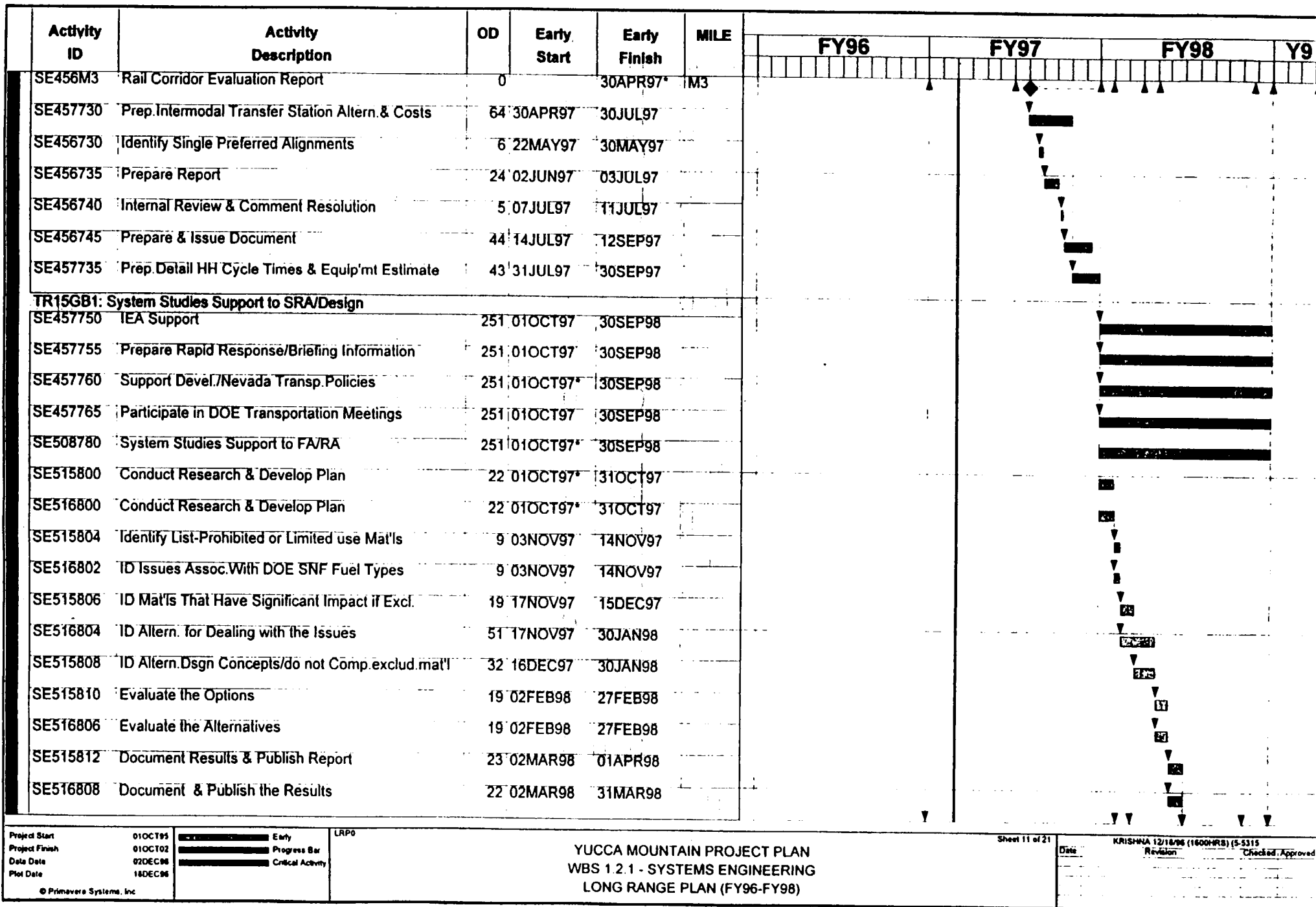
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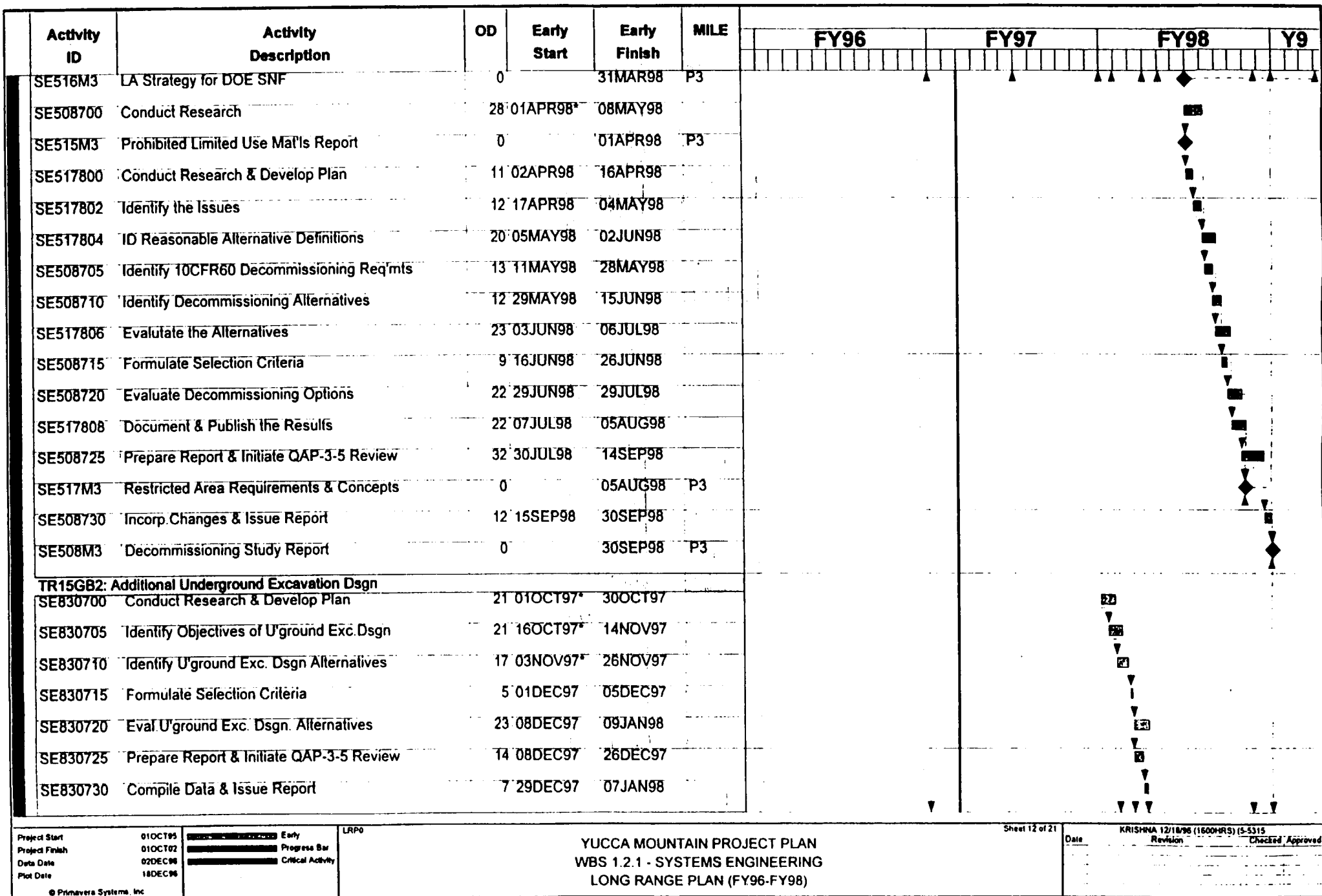
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 WBS 1.2.1 - SYSTEMS ENGINEERING  
 LONG RANGE PLAN (FY96-FY98)

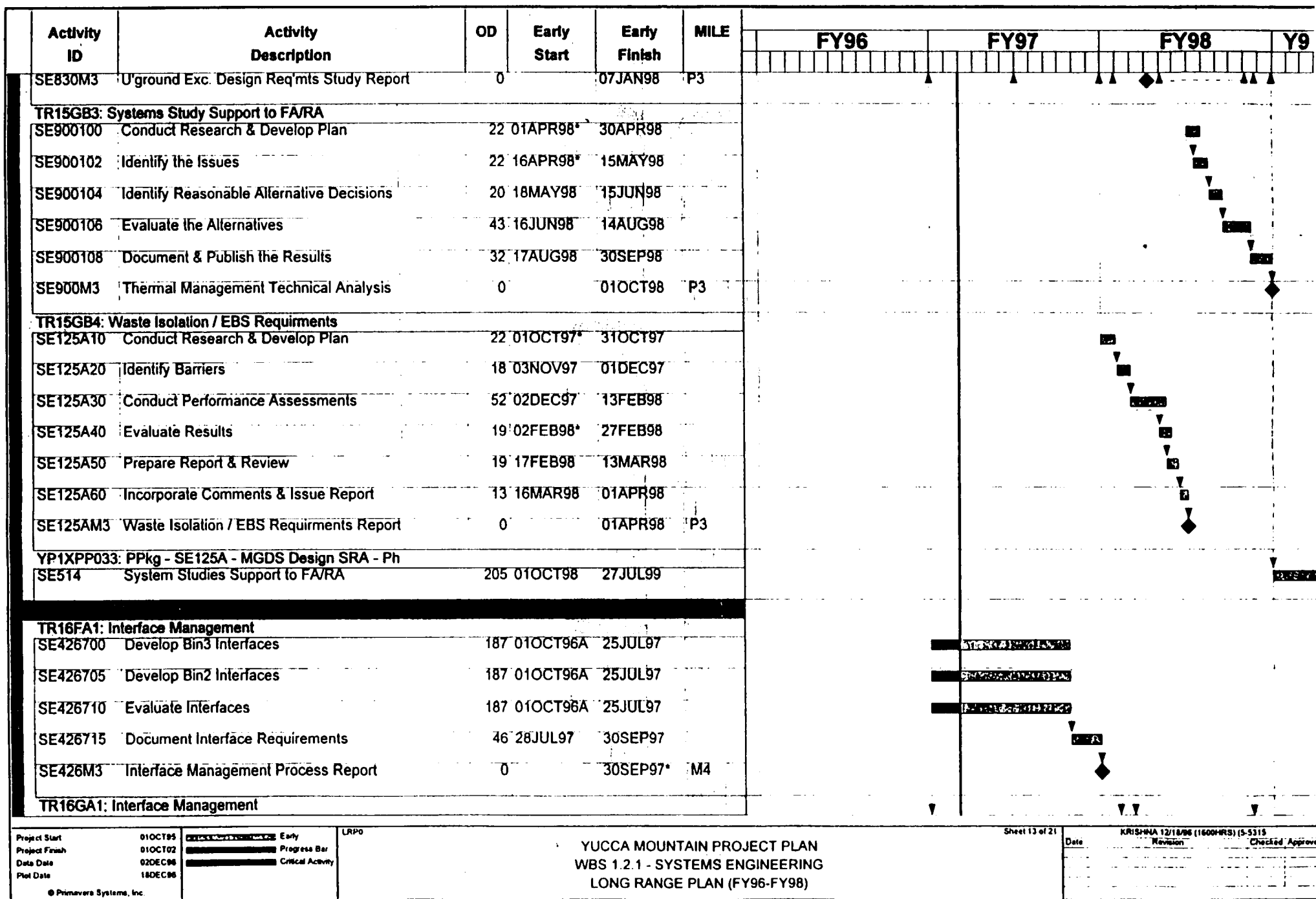
Sheet 9 of 21

KRISHNA 12/18/96 (1600HRS) (S-9318)  
 Date Revision Checked Approved









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 Project Finish 01OCT02  
 Data Date 02DEC96  
 Plot Date 18DEC96

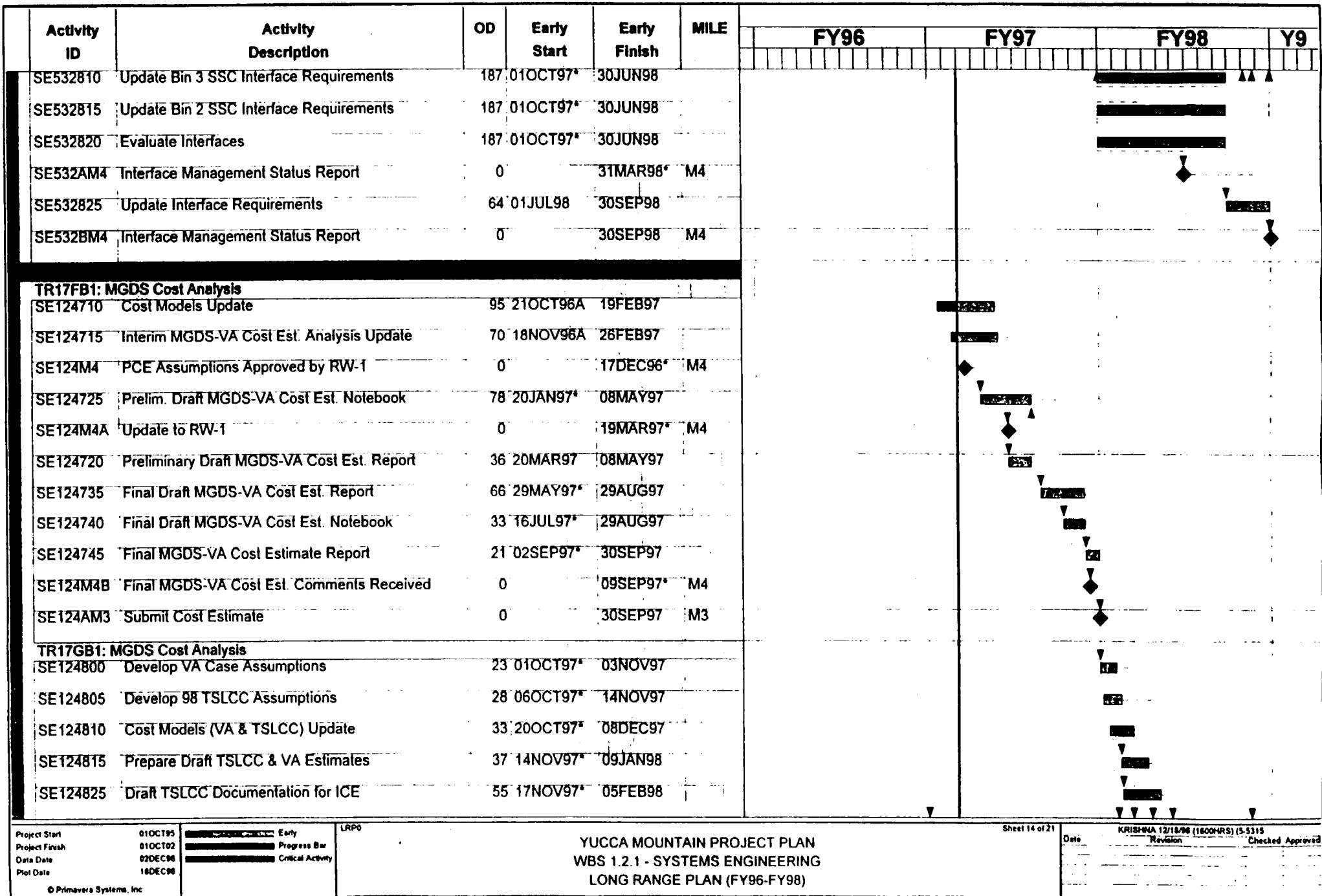
LRPO

YUCCA MOUNTAIN PROJECT PLAN  
 WBS 1.2.1 - SYSTEMS ENGINEERING  
 LONG RANGE PLAN (FY96-FY98)

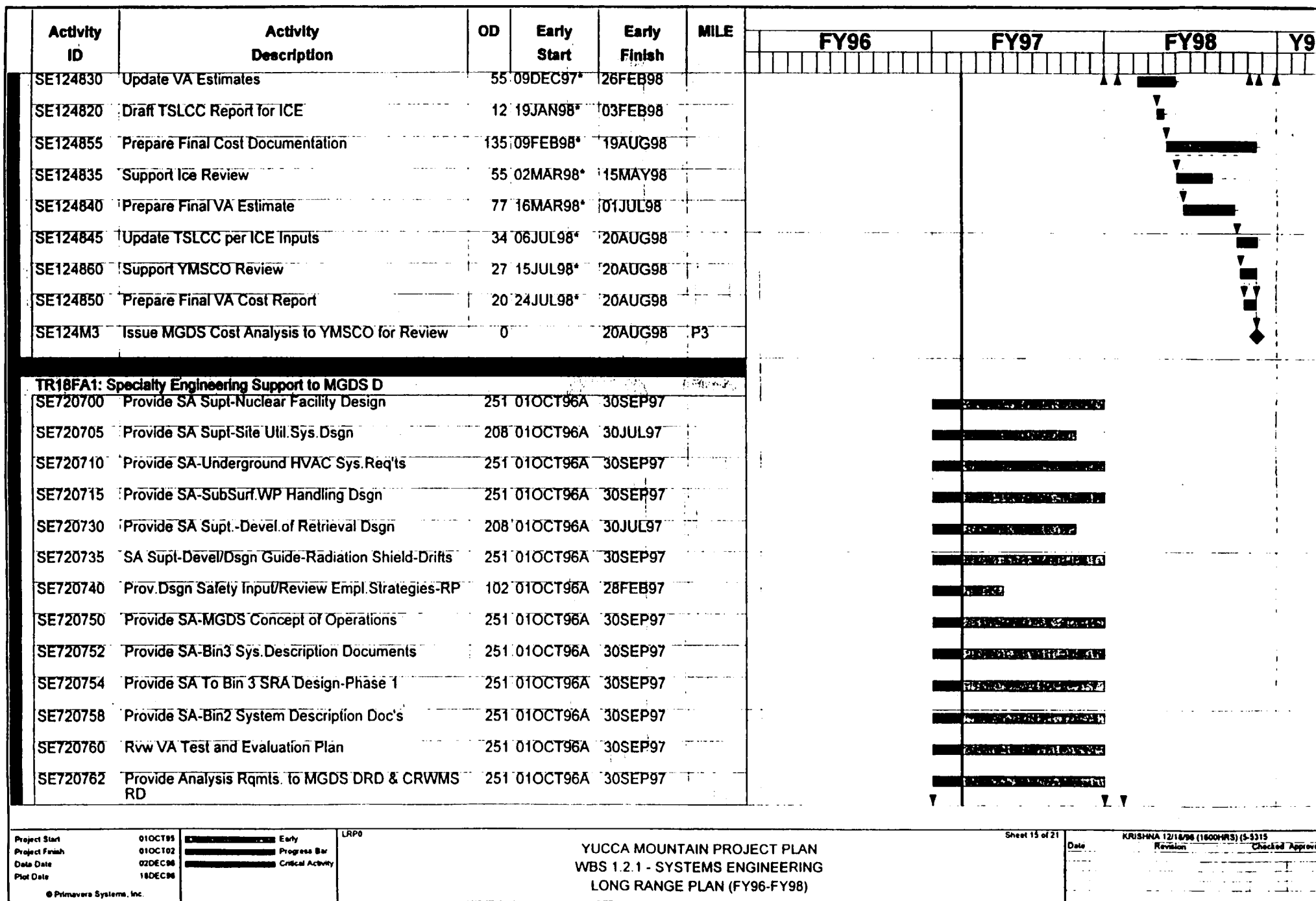
Sheet 13 of 21

KRISHNA 12/18/96 (1600HRS) (5-5315)

Date Revision Checked Approved

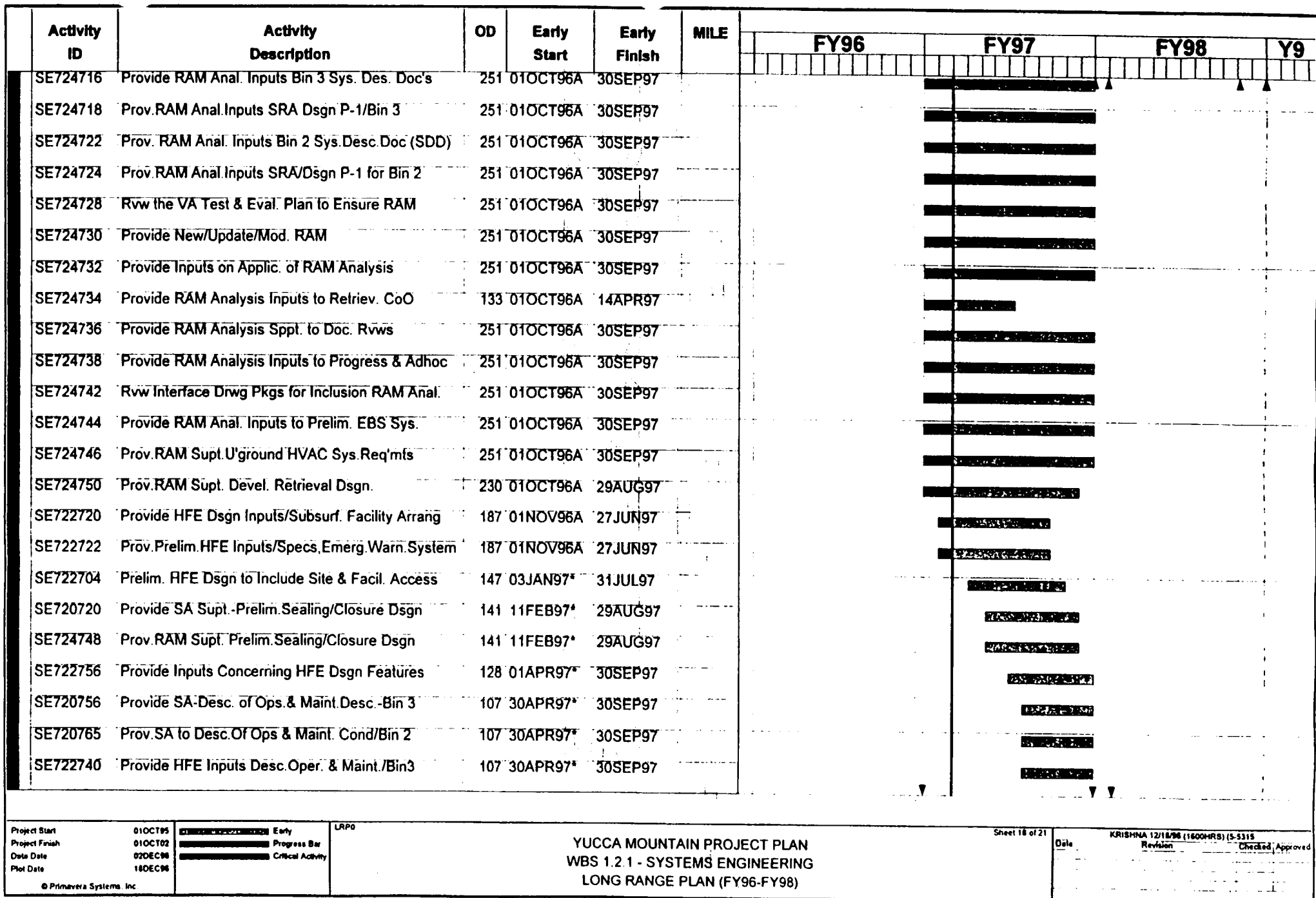








Activity ID	Activity Description	OD	Early Start	Early Finish	MILE	FY96												FY97												FY98												Y9
SE722734	Provide HFE Inputs to MGDS CoO	251	01OCT96A	30SEP97																																						
SE722736	Provide HFE Inputs to Bin 3 System Desc. Doc.	251	01OCT96A	30SEP97																																						
SE722738	Provide HFE Inputs SRA Dsgn-Bin 3 Ph-1	251	01OCT96A	30SEP97																																						
SE722742	Provide HFE Inputs to the Bin 2 Sys. Descr. Doc.	251	01OCT96A	30SEP97																																						
SE722744	Provide HFE Inputs SRA Dsgn-Bin 2 Ph-1	251	01OCT96A	30SEP97																																						
SE722748	Rvw VA Test & Eval. Plan	251	01OCT96A	30SEP97																																						
SE722750	Provide New/Updated/Mod. HFE Rqmts.	251	01OCT96A	30SEP97																																						
SE722752	Provide HFE Inputs for SSC Interfaces	251	01OCT96A	30SEP97																																						
SE722754	Provide Inputs on Applic. of HFE Reg. Guidelines	251	01OCT96A	30SEP97																																						
SE722758	Prov. HFE Inputs/Rvw MGDS Dsgn Assump. Doc	251	01OCT96A	30SEP97																																						
SE722760	Provide HFE Inputs to Retrievability CoO	133	01OCT96A	14APR97																																						
SE722762	Provide HFE Sppt. to Document Reviews	251	01OCT96A	30SEP97																																						
SE722764	Provide HFE Inputs to Progress and Adhoc Rpts	251	01OCT96A	30SEP97																																						
SE722766	Provide HFE Inputs to Safety Anal. Act. & Rpts.	251	01OCT96A	30SEP97																																						
SE722778	Rvw Interface Drwg Pkgs for HFE Rqmts	251	01OCT96A	30SEP97																																						
SE722780	Participate in Mockup Test to Eval. Welding Proc	251	01OCT96A	30SEP97																																						
SE722782	Dev/Eval. Proced. for Testing & Exam Closure Wel	251	01OCT96A	30SEP97																																						
SE722784	Provide HFE Inputs to Prelim. EBS Sys. Descr.	251	01OCT96A	30SEP97																																						
SE724700	RAM Sppt. to SRA/Dsgn	251	01OCT96A	30SEP97																																						
SE724702	Provide RAM Sppt. to Updaling/Integration	251	01OCT96A	30SEP97																																						
SE724704	Provide RAM Sppt. to Site-Utilities Sys. Dsn	208	01OCT96A	30JUL97																																						
SE724708	Provide RAM Sppt. to Subsurface WP Handling Dsgn	251	01OCT96A	30SEP97																																						
SE724714	Provide RAM Analysis Inputs to MGDS CoO	251	01OCT96A	30SEP97																																						



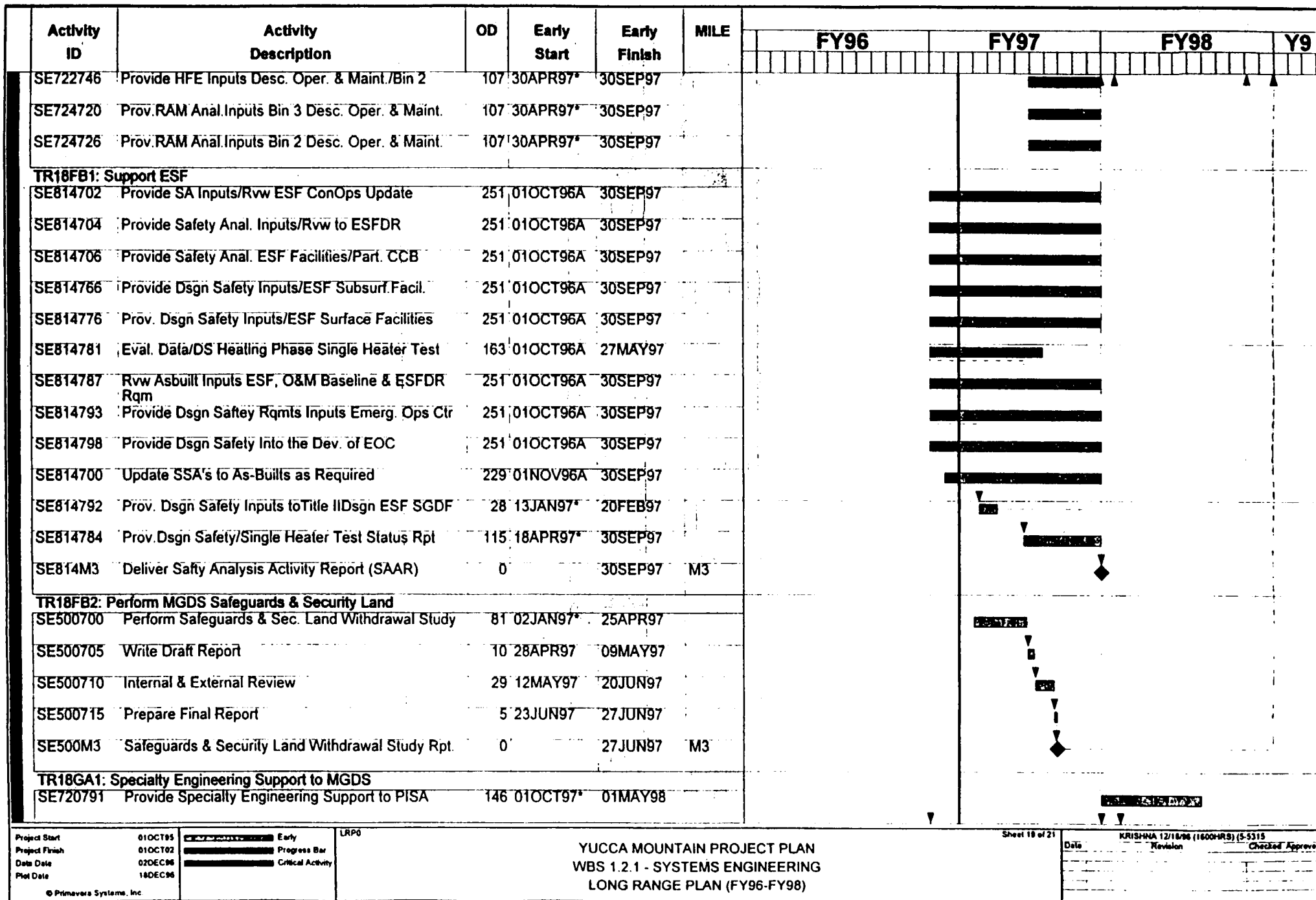
Project Start 01OCT95  
 Project Finish 01OCT02  
 Data Date 02DEC96  
 Plot Date 16DEC96

LRP0

YUCCA MOUNTAIN PROJECT PLAN  
 WBS 1.2.1 - SYSTEMS ENGINEERING  
 LONG RANGE PLAN (FY96-FY98)

Sheet 18 of 21

KRISHNA 12/18/96 (1600HRS) (5-5315)  
 Date Revision Checked Approved



Activity ID	Activity Description	OD	Early Start	Early Finish	MILE	FY96												FY97												FY98												Y9											
SE720A	Provide System Safety Support to SRA/Design	455	01OCT97	26JUL99																																																	
SE722A	Provide HFE Support to SRA/Design	455	01OCT97	26JUL99																																																	
SE724A	Provide RAM Support to SRA/Design	455	01OCT97	26JUL99																																																	
SE726A	Provide ILS Support to SRA/Design	455	01OCT97	26JUL99																																																	
<b>TR18GA2: Specialty Engineering Support to ESF</b>																																																					
SE812	Update Maindrift SSA to Add T U-Grnd Excavation	106	01MAY98*	30SEP98																																																	
SE812M4	Briefing Maindrift SSA	0		30SEP98	M4																																																
<b>TR18GA3: Safeguards &amp; Security</b>																																																					
SE730A	Provide Safeguards, Security to SRA/Design	455	01OCT97	26JUL99																																																	
<b>TR1AFA1: Degraded Mode Criticality</b>																																																					
SE1A700	Degraded Mode Criticality	32	01OCT96A	06DEC96																																																	
SE1A0M3	Degraded Mode Crit. Analysis of Immob. Plut.	0		06DEC96	M3																																																
<b>TR1AFA2: External Criticality</b>																																																					
SE1A705	External Criticality	198	02DEC96*	11SEP97																																																	
SE1A2M3	Rpt. External Criticality of Plutonium	0		11SEP97	M3																																																
<b>TR1AFA3: Plan/Strategy for Inclu of Plut Wst int</b>																																																					
SE1A710	Plan/Strategy -Inclusion of Plut.Waste in FWMS	145	01OCT96A	27MAY97																																																	
SE1A3M3	Approach to Incorp.Plut.Waste into FWMS	0		27MAY97	M3																																																
<b>TR1AFA4: Plan Implementation</b>																																																					
SE1A715	Plan Implementation	118	03MAR97*	15AUG97																																																	
SE1A4M3	Data Needs Document	0		30JUN97*	M3																																																
SE1A5M3	Draft MOA	0		29AUG97*	M3																																																
<b>TR1BFB1: DBE Definition &amp; Analysis</b>																																																					
SE310700	DBE FY'97 (1ST HALF)	123	01OCT96A	31MAR97																																																	
SE310705	DBE FY'97 (2ND HALF)	128	01APR97	30SEP97																																																	

Project Start: 01OCT95

Project Finish: 01OCT02

Date Date: 02DEC96

Plot Date: 18DEC96

LRP0

Legend:   
 Early   
 Progress Bar   
 Critical Activity

YUCCA MOUNTAIN PROJECT PLAN

WBS 1.2.1 - SYSTEMS ENGINEERING

LONG RANGE PLAN (FY96-FY98)

Sheet 20 of 21

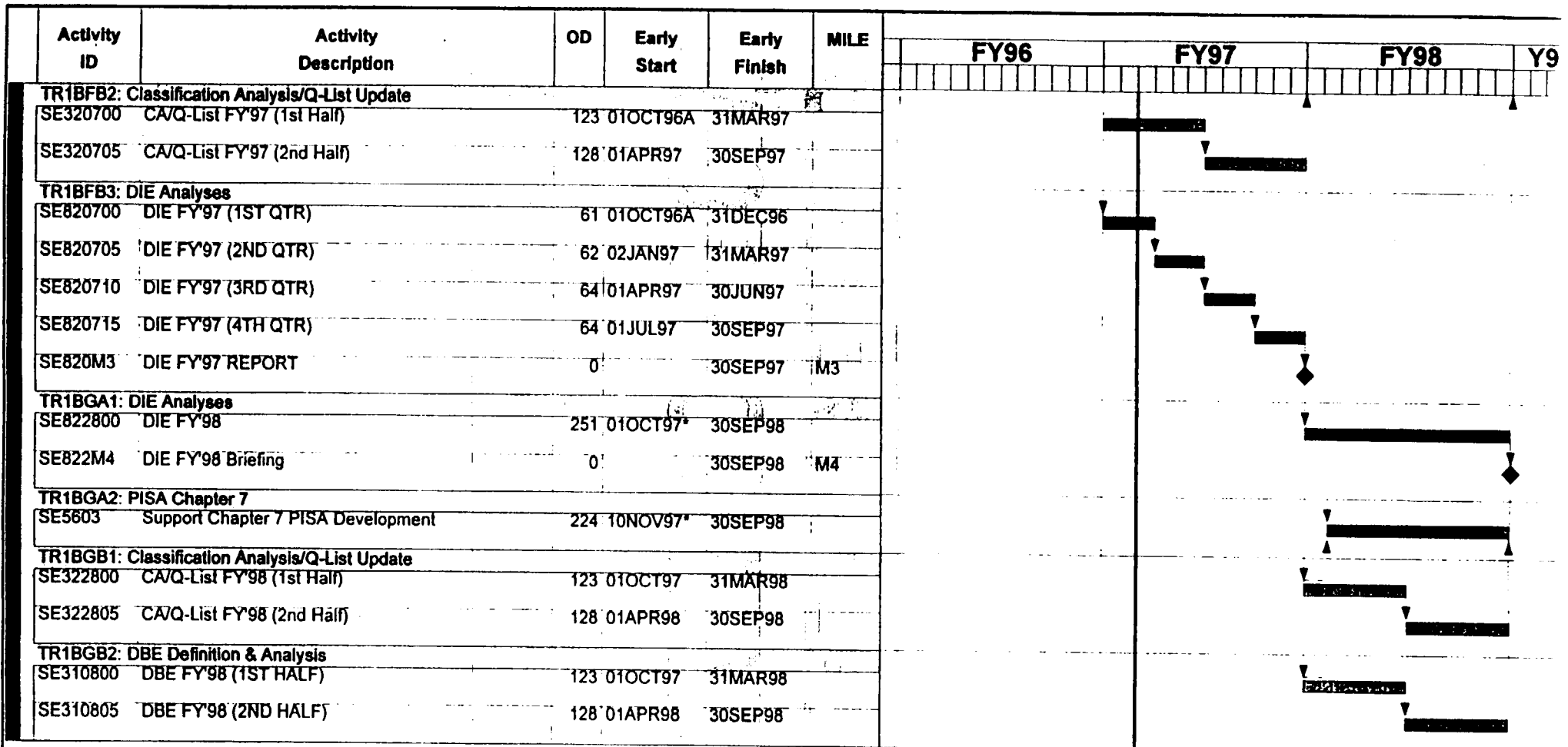
Revision: KRISHNA 12/18/96 (1600HRS) (S-5315)

Date: \_\_\_\_\_

Checked: \_\_\_\_\_

Approved: \_\_\_\_\_

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Project Start 01OCT95  
 Project Finish 01OCT92  
 Data Date 02DEC96  
 Plot Date 18DEC96

LRPO

YUCCA MOUNTAIN PROJECT PLAN  
 WBS 1.2.1 - SYSTEMS ENGINEERING  
 LONG RANGE PLAN (FY96-FY98)

Sheet 21 of 21

Date KRISHNA 12/18/96 (1800HRS) (S-5315)  
 Revision  
 Checked Approved

## **APPENDIX J**

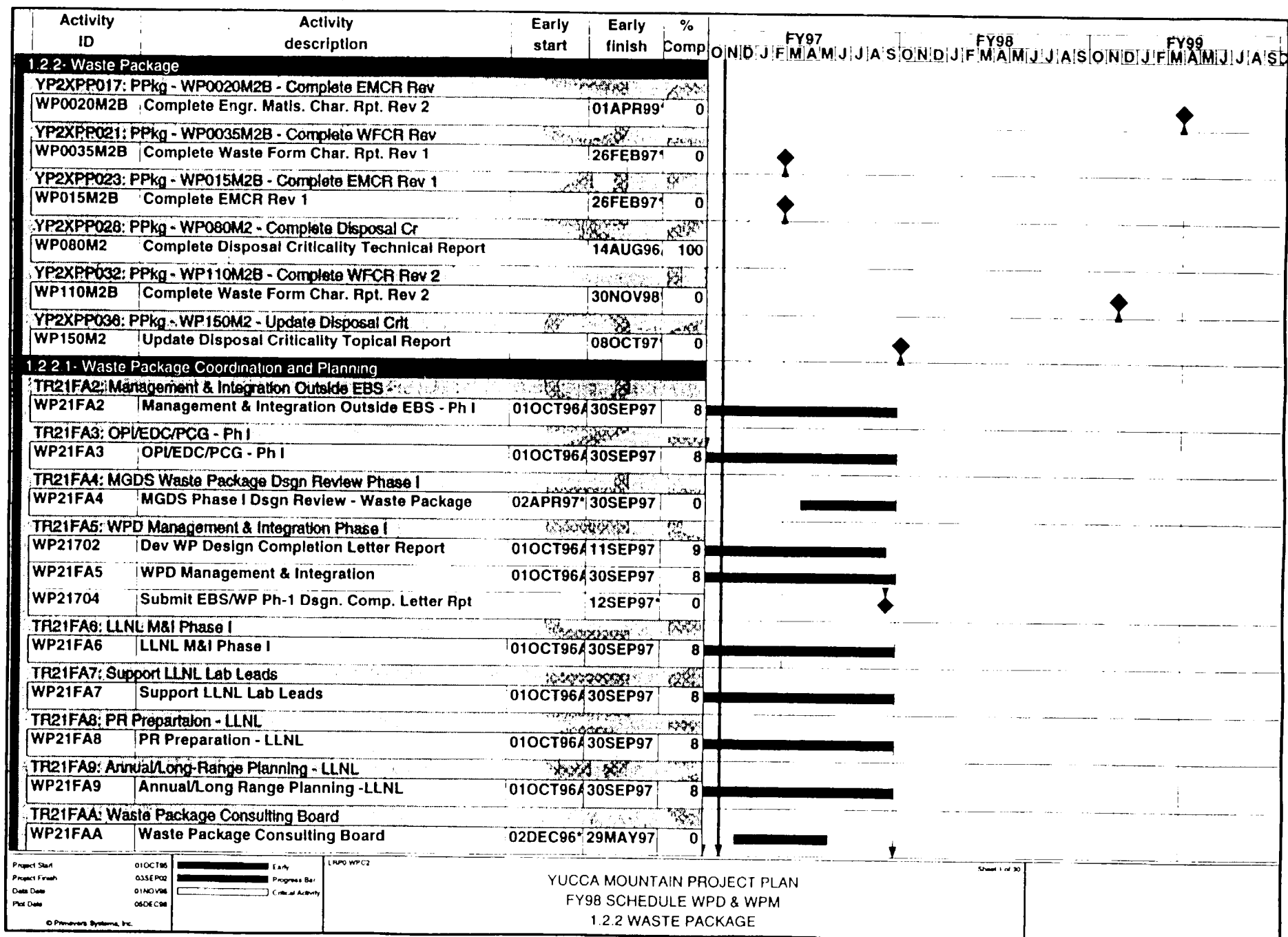
### **WASTE PACKAGE DEVELOPMENT AND MATERIALS SCHEDULE**

The data contained in this appendix reflects the status of the Yucca Mountain Site Characterization Project as of 12/16/96. Because of the evolving conditions of the Yucca Mountain Site Characterization Project, data in this appendix is changed or updated as necessary. However, this VA Design and Review Plan will not be revised or reissued as a result of data updates. For a current status of the data in this appendix and/or a copy of the current version, contact C. Chagnon. For suggested changes to the contents, contact A. Segrest.



## **WASTE PACKAGE DEVELOPMENT AND MATERIALS SCHEDULE**

The Waste Package Development and Materials (WBS 1.2.2) schedule for FY 97/98 is provided. This schedule reflects the current status of the FY 98 planning activity. All of the Waste Package Development and Materials activities are tied to the VA milestone, except those that exclusively support the EIS/NEPA development.



Activity ID	Activity description	Early start	Early finish	% Comp	
TR21FB1: WPD Long Range & Annual Planning					
WP21FB1	Annual/Long Range Planning -WPD	01OCT96	30SEP97	8	
TR21GA1: WPM M&I Phase II					
WP21GA1	WPM Management & Integraton, Ph II	01OCT97	30SEP98	0	
TR21GA2: WPD Management & Integration Phase II					
WP0712	Management & Integration Support, Ph II	01OCT97	30SEP98	0	
WP0813	WPD Management & Integration	01OCT98	26FEB99	0	
WP2751	Support Development of LA	30JUL99	28JUL00	0	
TR21GA3: WPD Progress Reports, Ph II					
WP0701	Prepare Progress Reports, Ph II	01OCT97	30SEP99	0	
WPPR18M3	WPMWPD Input to Progress Report 18		13MAR98	0	
WPPR19M3	WPMWPD Input to Progress Report 19		15SEP98	0	
WPPR20M3	WPM/WPD Input to Progress Report 20		15MAR99	0	
WPPR21M3	WPMWPD Input to Progress Report 21		17SEP99	0	
TR21GA4: M&I Outside EBS, Ph II					
WP0825	Management & Integration Outside EBS	01OCT97	01MAR02	0	
TR21GA5: OPI/EDC/PCG - Phase II					
WP0830	OPI/EDC/PCG, Ph II	01OCT97	01MAR02	0	
TR21GA6: MGDS Waste Package Dsgn Rev, Ph II					
WP210809	WPD/WPM Input to VA Design Summary Prep	01OCT97	20FEB98	0	
WP210811	WPD/WPM Input to MGDS VA Review	01OCT97	30SEP98	0	
WP21GA6	MGDS Ph-II Design Review - WP	01OCT97	30SEP98	0	
TR21GA7: LLNL Lab Leads Support, Ph II					
WP21GA7	LLNL Lab Leads Support	01OCT97	30SEP98	0	
TR21GA8: WPM Progress Reports, Ph II					
WP21GA8	WPM Progress Reports, Ph II	01OCT97	30SEP99	0	
TR21GA9: WPM Annual/Long-Range Planning Ph II					
WP21GA9	WPM Annual/Long-Range Planning	01OCT97	30SEP98	0	
TR21GAA: Waste Package Consulting Board, Ph II					
WP21GAA	Waste Package Consulting Board, Ph II	01OCT97	30SEP98	0	
TR21GAB: WPD Long Range & Annual Planning Ph II					
WP21GB1	WPD Long Range & Annual Planning	01OCT97	30SEP98	0	

1.2.2.2 Waste Package Requirements

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Project Finish: 03SEP02

Date Date: 01NOV98

Plot Date: 05DEC98

Legend:

- Early
- Progress Bar
- Critical Activity

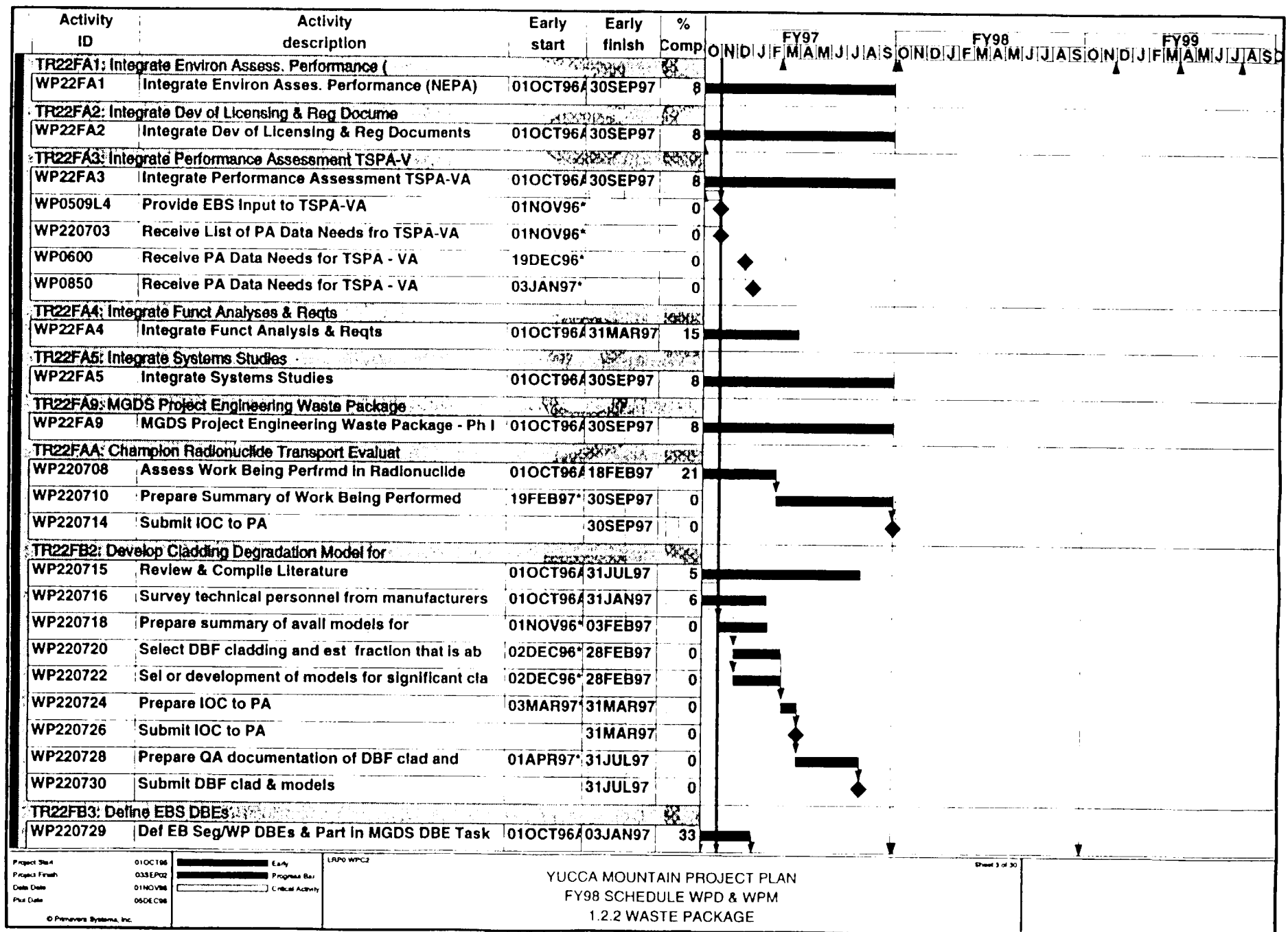
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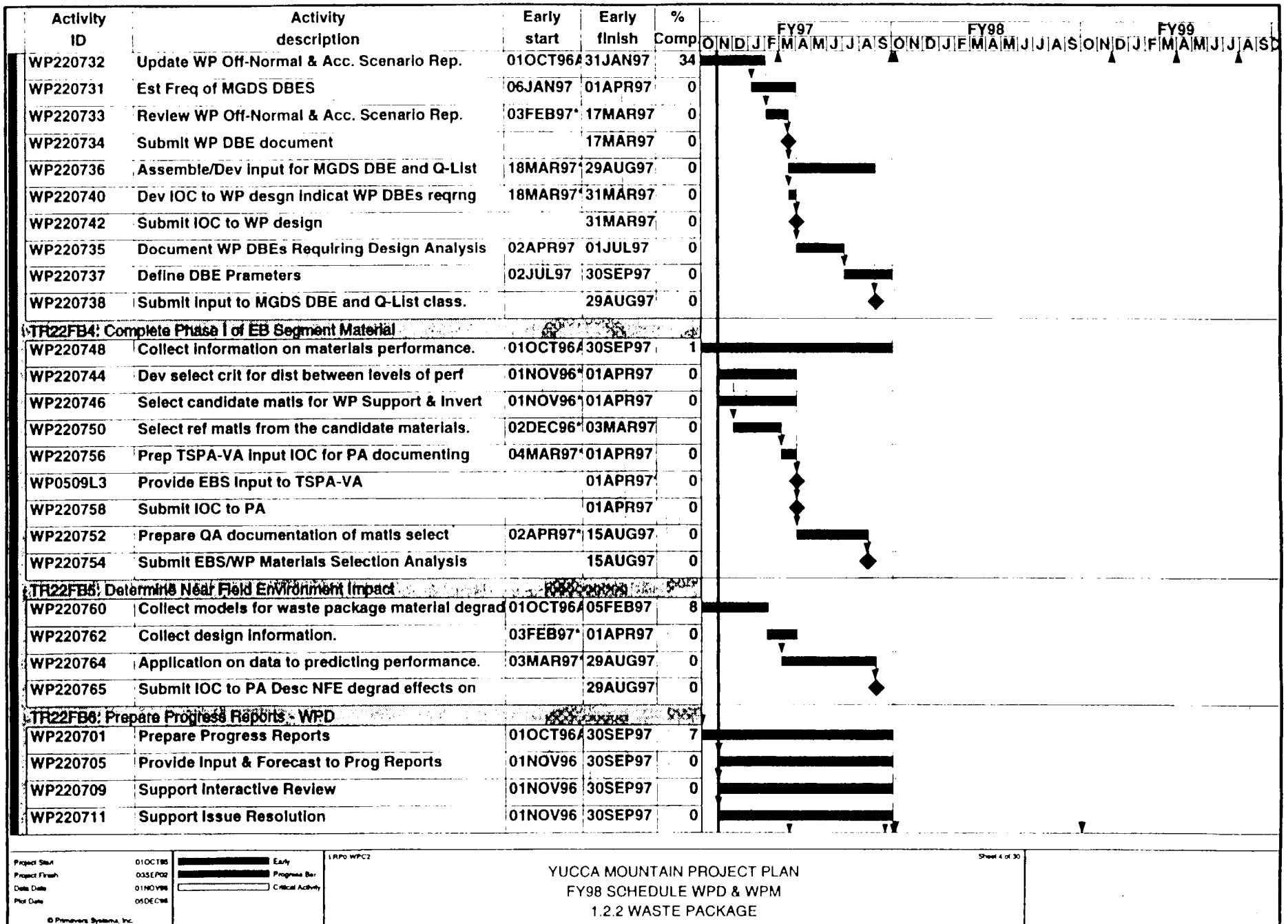
YUCCA MOUNTAIN PROJECT PLAN

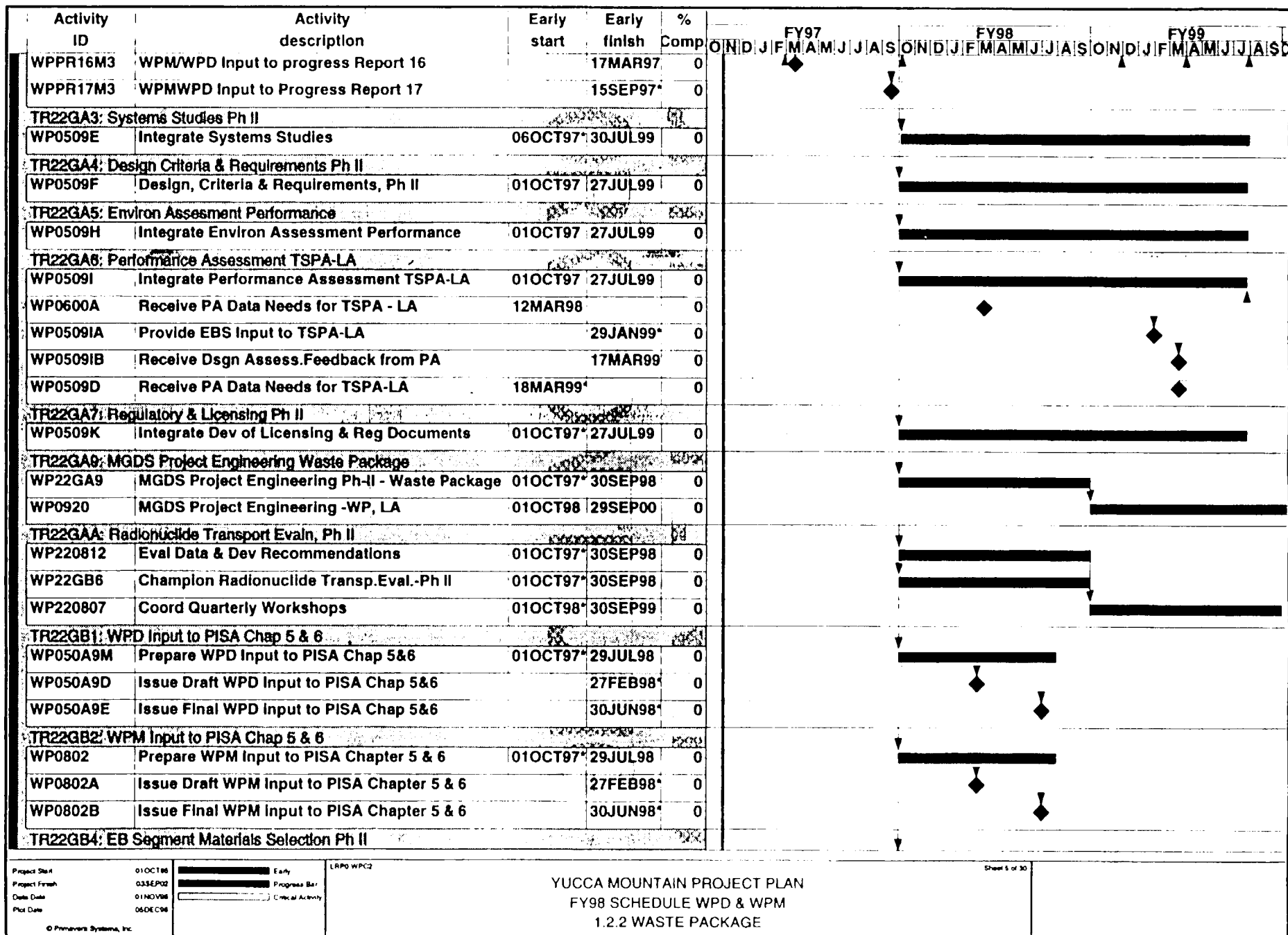
FY98 SCHEDULE WPD & WPM

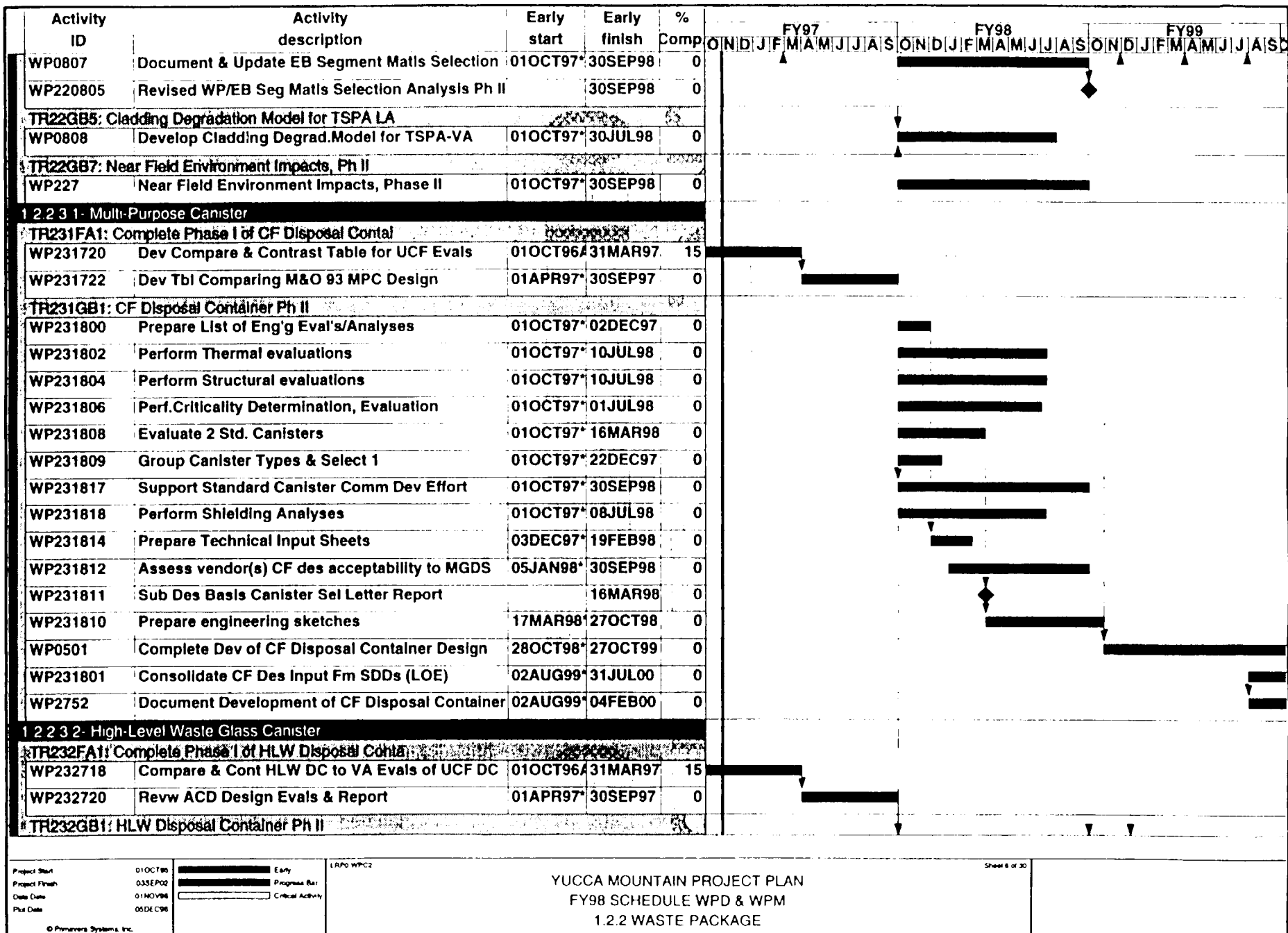
1.2.2 WASTE PACKAGE

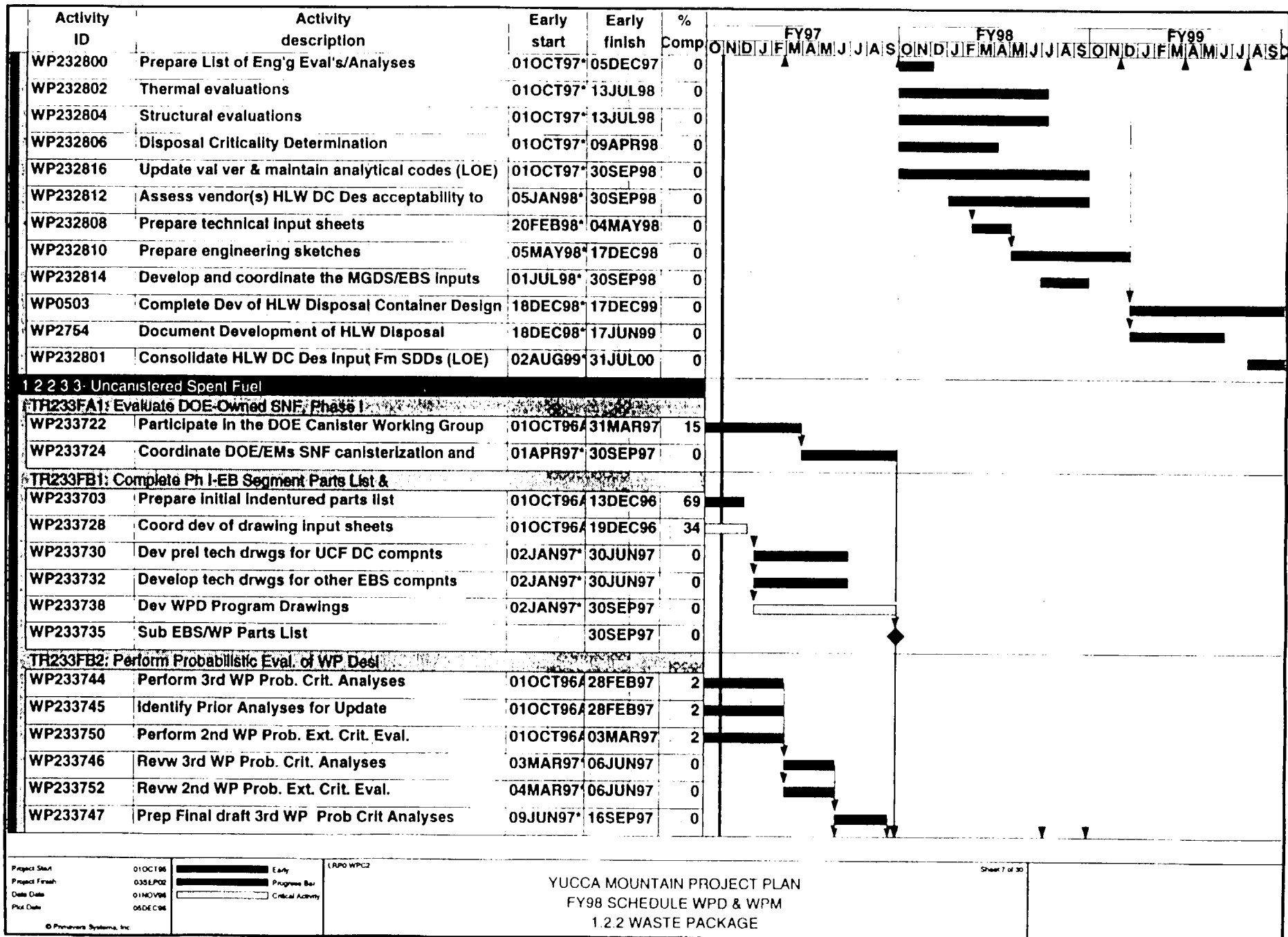
Sheet 2 of 30



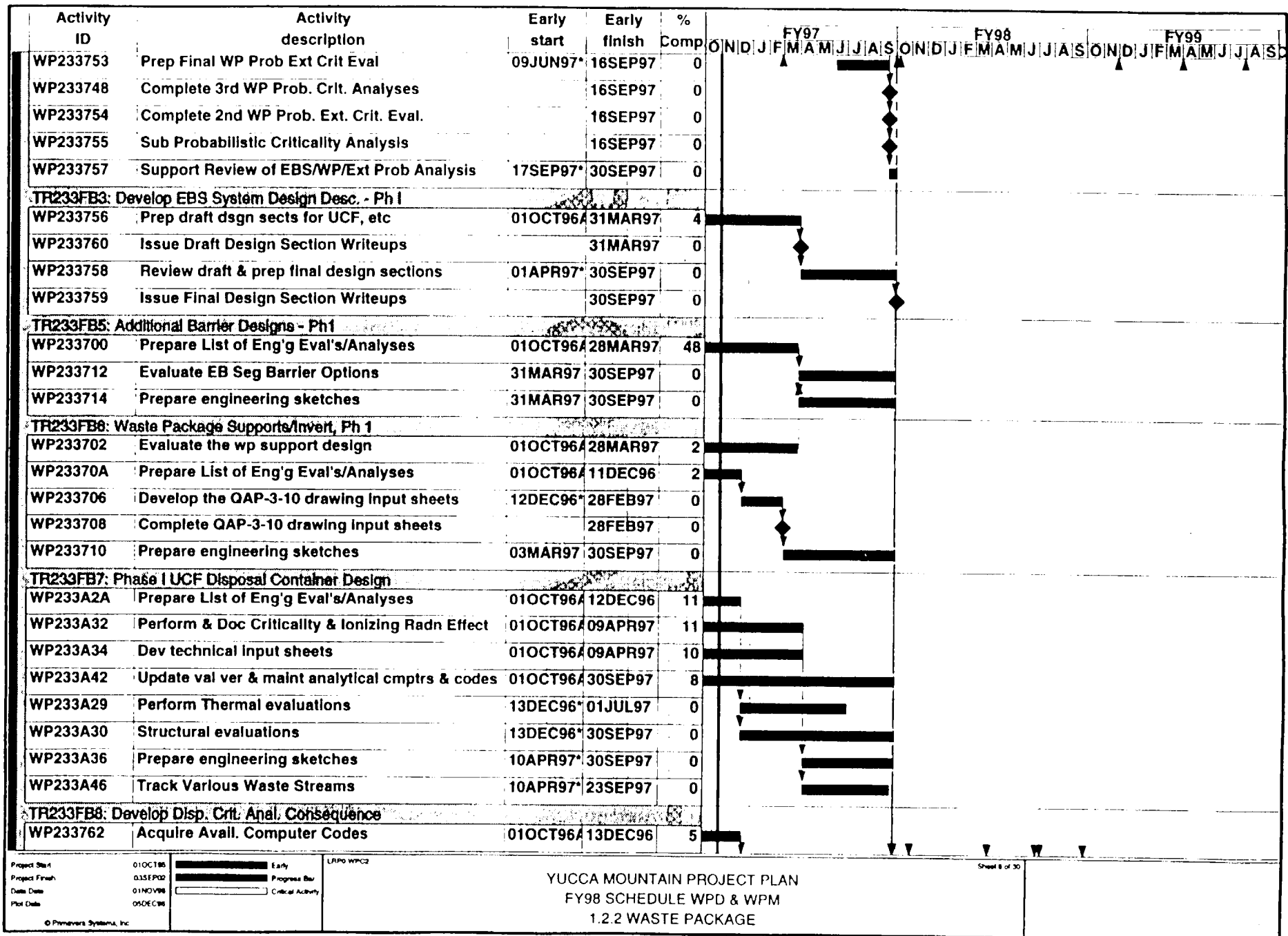


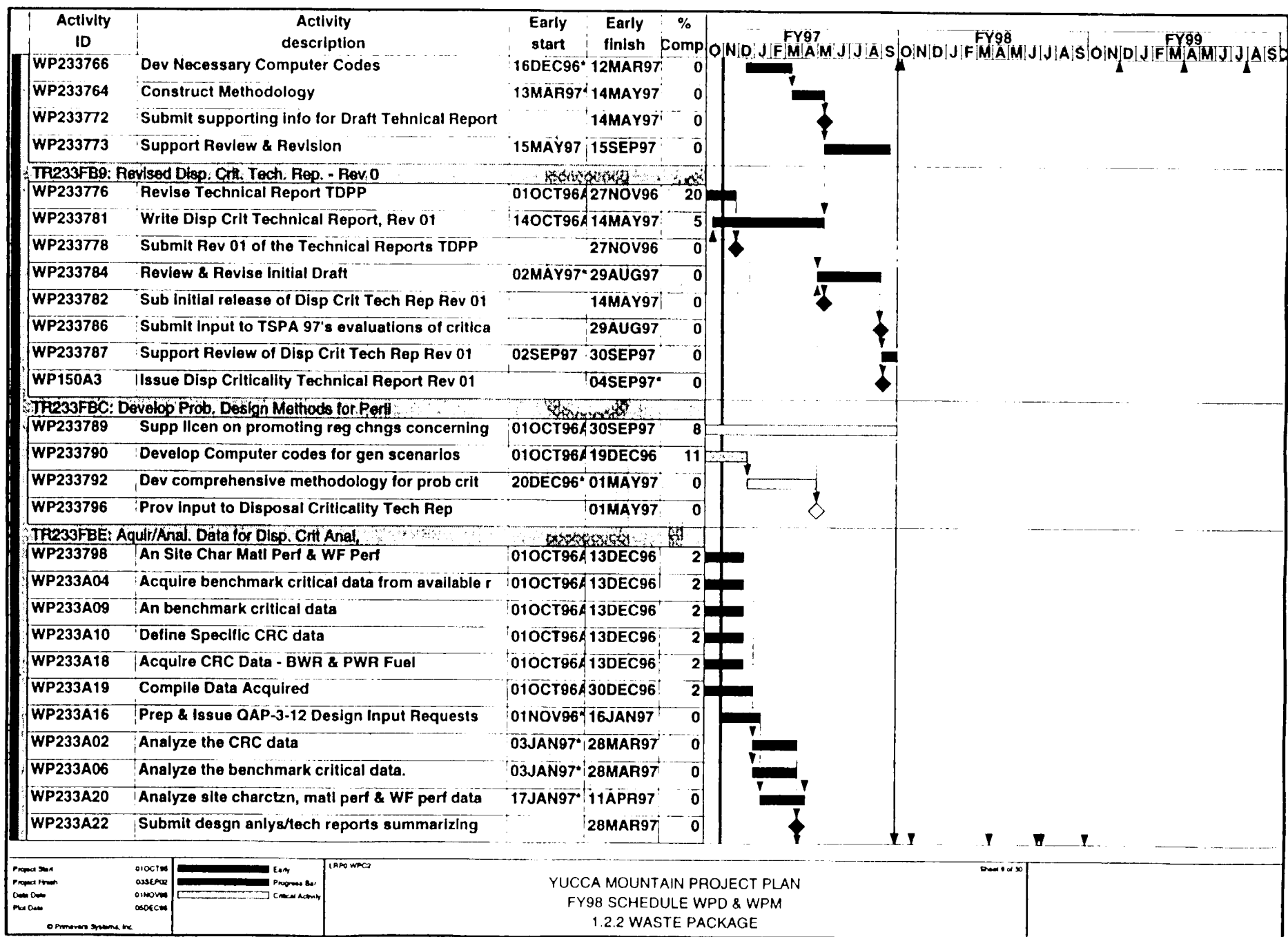


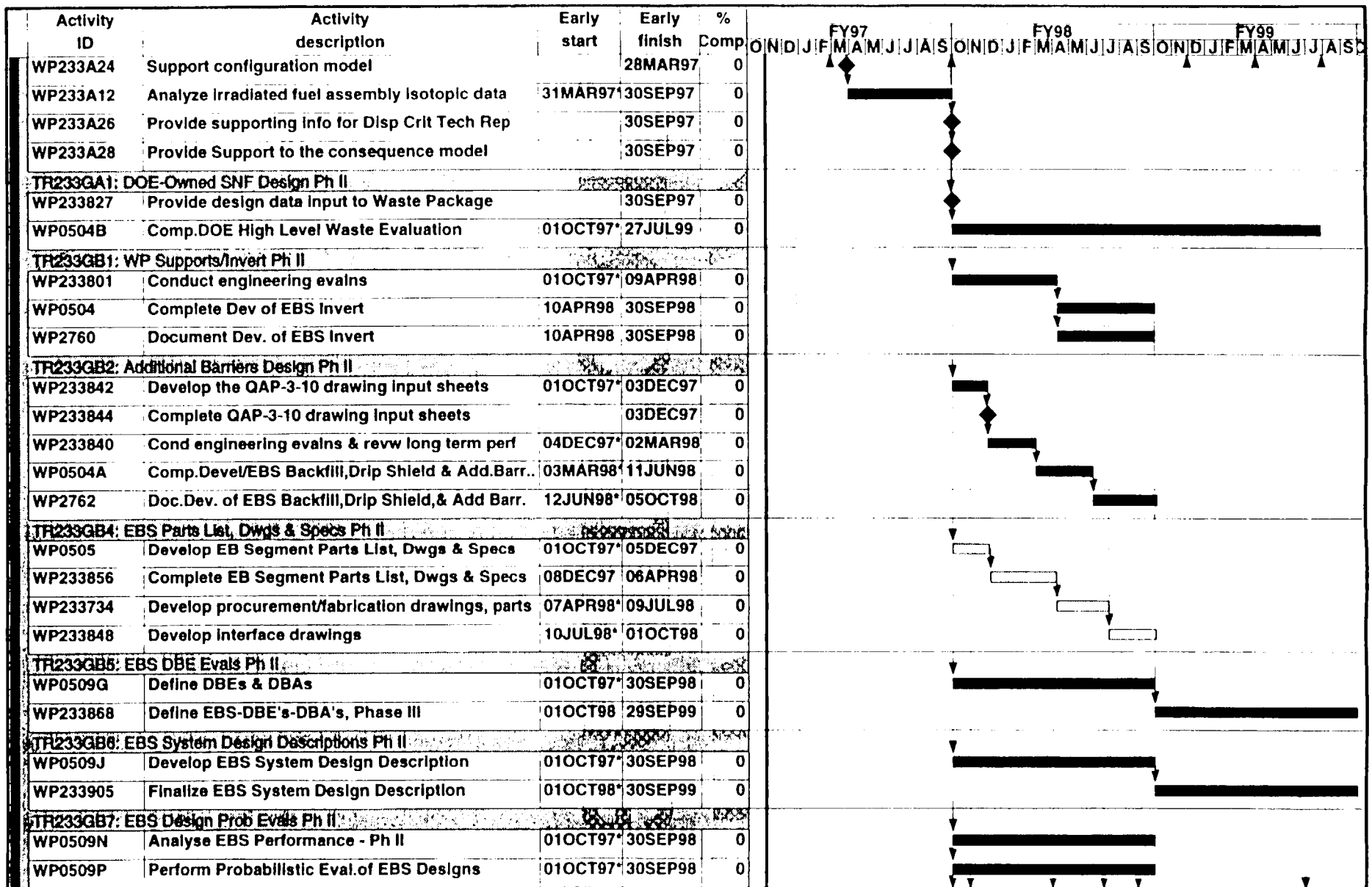












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 Project Finish: 03SEP02  
 Data Date: 01NOV98  
 Plot Date: 05DEC98

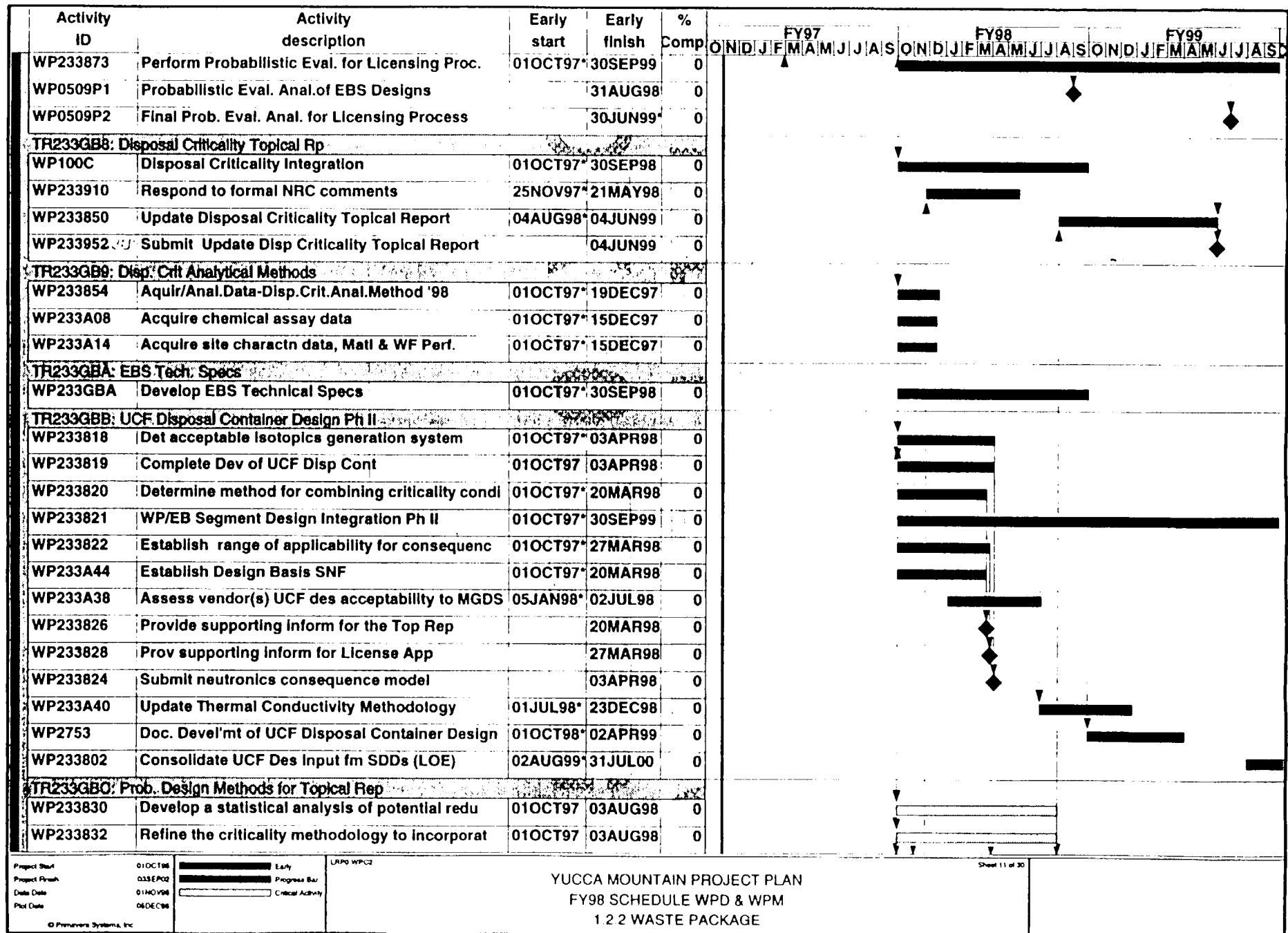
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 ■ Early  
 ■ Progress Bar  
 ■ Critical Activity

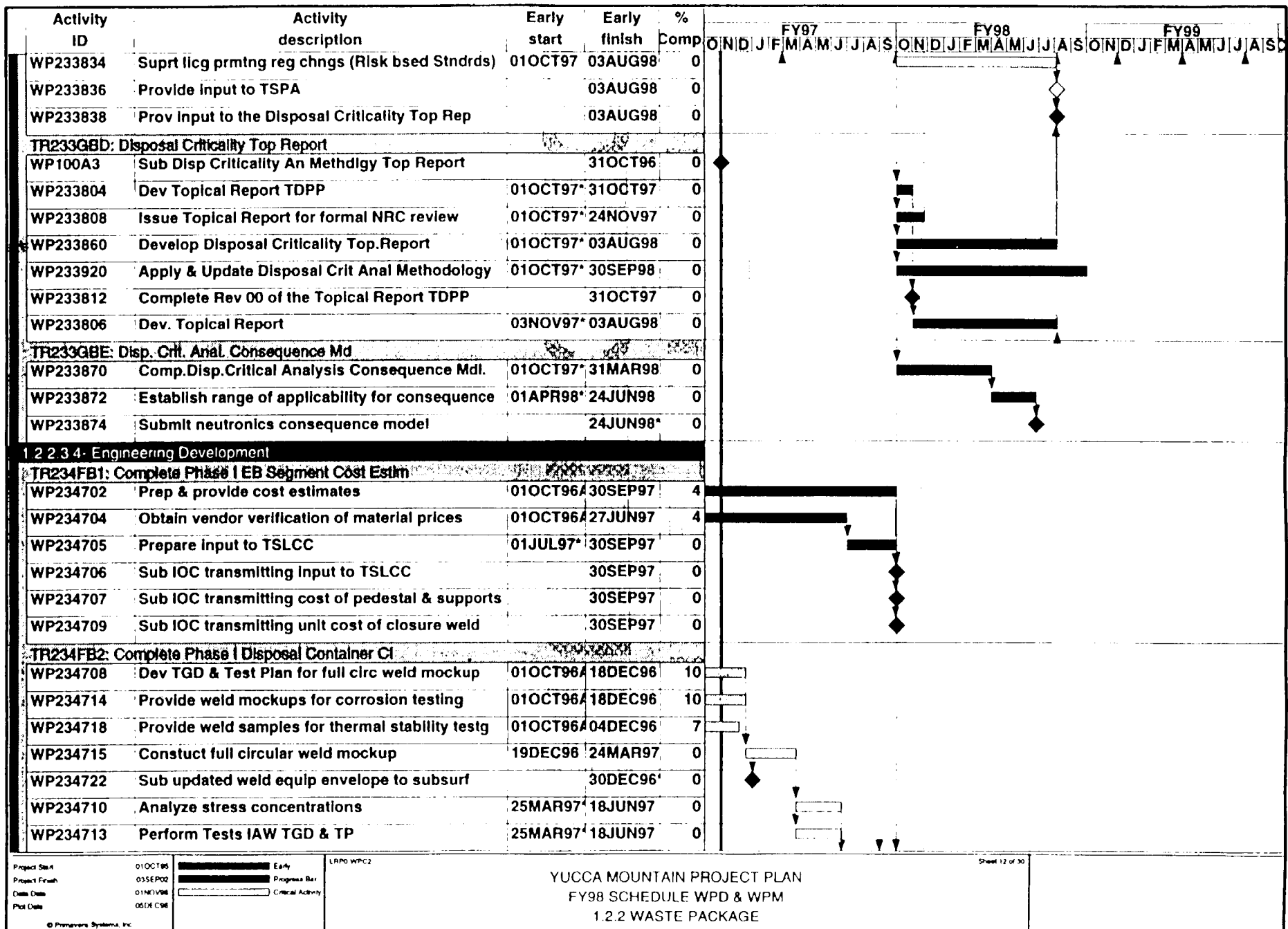
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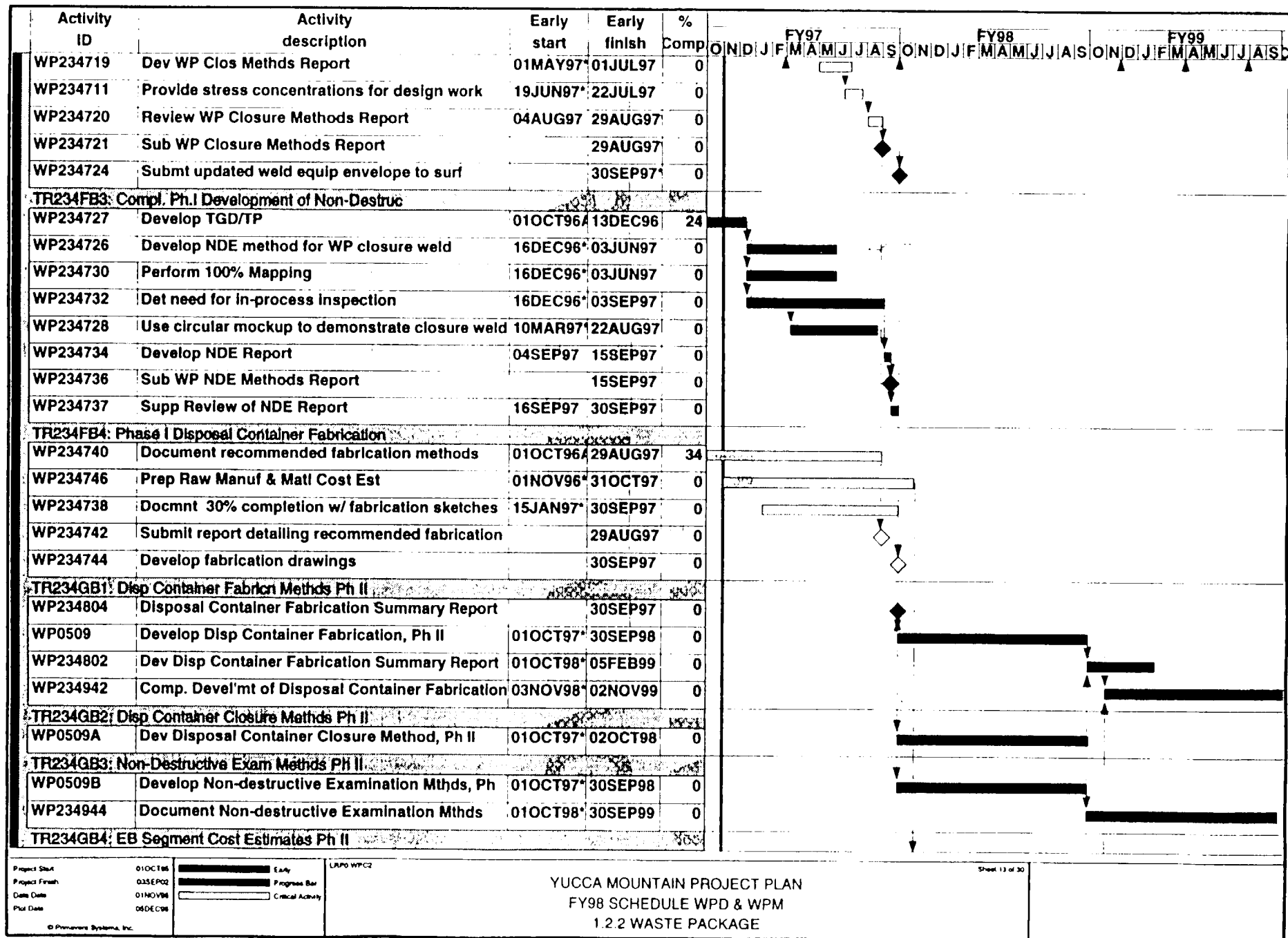
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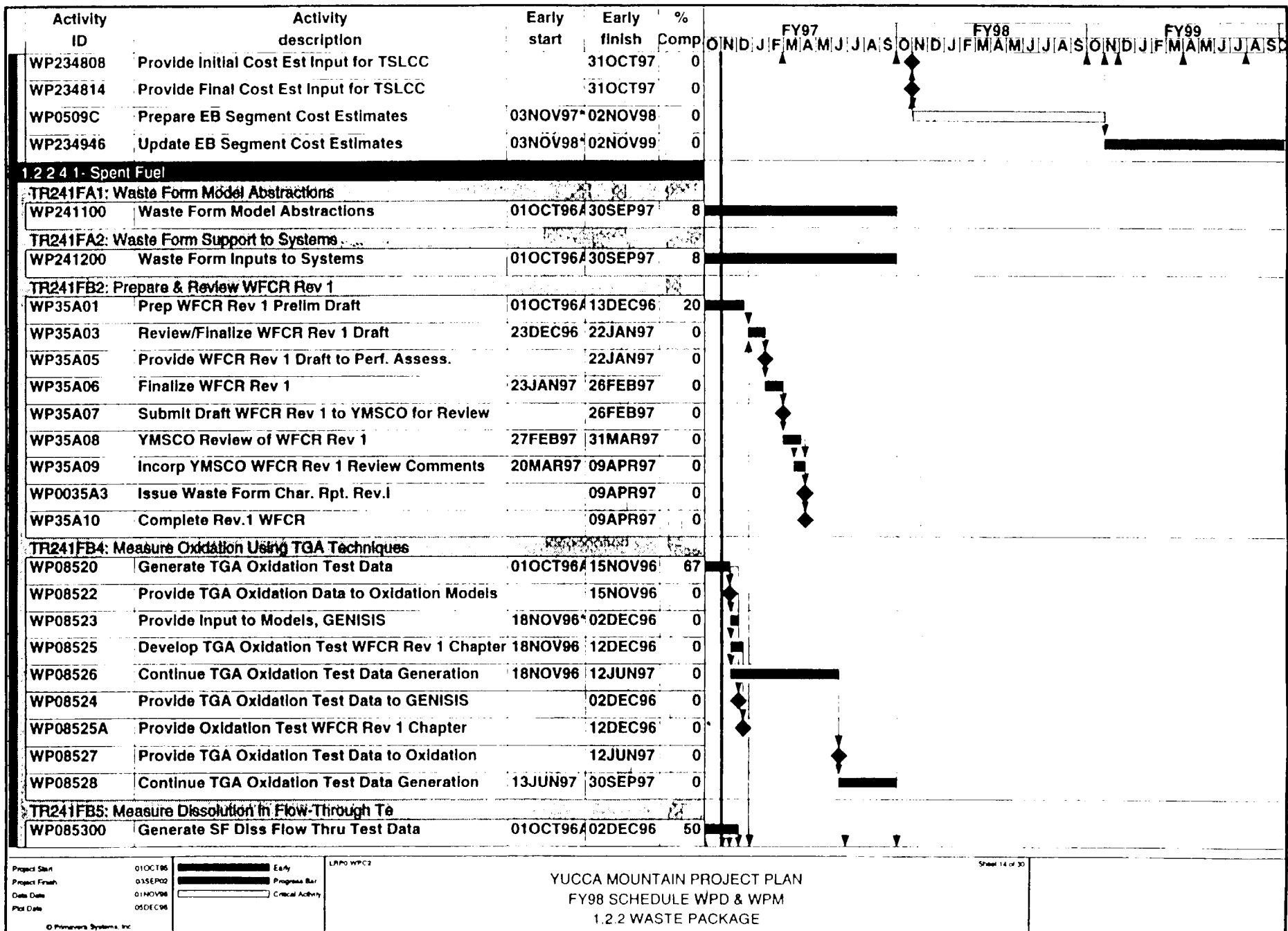
YUCCA MOUNTAIN PROJECT PLAN  
 FY98 SCHEDULE WPD & WPM  
 1.2.2 WASTE PACKAGE

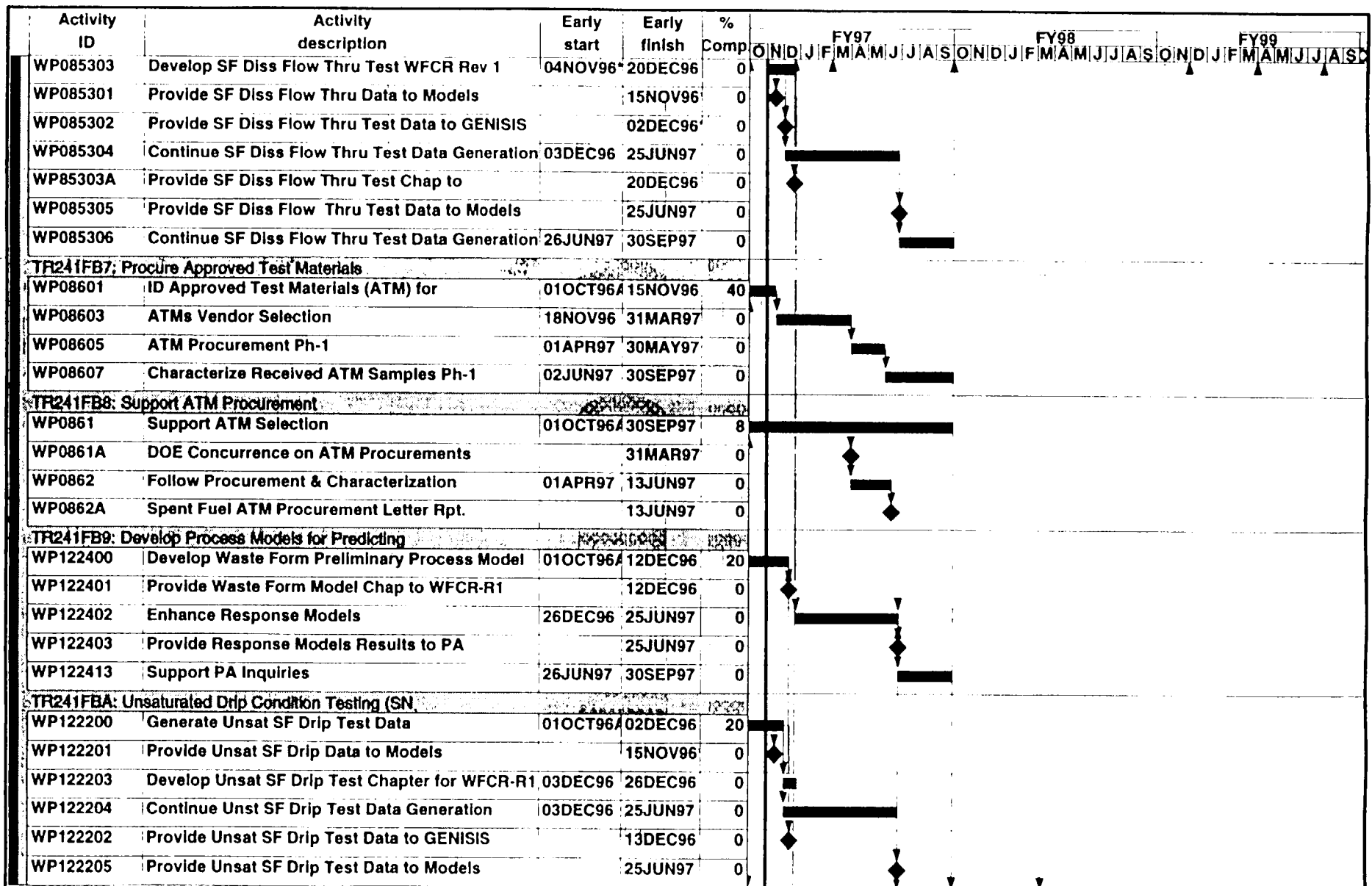
Sheet 10 of 30











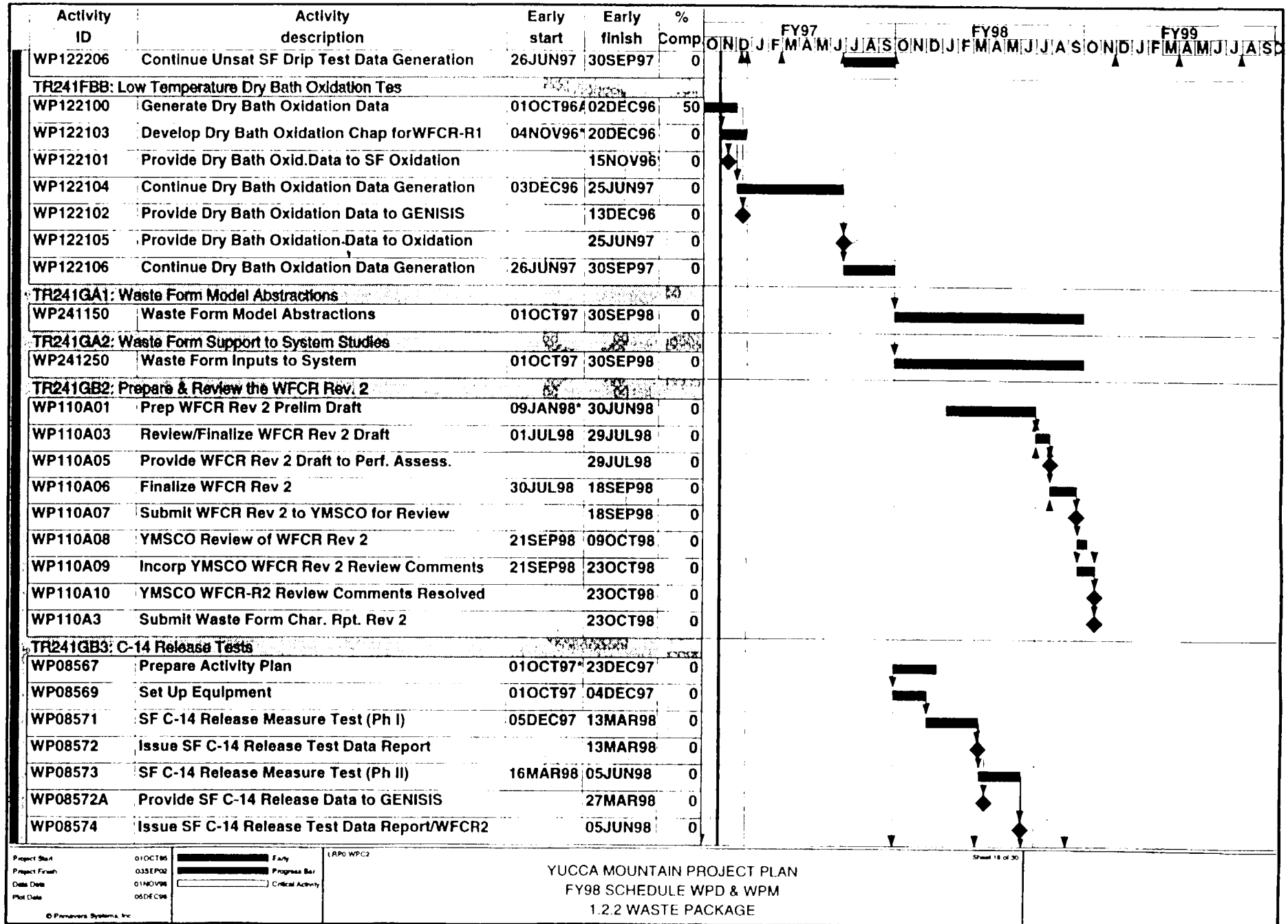
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 Plot Date: 05DEC96

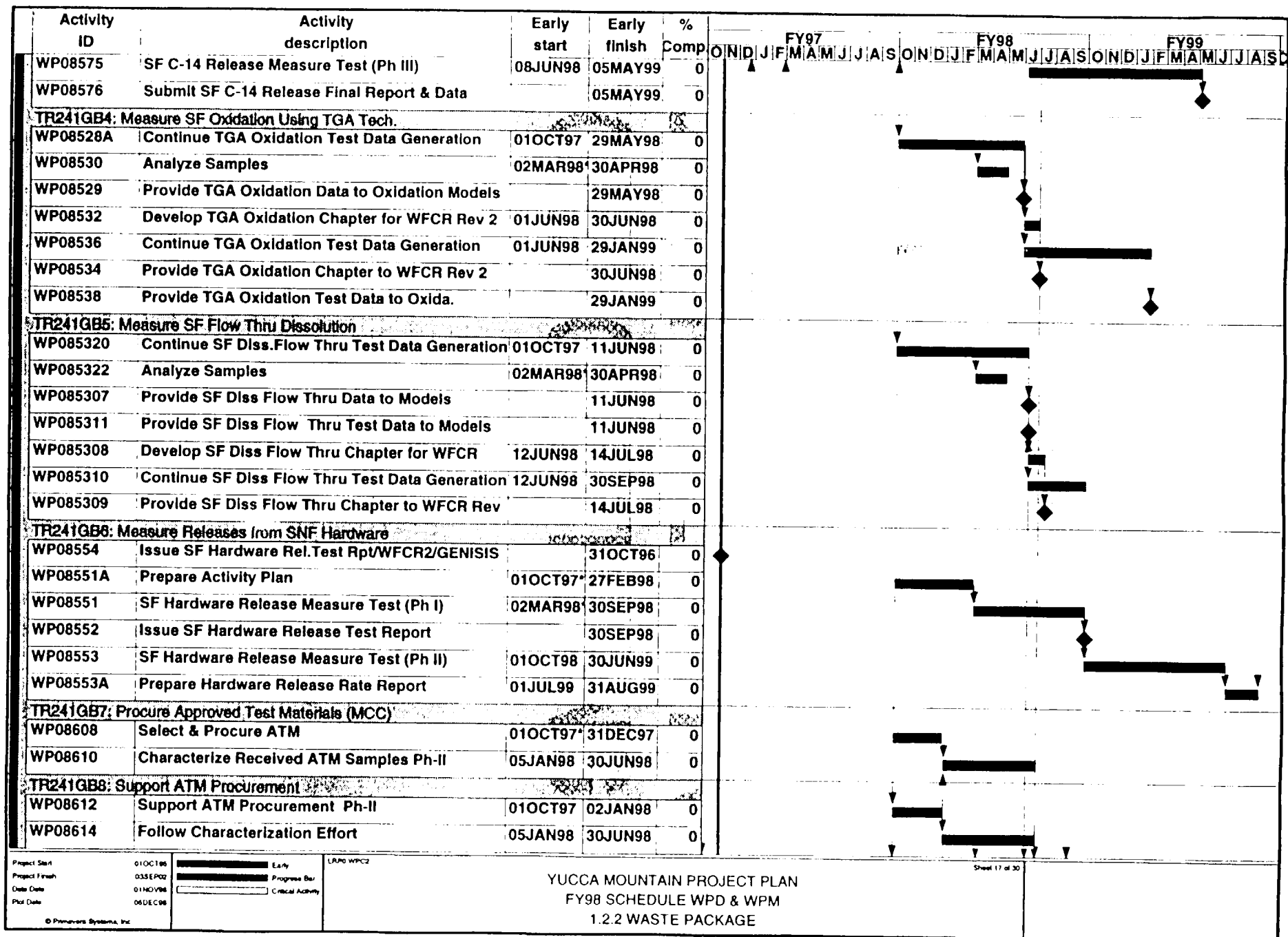
LPO WPL2

YUCCA MOUNTAIN PROJECT PLAN  
 FY98 SCHEDULE WPD & WPM  
 1.2.2 WASTE PACKAGE

Sheet 15 of 30







Activity ID	Activity description	Early start	Early finish	% Comp	
WP08616	Provide Letter Report to YMSCO		30JUN98	0	
<b>TR241GB9: Develop Waste Form Process Model</b>					
WP122407	Enhance Response Model (Excluding	01NOV96	09APR97	0	
WP122404	Improve Response Model(Including Dissolution)	10MAR98	11JUN98	0	
WP122405	Prepare Response Model Chap to WFCR-R2	12JUN98	31AUG98	0	
WP122420	Improve Response Model Continued	12JUN98	08MAR99	0	
WP122406	Provide Response Model to PA & WFCR-Rev 2		31AUG98	0	
<b>TR241GBA: Unsat. SF Drip Condition Testing</b>					
WP122220	Continue Unsat.SF Drip Test Data Generation	01OCT97*	11JUN98	0	
WP122222	Analyze Samples	02MAR98	29MAY98	0	
WP122207	Provide Unsat SF Drip Data to Models		11JUN98	0	
WP122208	Develop Drip Test Chapter for WFCR Rev 2	12JUN98	14JUL98	0	
WP122210	Continue Unsat SF Drip Test Data Generation	12JUN98	14OCT98	0	
WP122209	Provide Drip Test Chapter to WFCR Rev 2		14JUL98	0	
WP122211	Provide Unsat SF Drip Test Data to Models		14OCT98	0	
<b>TR241GBB: Dry Bath SF Oxidation Testing</b>					
WP122120	Continue Dry Bath Oxidation Data Generation	01OCT97	11JUN98	0	
WP122122	Analyze Samples	02MAR98	29MAY98	0	
WP122107	Provide Dry Bath Data to Oxidation Models		11JUN98	0	
WP122108	Develop Dry Bath Oxidation Chap for WFCR-R2	12JUN98	14JUL98	0	
WP122110	Continue Dry Bath Oxidation Data Generation	12JUN98	11FEB99	0	
WP122109	Provide Dry Bath Oxidation Chap to WFCR-R2		14JUL98	0	
WP122111	Provide Dry Bath Data to Oxidation Models		30SEP98*	0	
<b>TR241GBC: Cladding Degradation Testing</b>					
WP241800	Prepare Activity Plan	01OCT97*	30JAN98	0	
WP241802	Set Up Equipment	01DEC97*	31MAR98	0	
WP241804	Conduct Phase I tests	01APR98	30SEP98	0	
WP241806	Analyze Samples	01JUL98	30SEP98	0	
<b>1.2.2.4.2- Borosilicale Glass</b>					
<b>TR242FB1: HLWG Degradation Parameter Tests</b>					
WP085600	Prepare Activity Plan	01OCT96*	31JAN97	25	

Project Start: 01OCT96

Project Finish: 03SEP98

Date Date: 01NOV98

Plot Date: 05DEC98

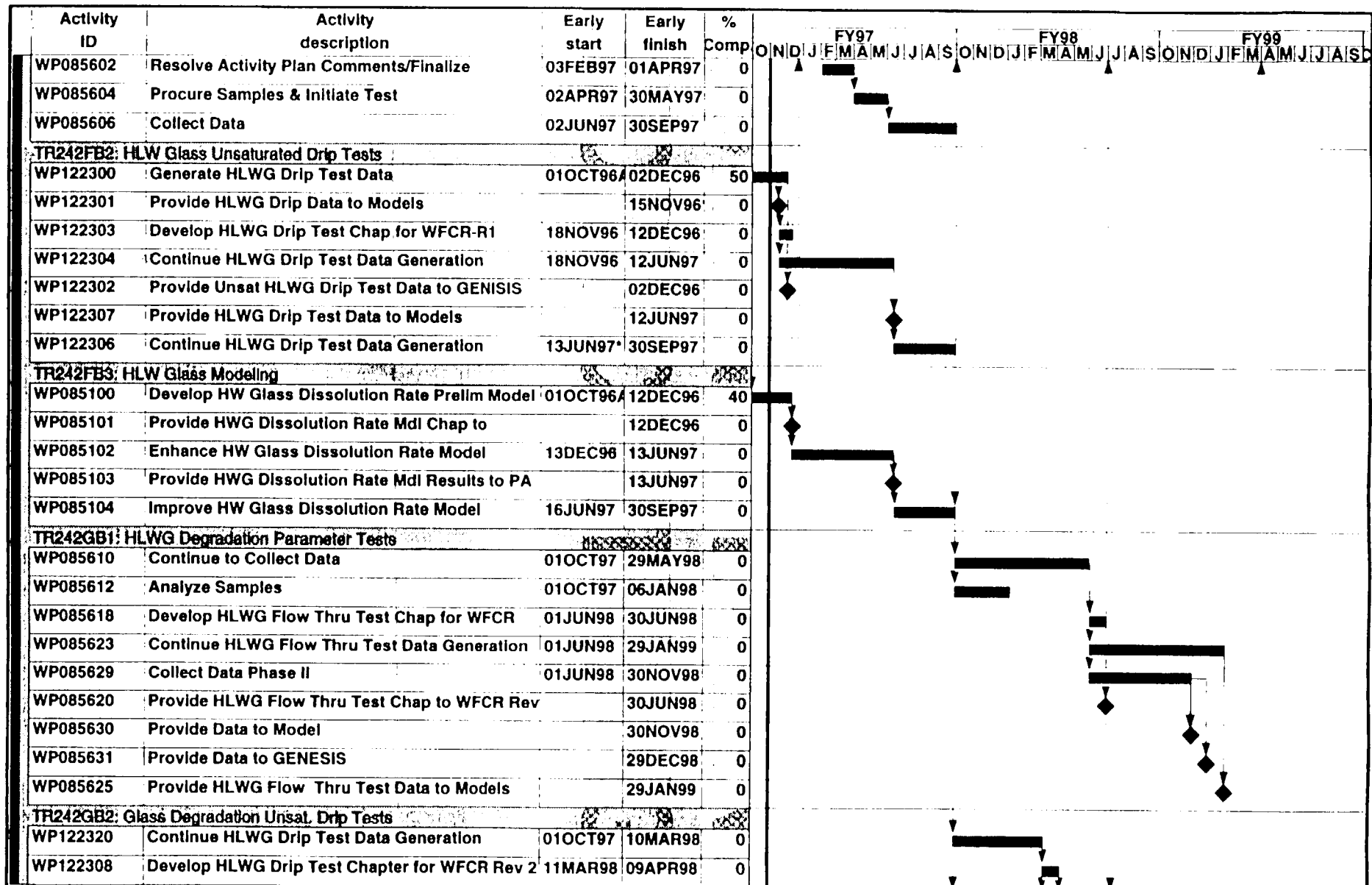
Legend:

- Early
- Progress Bar
- Critical Activity

YUCCA MOUNTAIN PROJECT PLAN

FY98 SCHEDULE WPD & WPM

1.2.2 WASTE PACKAGE



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 Project Finish: 03SEP98  
 Data Date: 01NOV98  
 Plot Date: 05DEC98

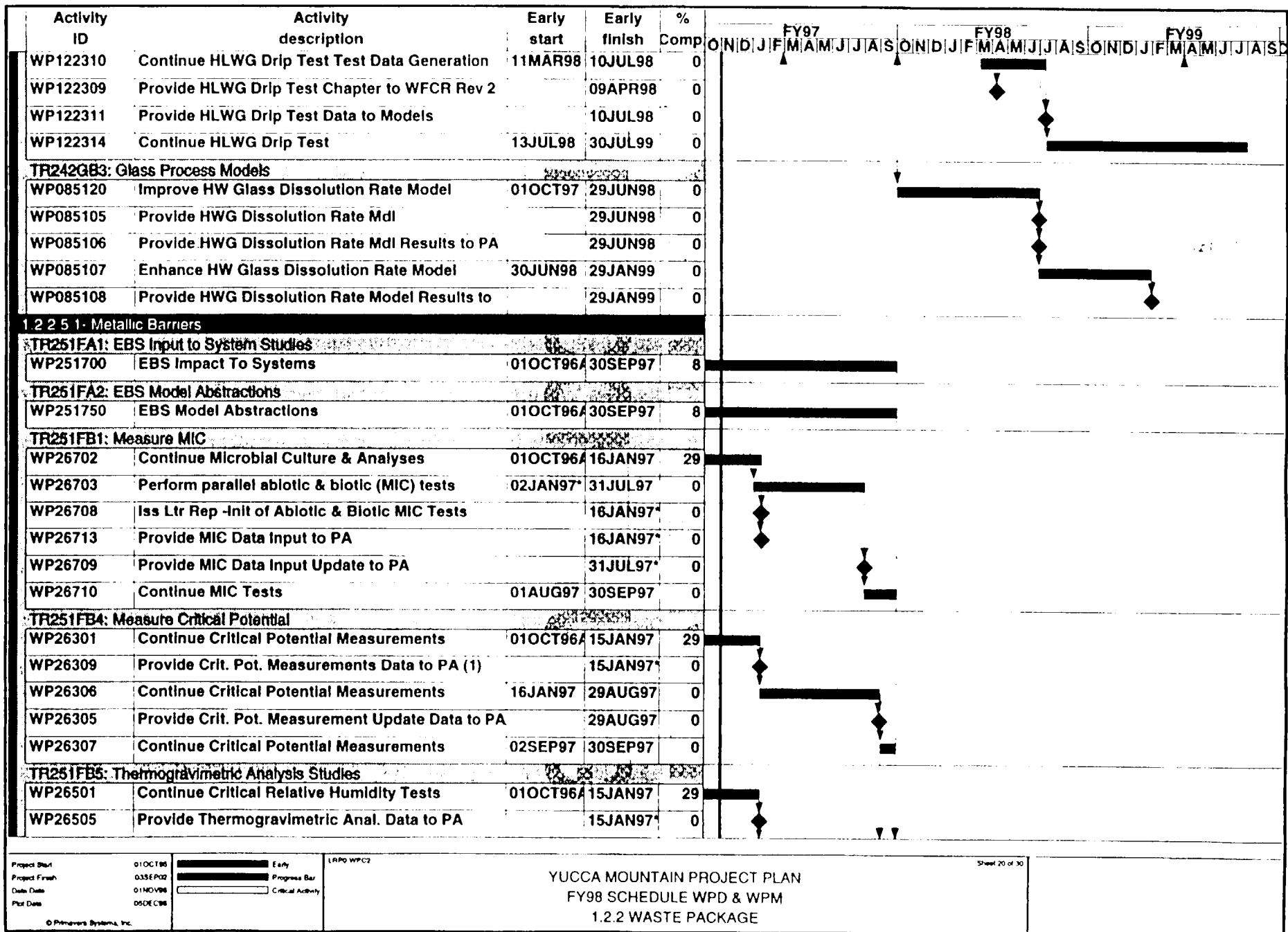
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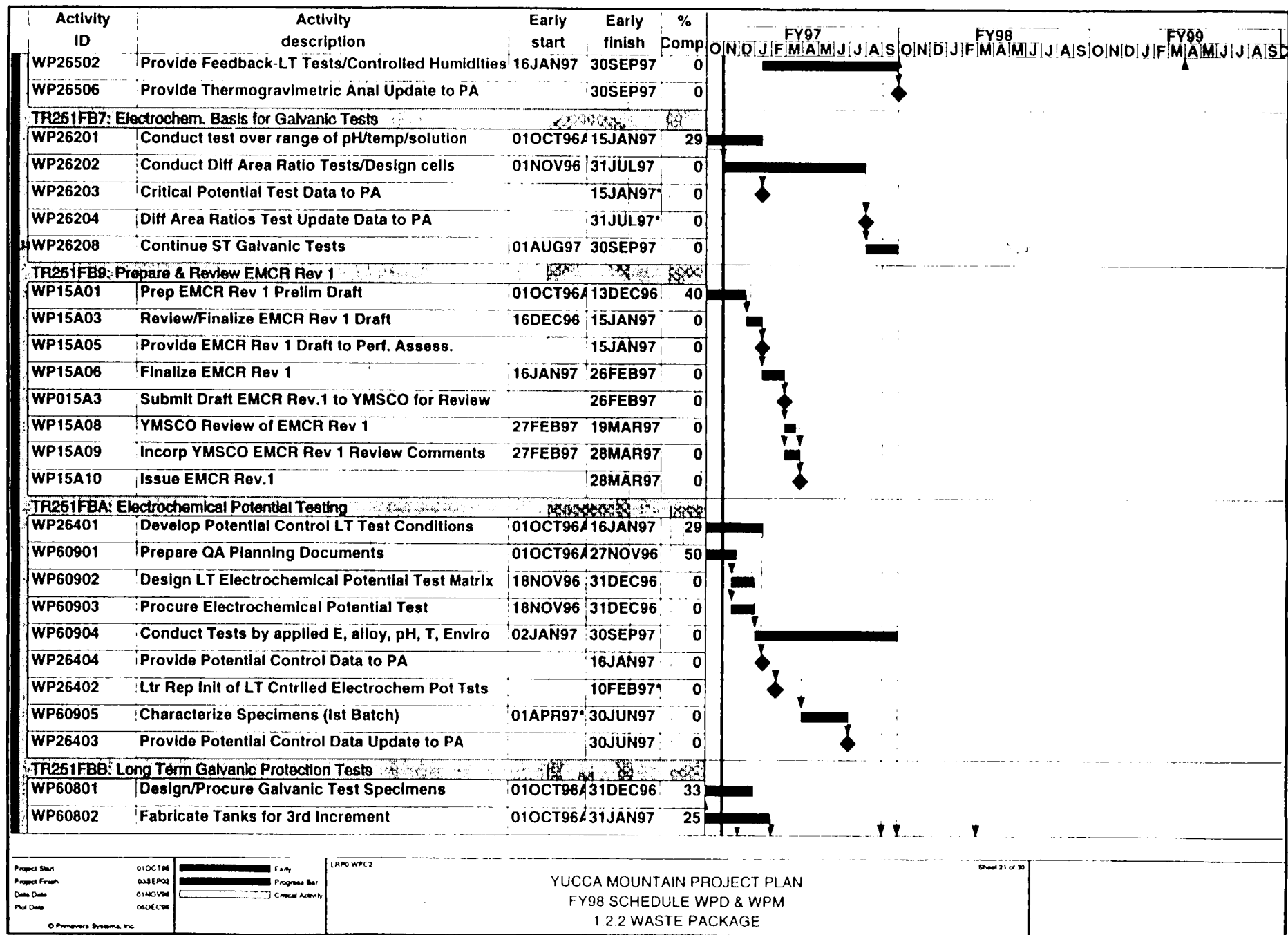
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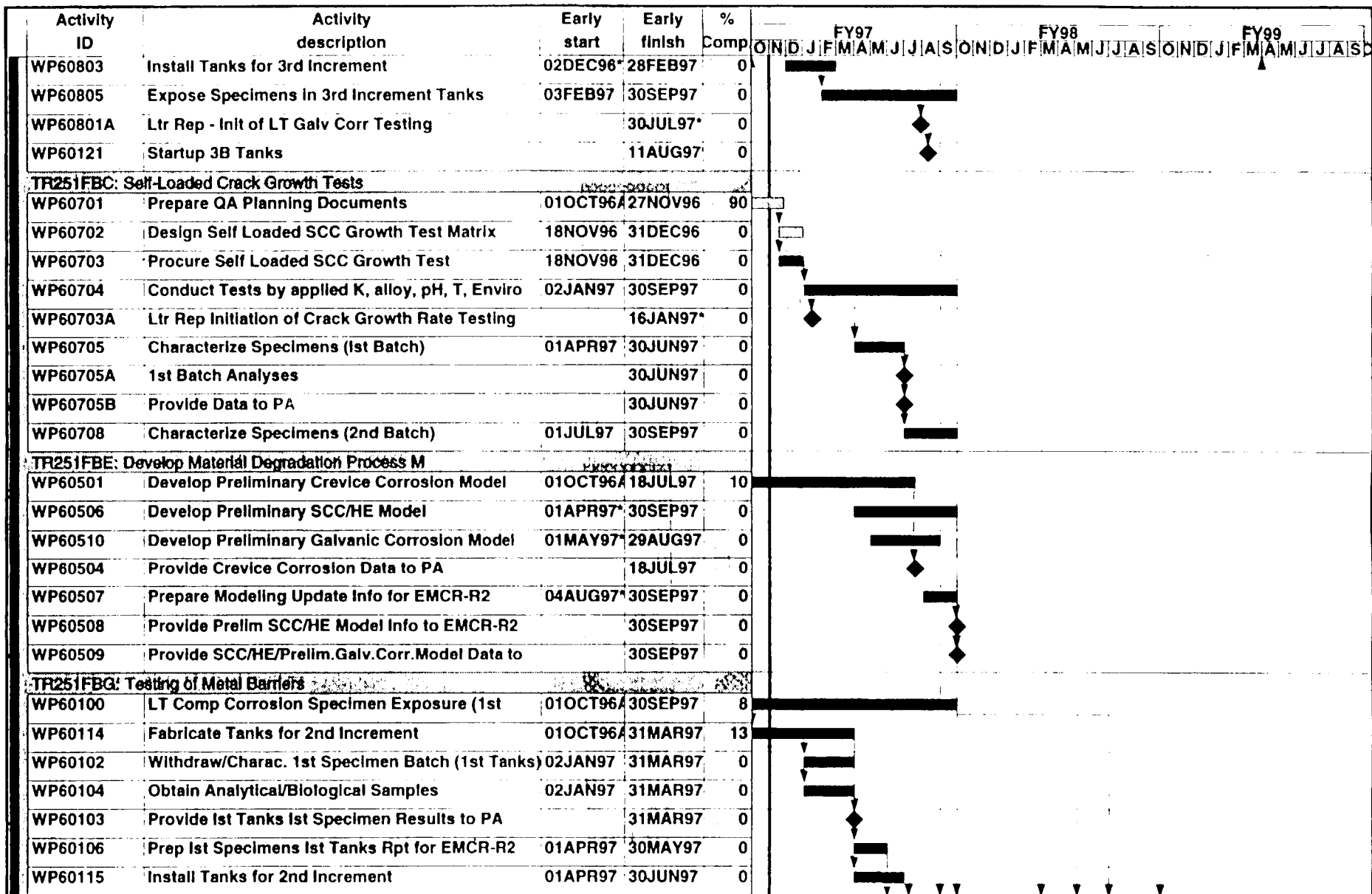
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YUCCA MOUNTAIN PROJECT PLAN  
 FY98 SCHEDULE WPD & WPM  
 1.2.2 WASTE PACKAGE

Sheet 18 of 30





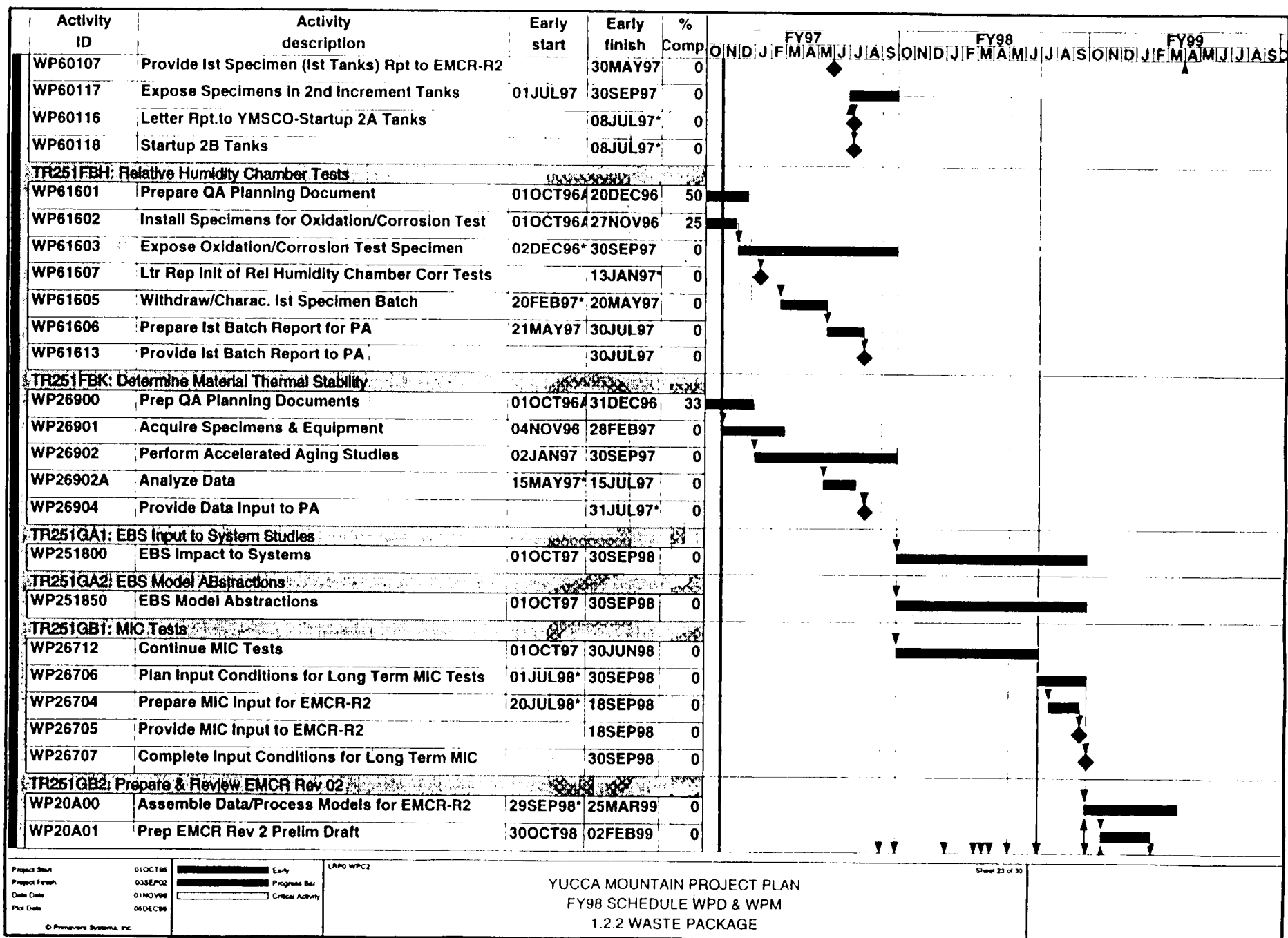


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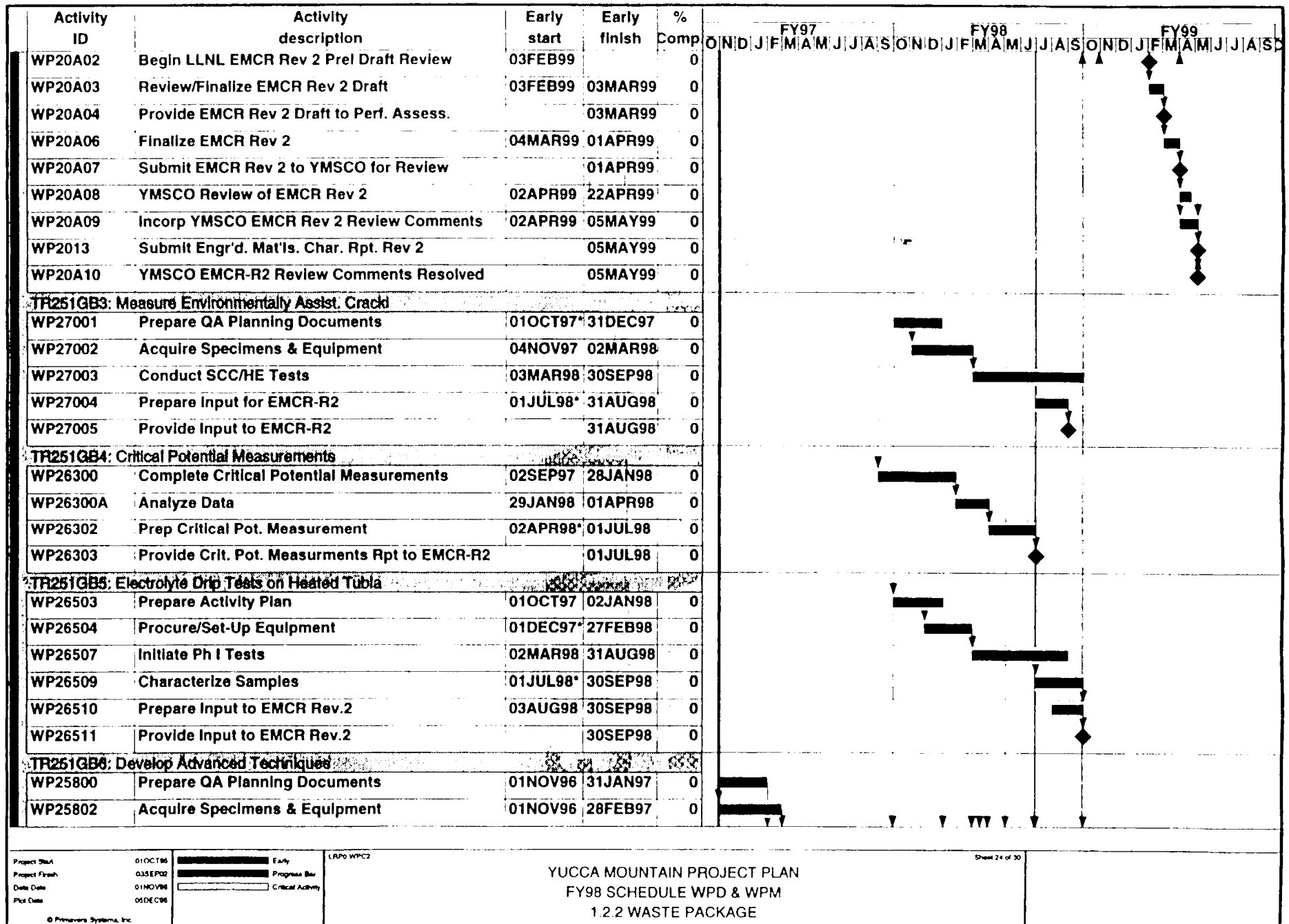
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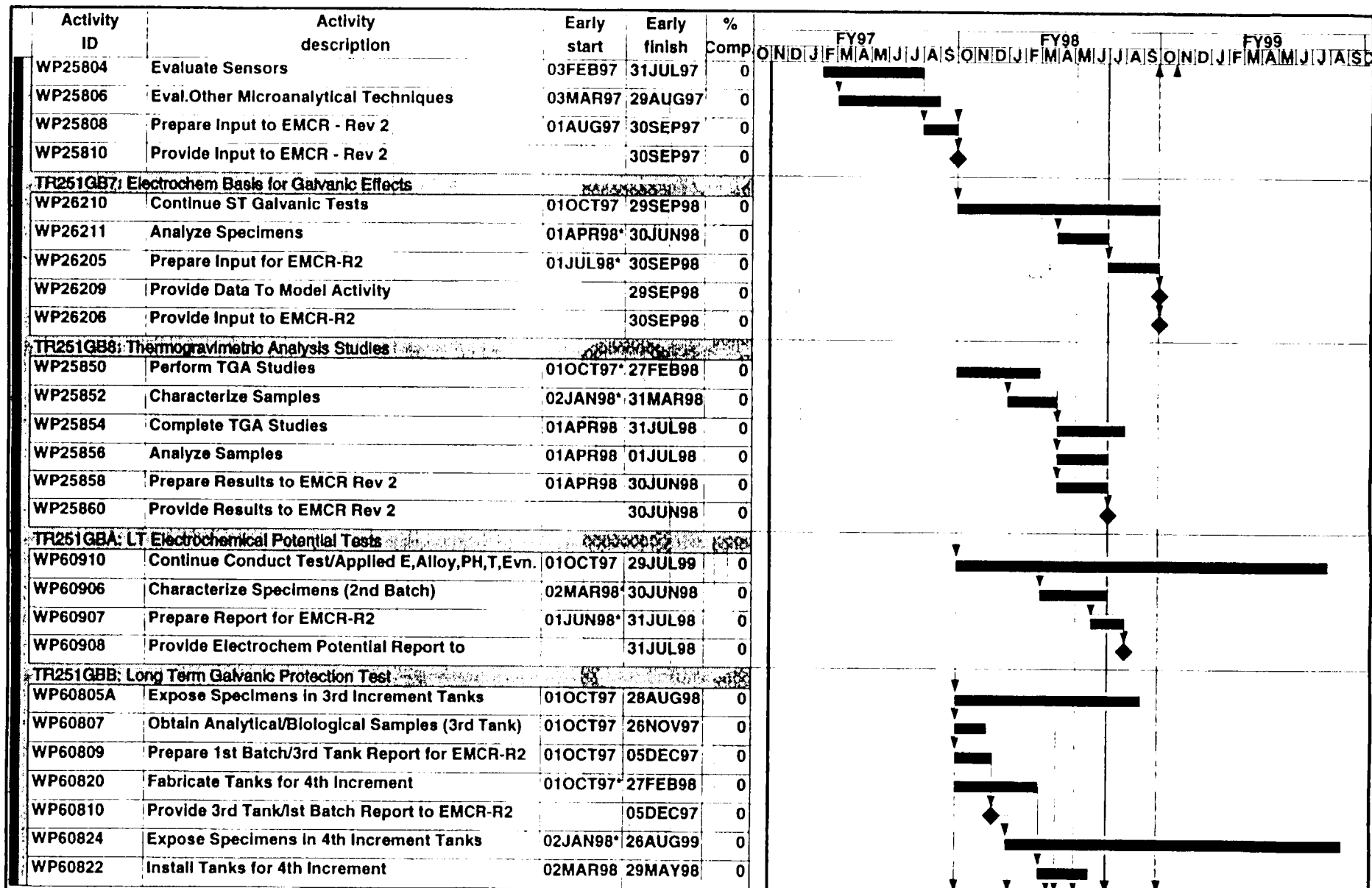
YUCCA MOUNTAIN PROJECT PLAN  
 FY98 SCHEDULE WPD & WPM  
 1.2.2 WASTE PACKAGE

Sheet 22 of 30









Project Start: 01OCT98  
 Project Finish: 03SEP02  
 Data Date: 01NOV98  
 Plot Date: 06DEC98

Legend:  
 [Solid Bar] Early  
 [Patterned Bar] Progress Bar  
 [Dashed Bar] Critical Activity

UAPC WPC2

YUCCA MOUNTAIN PROJECT PLAN  
 FY98 SCHEDULE WPD & WPM  
 1.2.2 WASTE PACKAGE

Sheet 25 of 30

Activity ID	Activity description	Early start	Early finish	% Comp	FY97												FY98												FY99											
					O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S
WP60806	Withdraw/Charac. 1st Batch (3rd Tanks)	01APR98*	29MAY98	0																																				
TR251GBC: Self Loaded SCC Growth Test																																								
WP60704A	Conduct Tests by Applied K, Alloy, Ph, T, Envn.	01OCT97	27FEB98	0																																				
WP60709	Characterize Specimens (2nd Batch)	01OCT97	31OCT97	0																																				
WP60704B	Characterize Specimens	02MAR98	30JUN98	0																																				
WP60704C	Continue SCC Tests	02MAR98	30SEP98	0																																				
WP60706	Prepare Report for EMCR-R2	01JUL98*	31AUG98	0																																				
WP60707	Provide Self Loaded SCC Growth Report to		31AUG98	0																																				
TR251GBD: Provide Feed-Back to Near-Term Environ																																								
WP26827	Prepare Feedback for Near Field Environment	01OCT97*	04DEC97	0																																				
WP26828	Provide Feedback to Near-Field Environment		04DEC97	0																																				
WP26829	Provide Data to Performance Assessment		04DEC97	0																																				
WP26830	Prepare Input for Planning Longer Term Test	02JAN98*	30MAR98	0																																				
WP26831	Provide Planning Input to Longer Term Testing		30MAR98	0																																				
WP26825	Prepare Input for EMCR-R2	04MAY98*	30SEP98	0																																				
WP26832	Prepare Add'l. Feedback to Near Field Environ.	01JUL98*	30SEP98	0																																				
WP26826	Provide Input to EMCR-R2		30SEP98	0																																				
WP26833	Provide Add'l. Input to Near Field Environment		30SEP98	0																																				
TR251GBE: Develop Material Degradation Proc. Model																																								
WP60505	Devel.Enhanced Crevice Corrosion Model	01OCT97*	19MAY98	0																																				
WP60536	Advance Pitting Corrosion Model	01OCT97*	30SEP98	0																																				
WP60541	Advanced Oxidation/General Corrosion Model	01OCT97*	31AUG98	0																																				
WP60513	Enhance Galvanic Corrosion Model	14OCT97*	31JUL98	0																																				
WP60520	Enhance Preliminary MIC Model	05JAN98*	30SEP98	0																																				
WP60528	Develop Preliminary Phase Stability Model	02FEB98*	31AUG98	0																																				
WP60502	Prepare Modeling Update Info for EMCR-R2	20MAY98*	20JUL98	0																																				
WP60514	Prepare Modeling Update Info for EMCR-R2	01JUN98*	27JUL98	0																																				
WP60530	Prepare Phase Stability Model Update for	01JUL98*	31AUG98	0																																				
WP60542	Prep Oxidation/Gen Corrosion Update for	01JUL98*	31AUG98	0																																				
WP60503	Provide Prel Crevice Corrosion Update to		20JUL98	0																																				

Project Start: 01OCT86

Project Finish: 03SEP02

Date: 01NOV98

Plot Date: 06DEC98

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Legend:

- Early
- Progress Bar
- Critical Activity

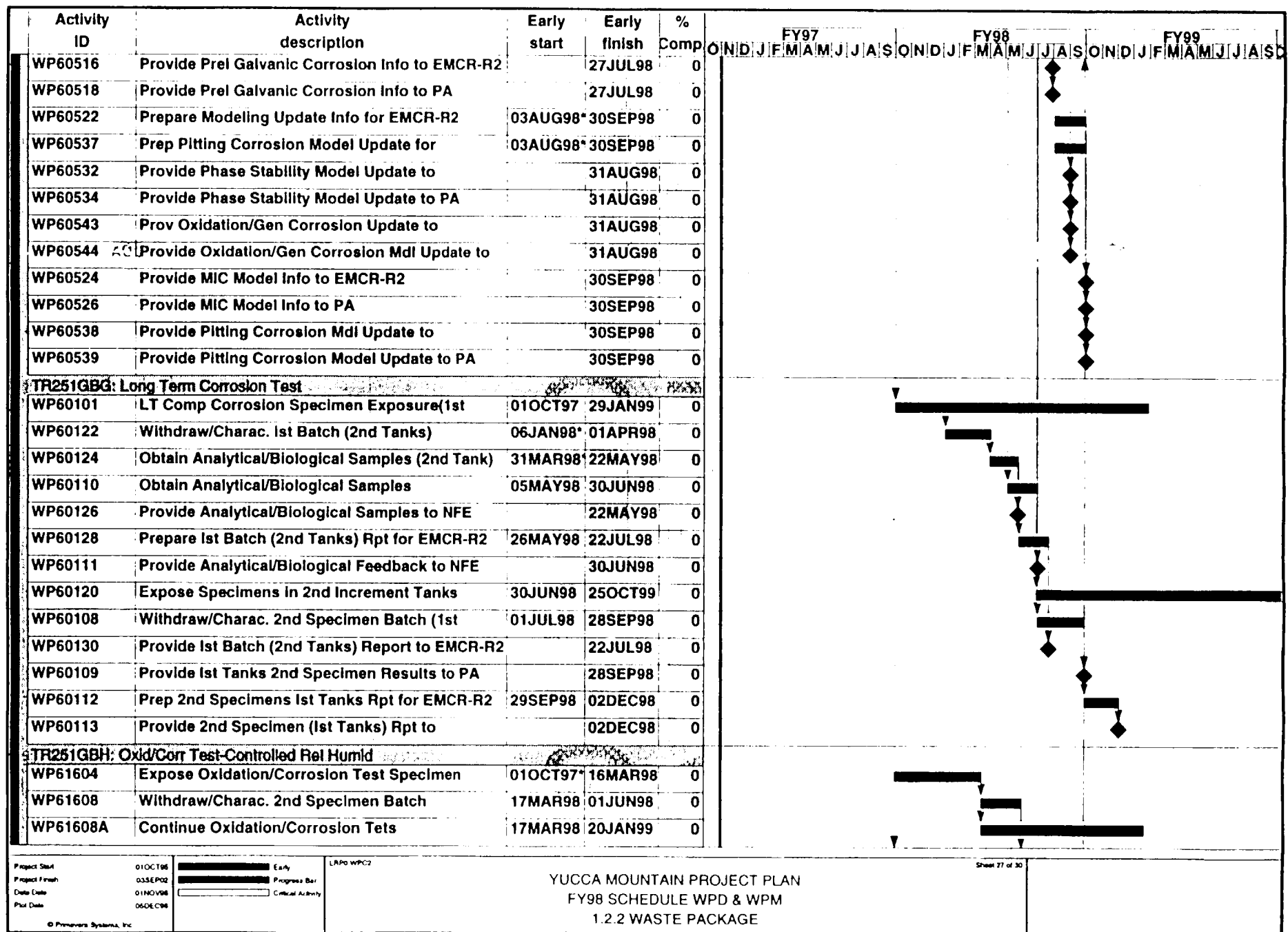
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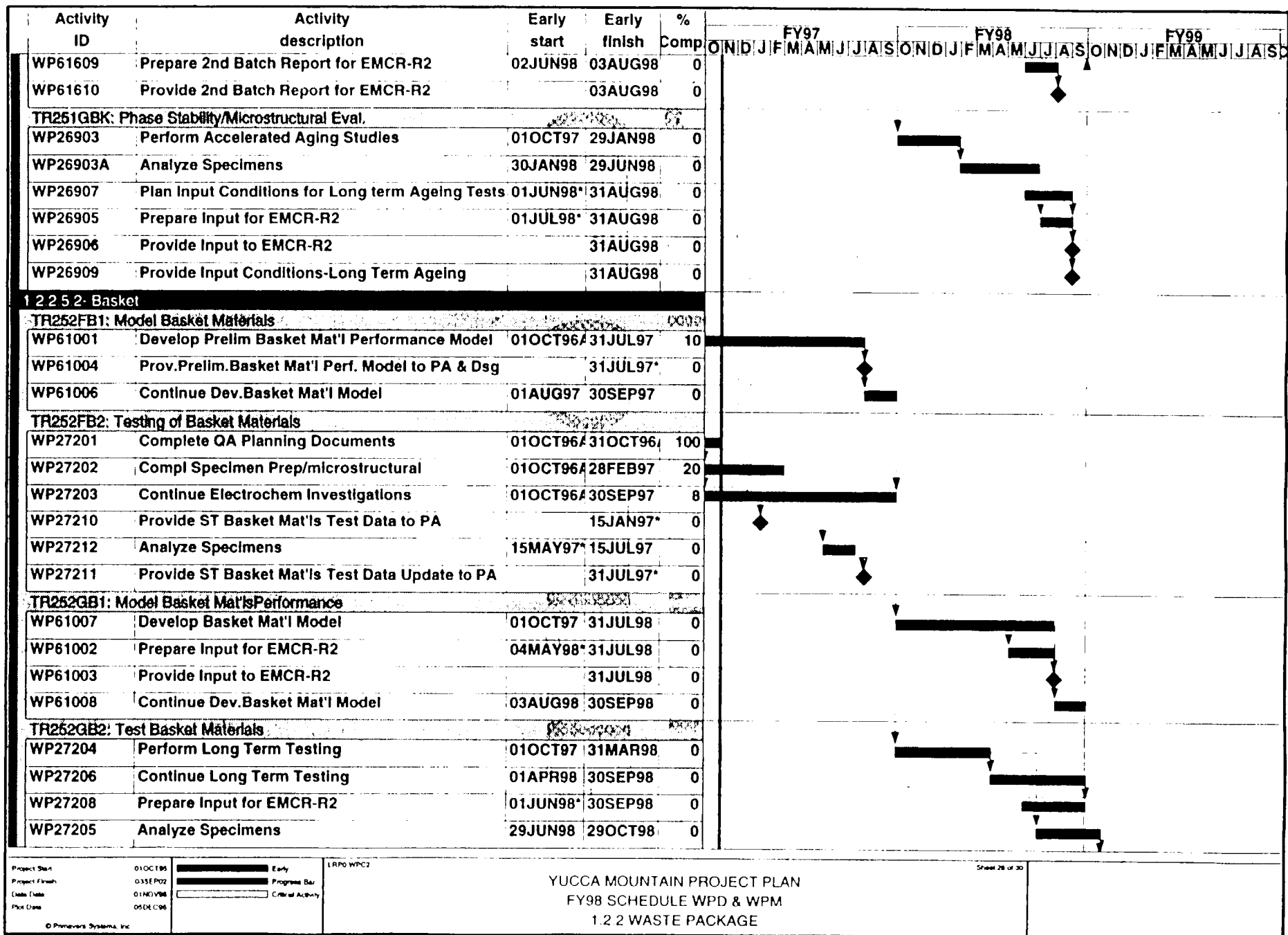
YUCCA MOUNTAIN PROJECT PLAN

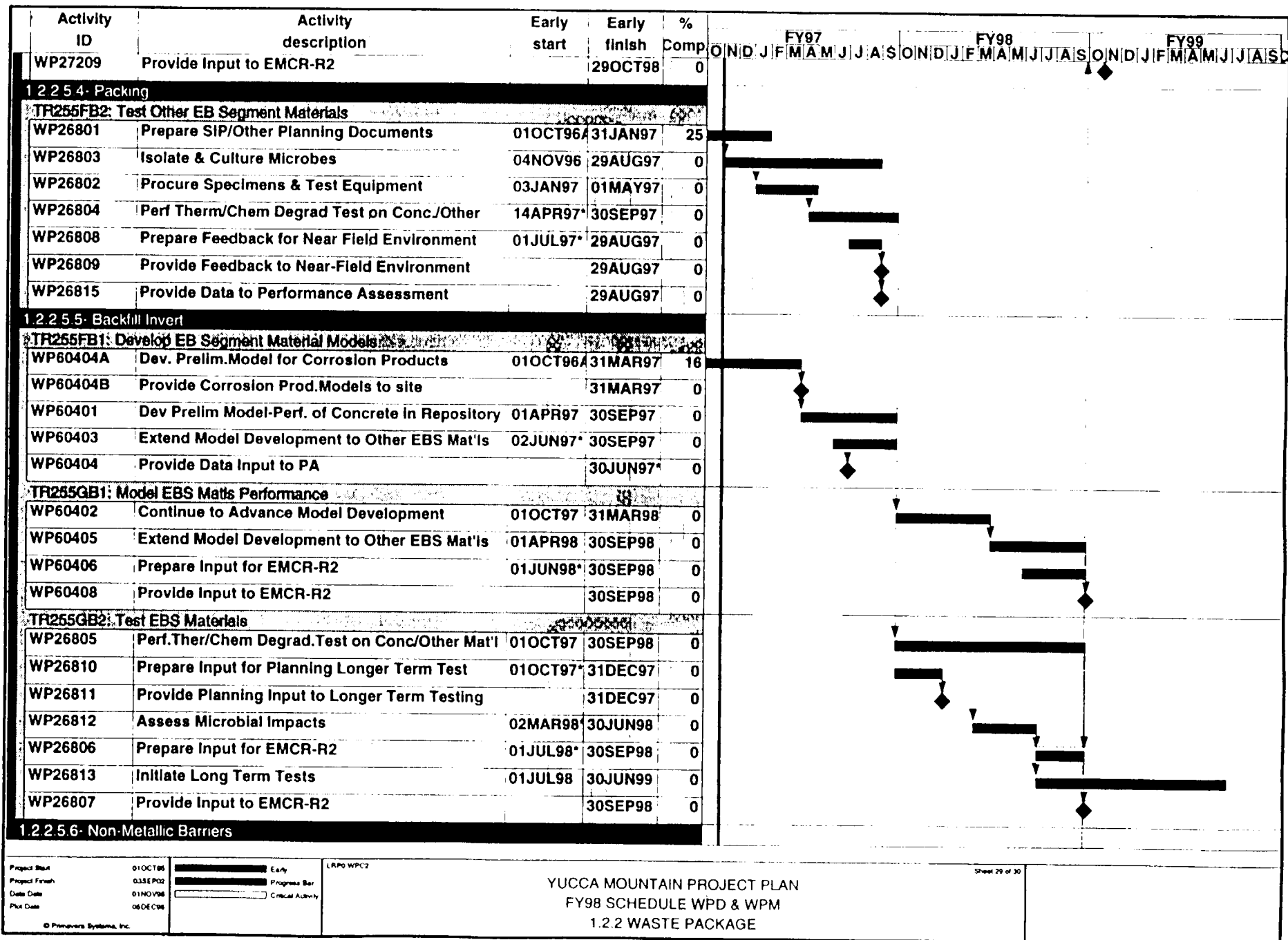
FY98 SCHEDULE WPD & WPM

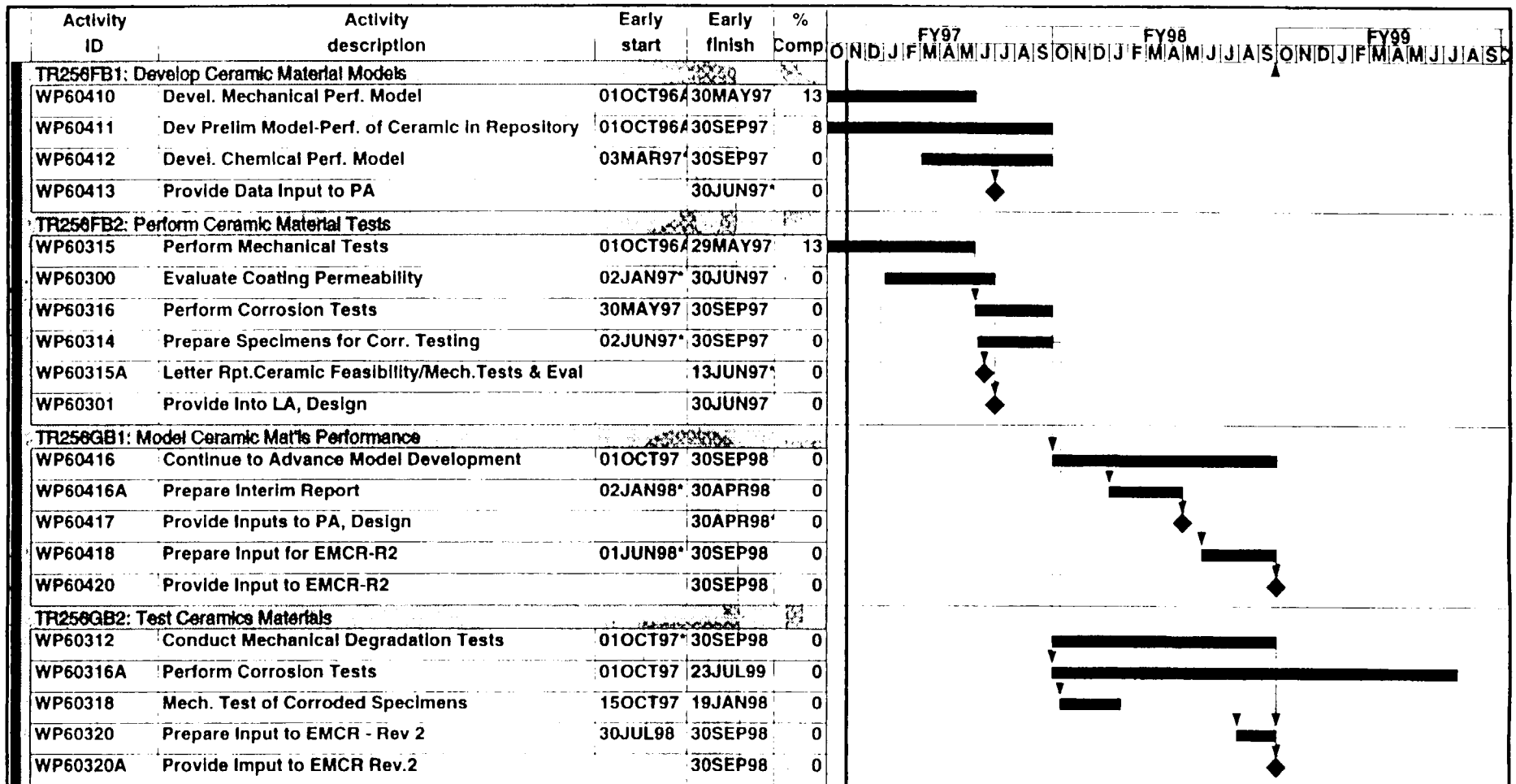
1.2.2 WASTE PACKAGE

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Project Start: 01OCT96  
 Project Finish: 03SEP98  
 Data Date: 01NOV98  
 Print Date: 05DEC98

LHPD WPC2

YUCCA MOUNTAIN PROJECT PLAN  
 FY98 SCHEDULE WPD & WPM  
 1.2.2 WASTE PACKAGE

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## **APPENDIX K**

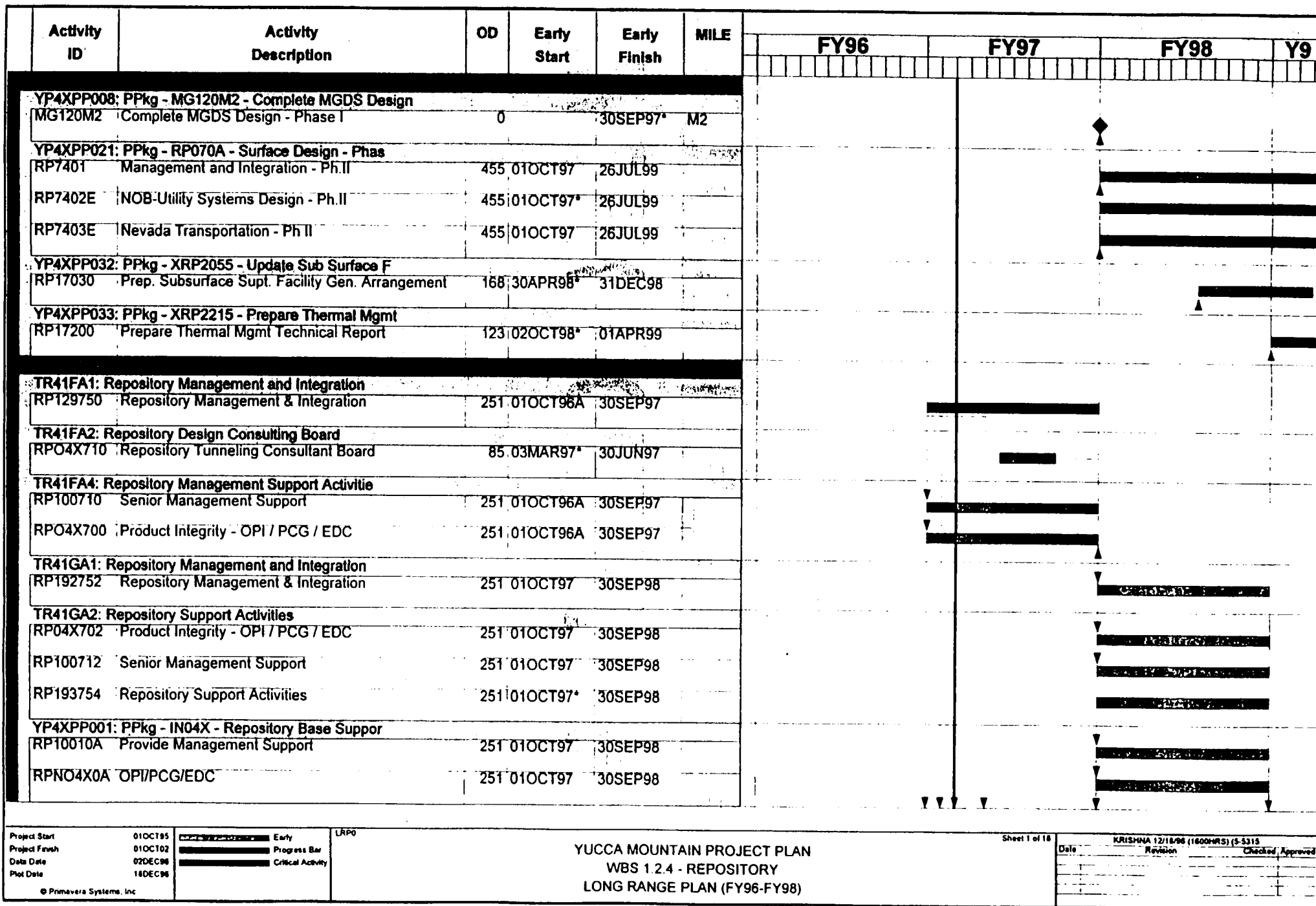
### **REPOSITORY SURFACE AND SUBSURFACE SCHEDULE**

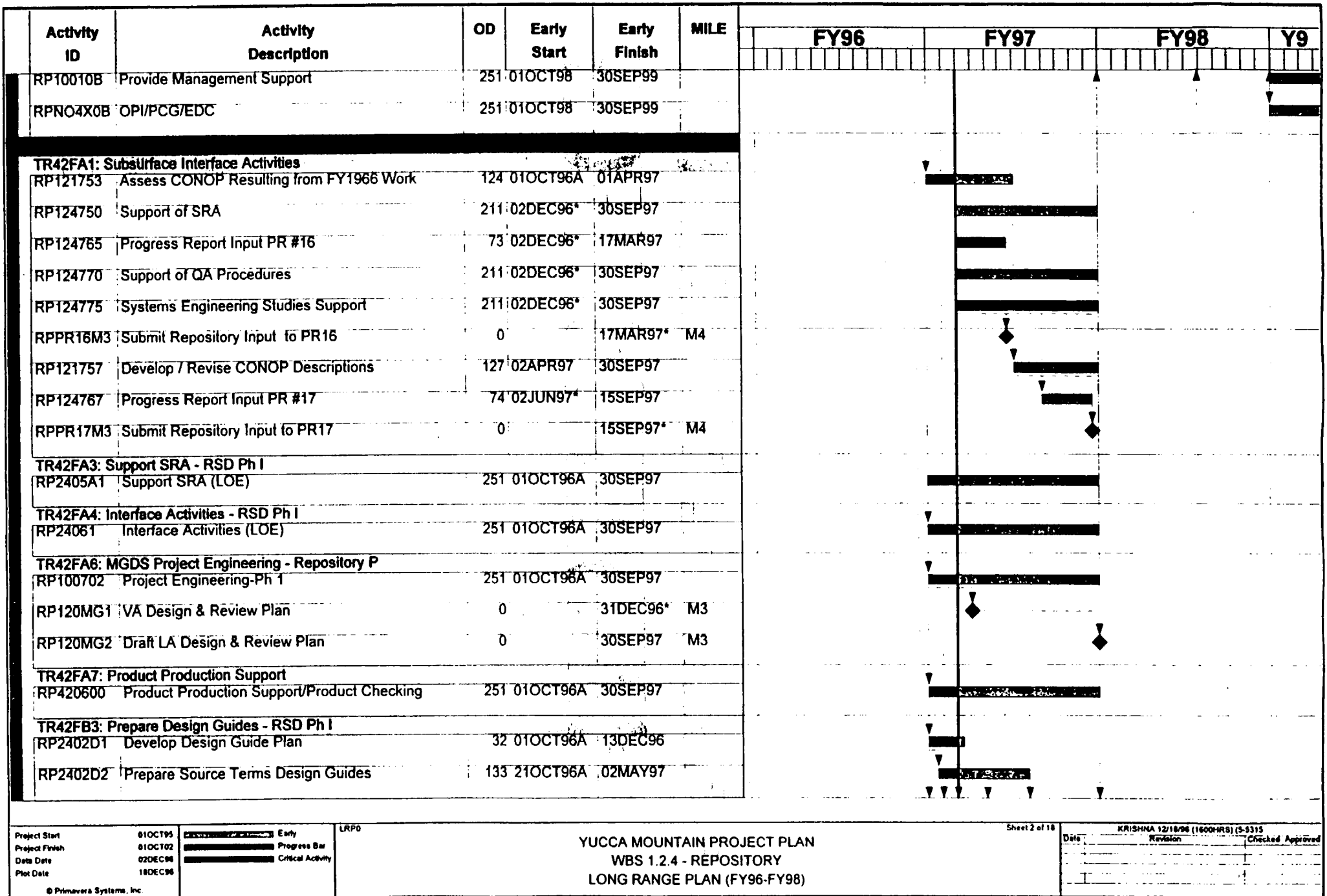
The data contained in this appendix reflects the status of the Yucca Mountain Site Characterization Project as of 12/16/96. Because of the evolving conditions of the Yucca Mountain Site Characterization Project, data in this appendix is changed or updated as necessary. However, this VA Design and Review Plan will not be revised or reissued as a result of data updates. For a current status of the data in this appendix and/or a copy of the current version, contact B. Stanley. For suggested changes to the contents, contact A. Segrest.

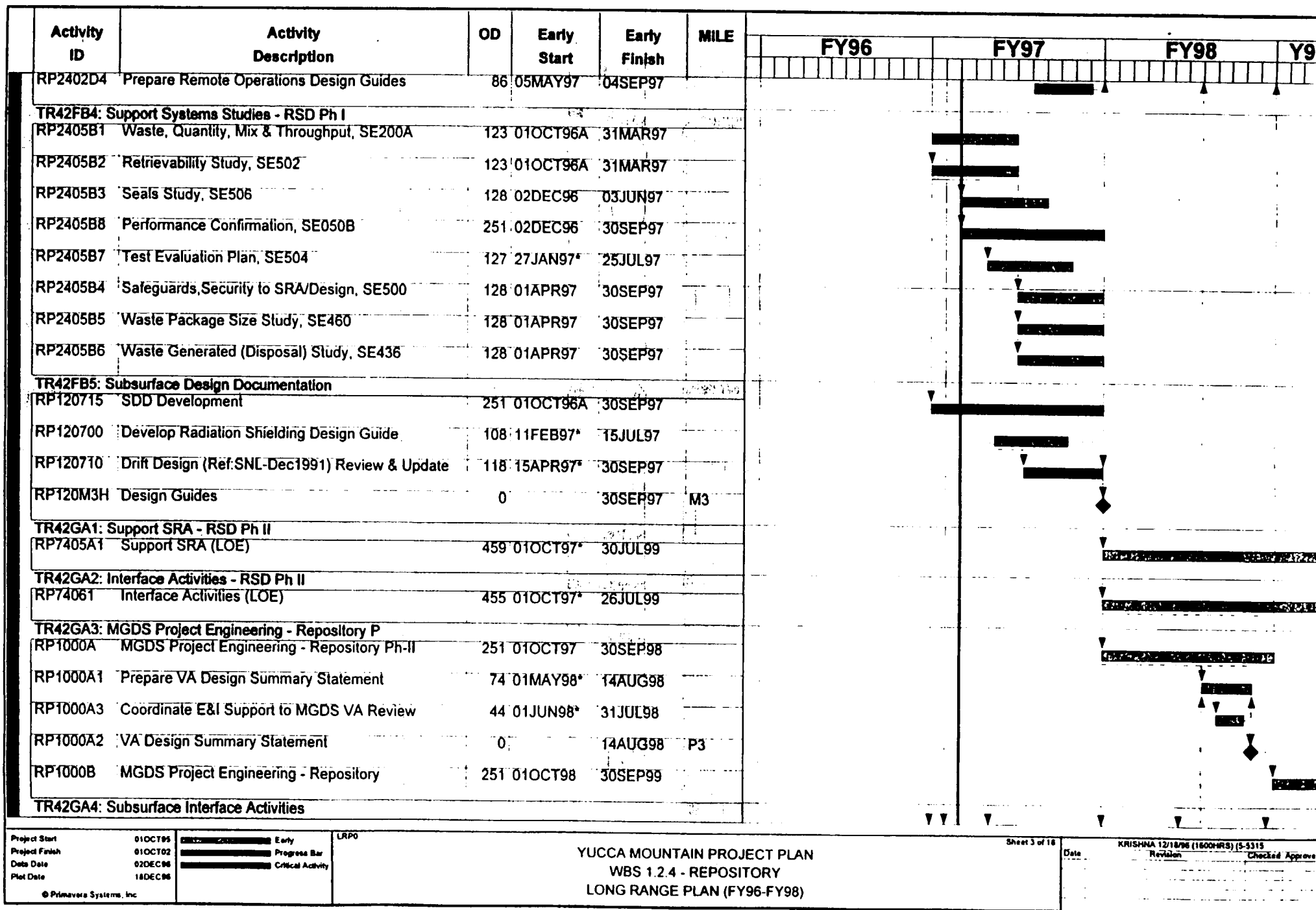


## **REPOSITORY SURFACE AND SUBSURFACE SCHEDULE**

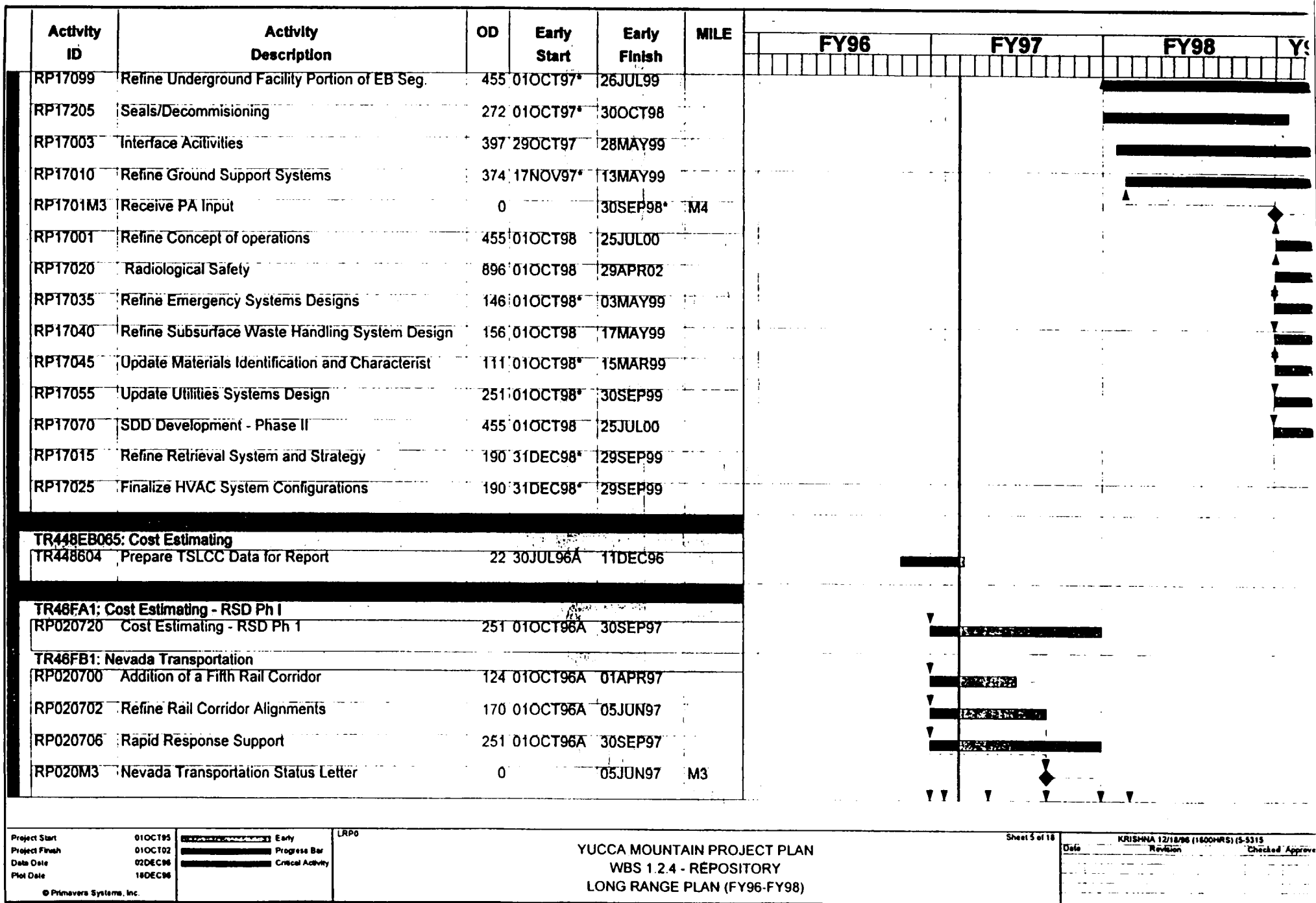
The Repository Surface and Subsurface (WBS 1.2.4) schedule for FY 97/98 is provided. This schedule reflects the current status of the FY 98 planning activity. All of the Repository Surface and Subsurface activities are tied to the VA milestone, except those that exclusively support the EIS/NEPA development and Nevada Transportation.

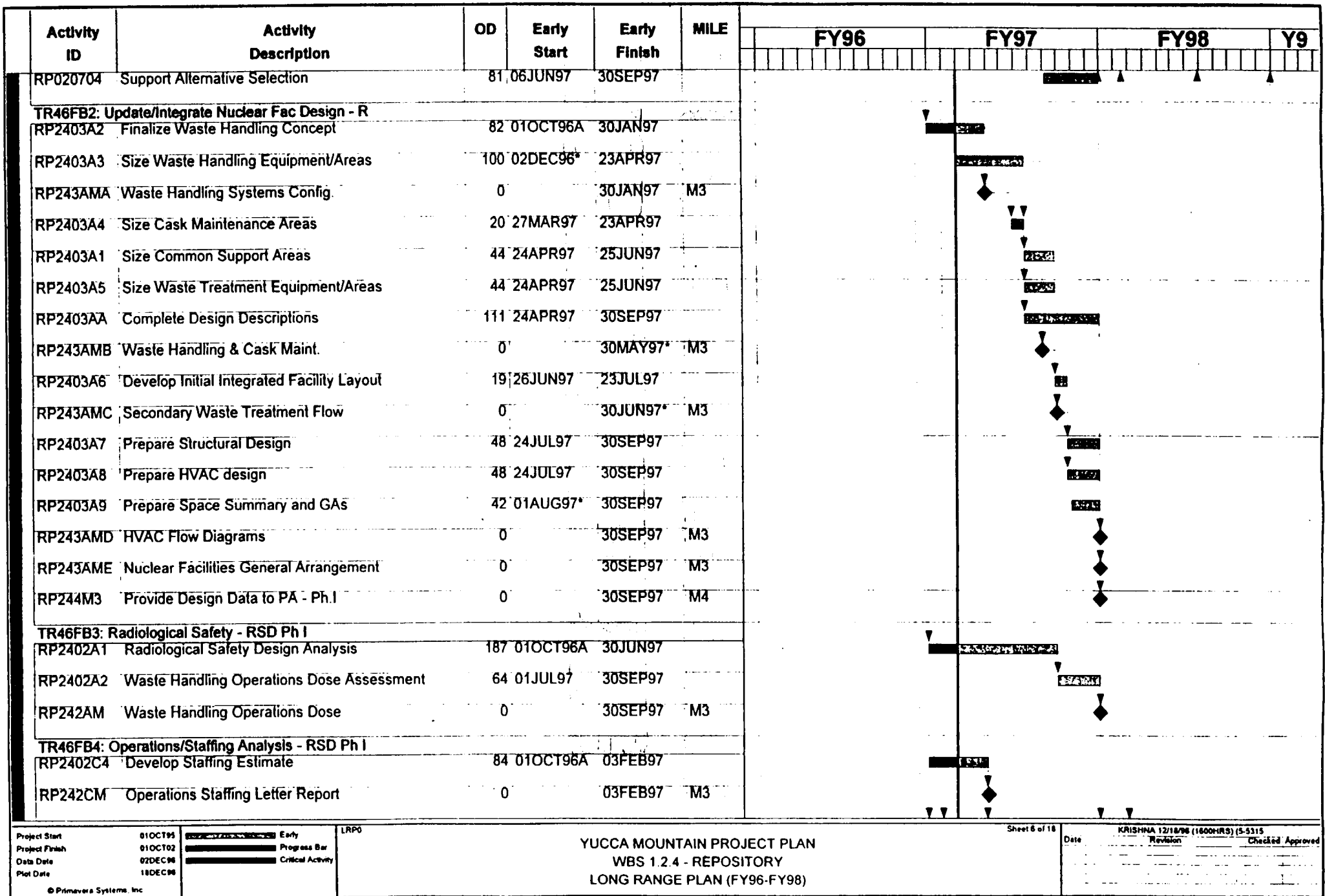






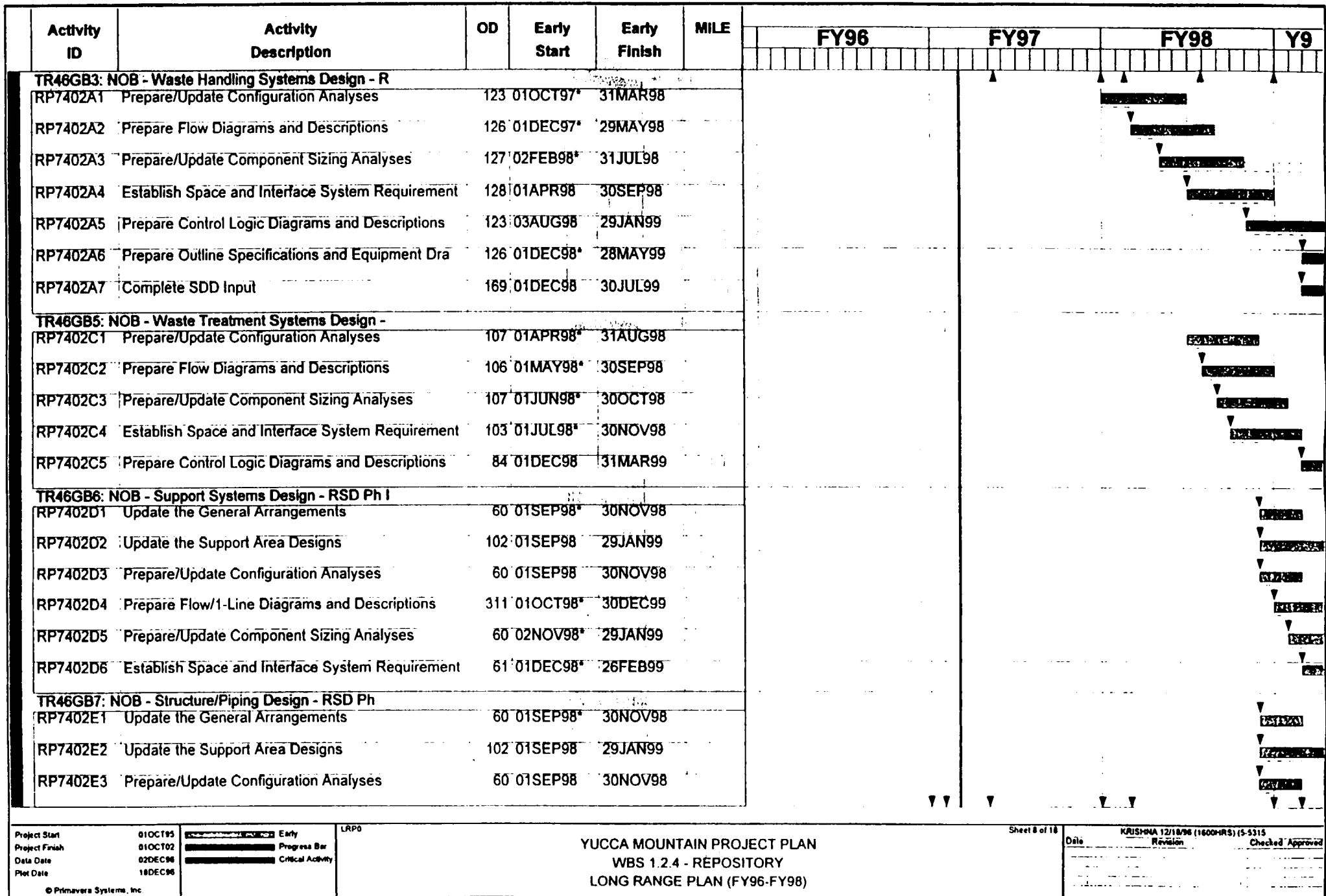


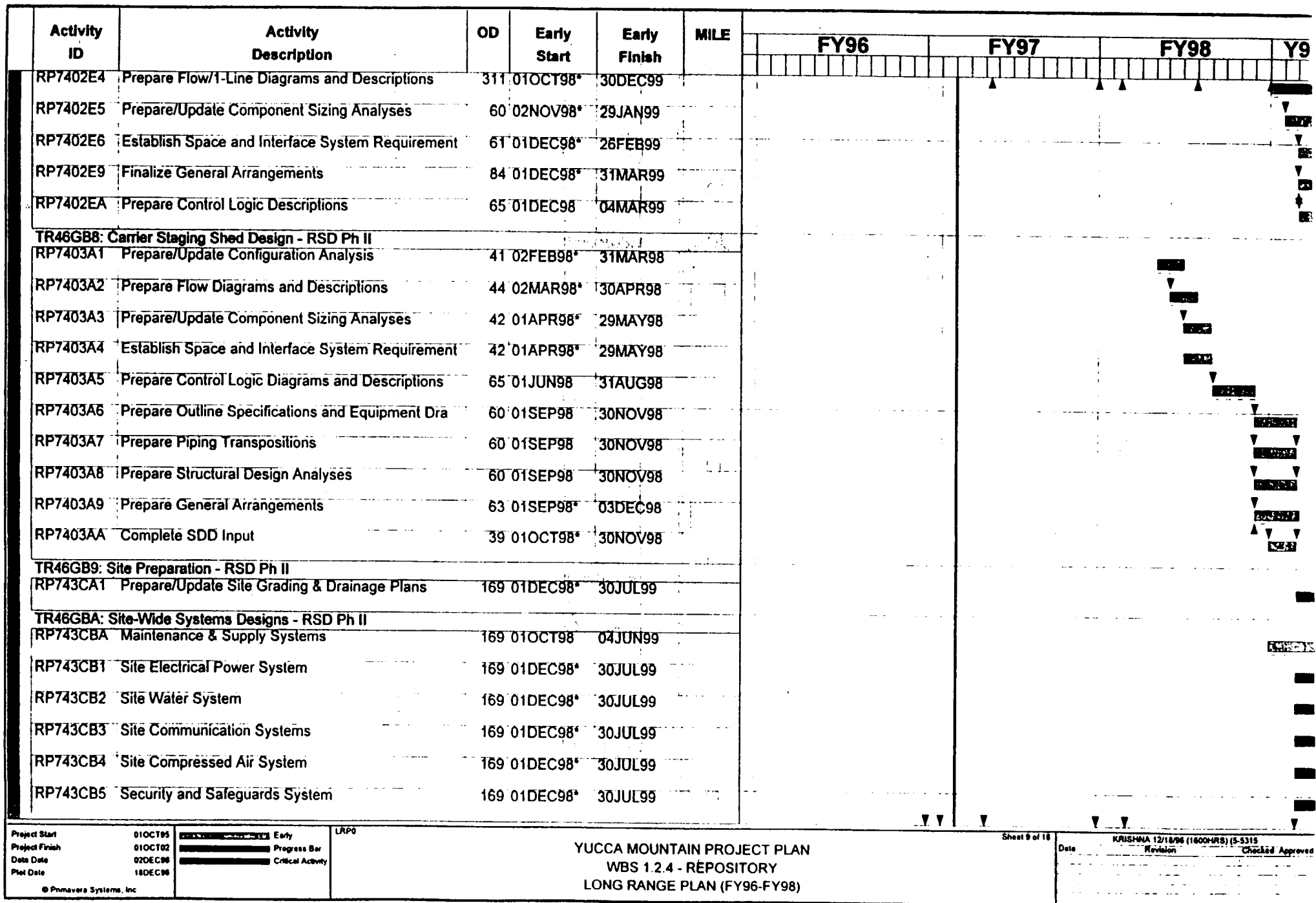




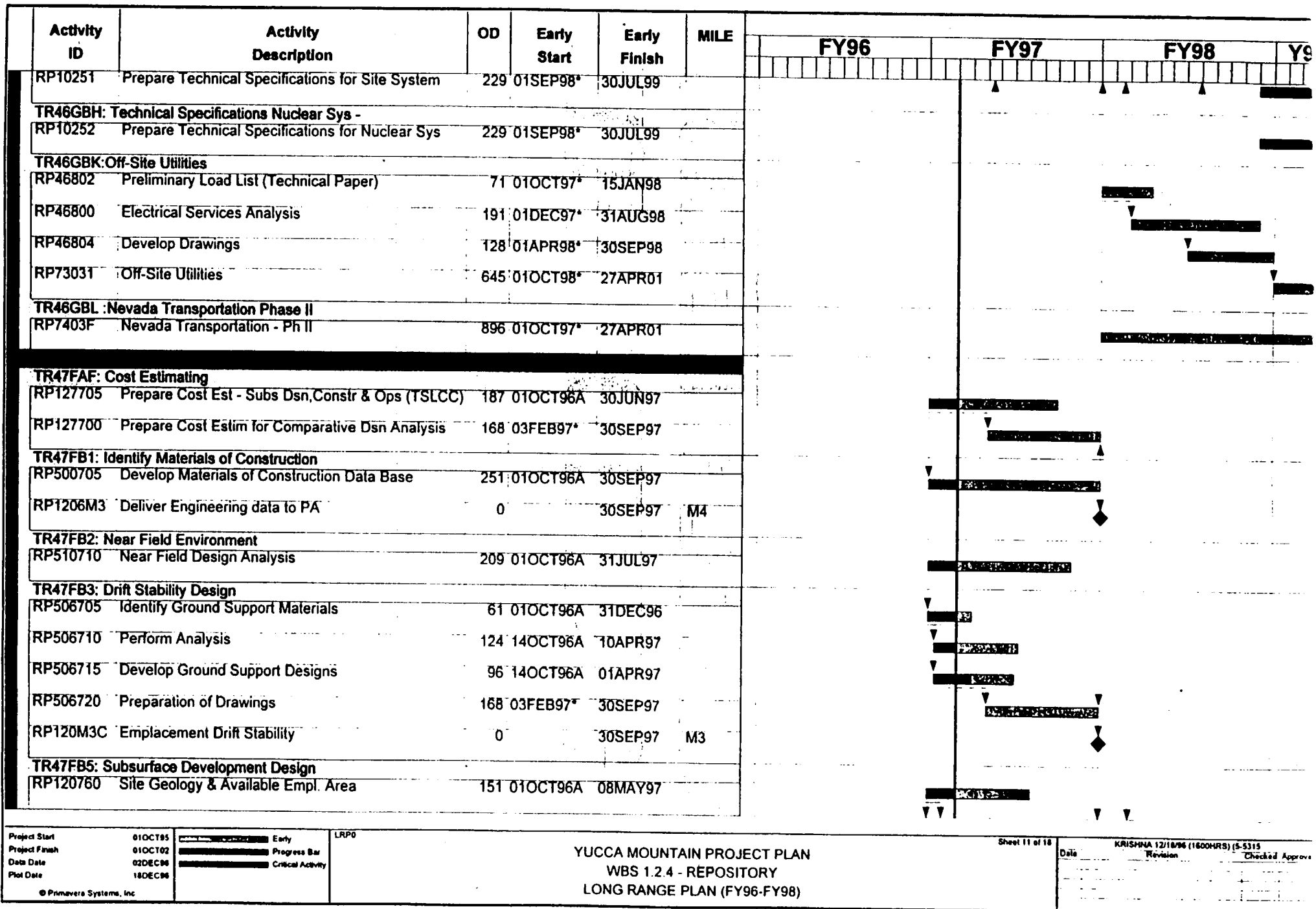


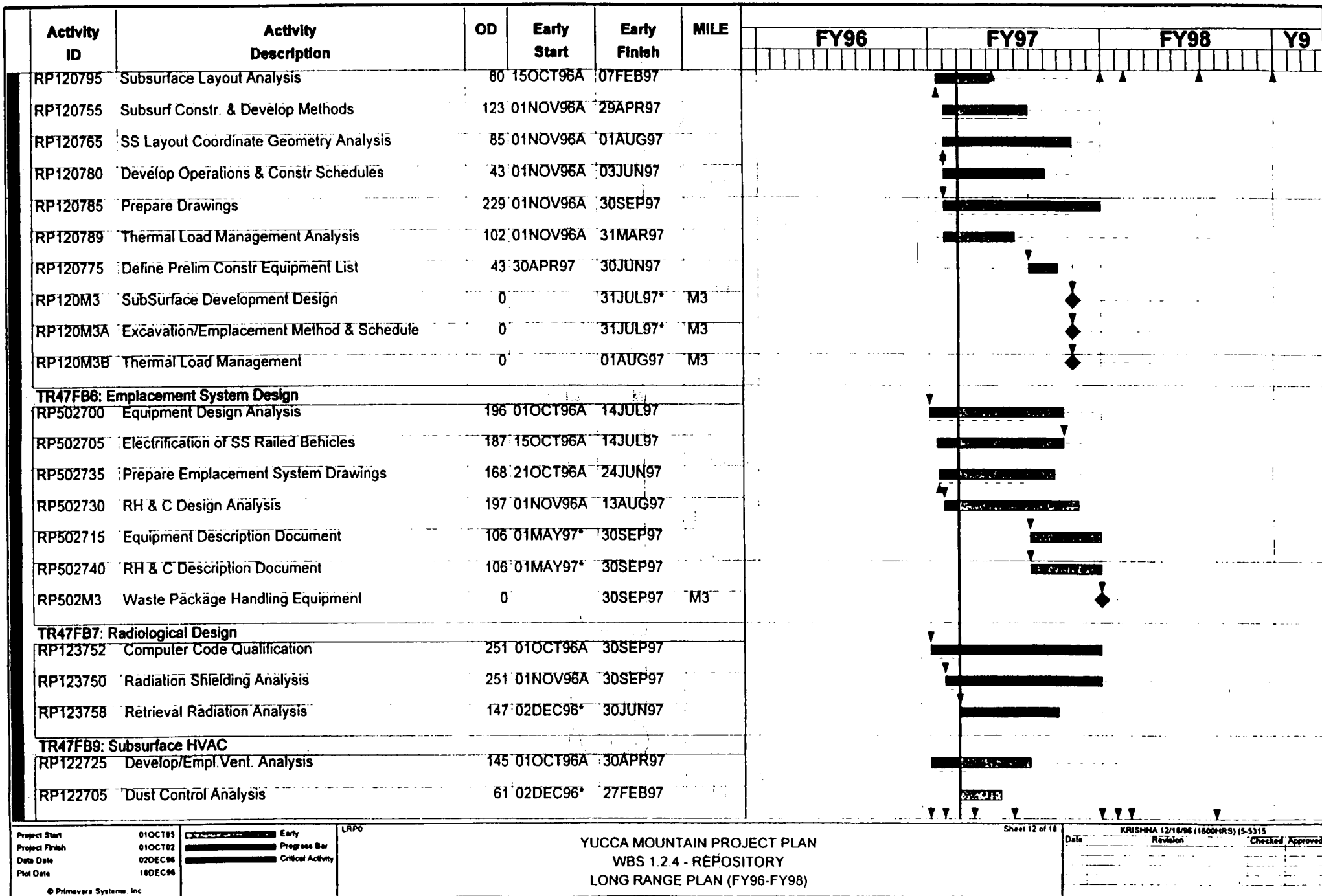


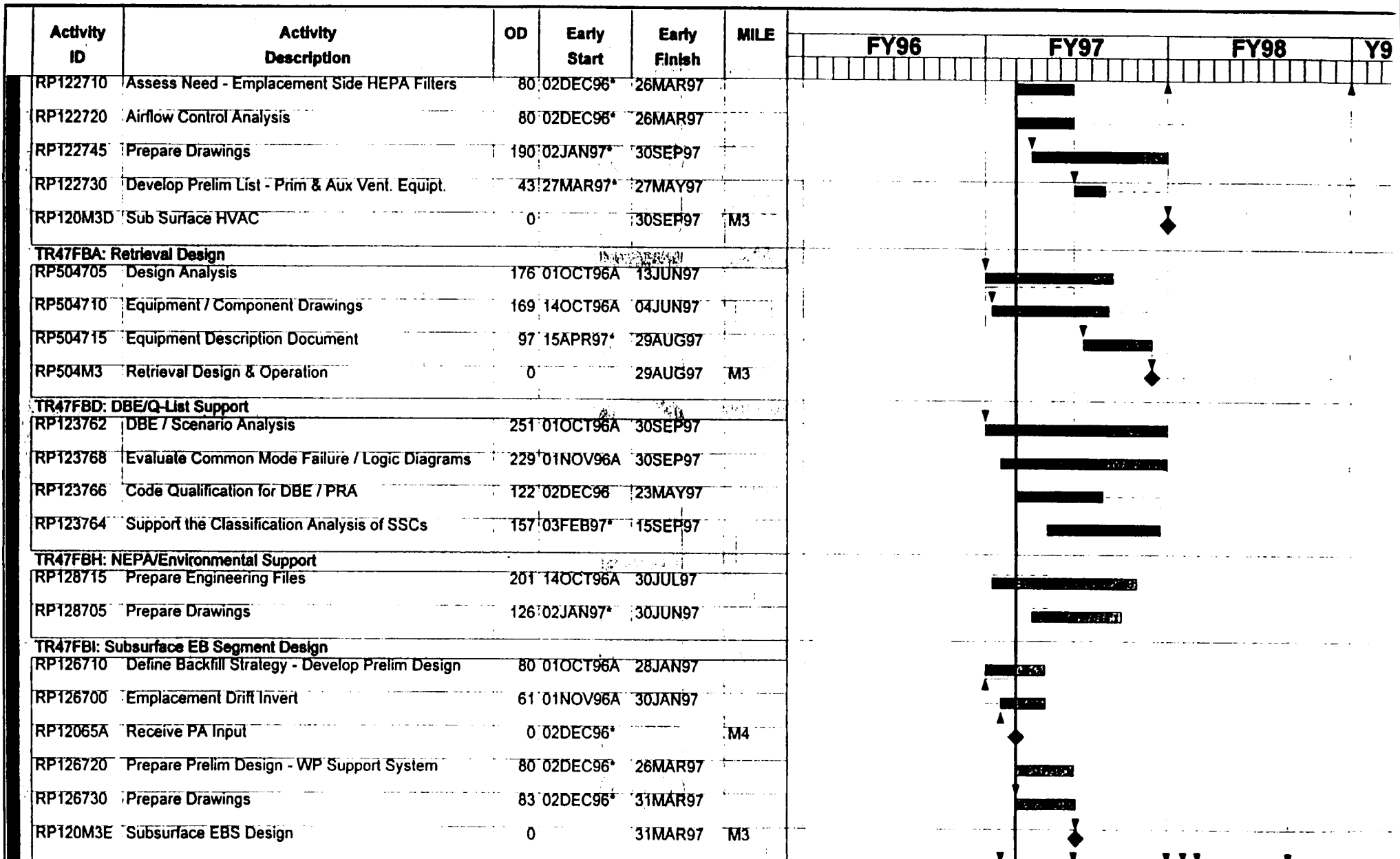












Project Start 01OCT95  
 Project Finish 01OCT02  
 Data Date 02DEC96  
 Plot Date 18DEC96

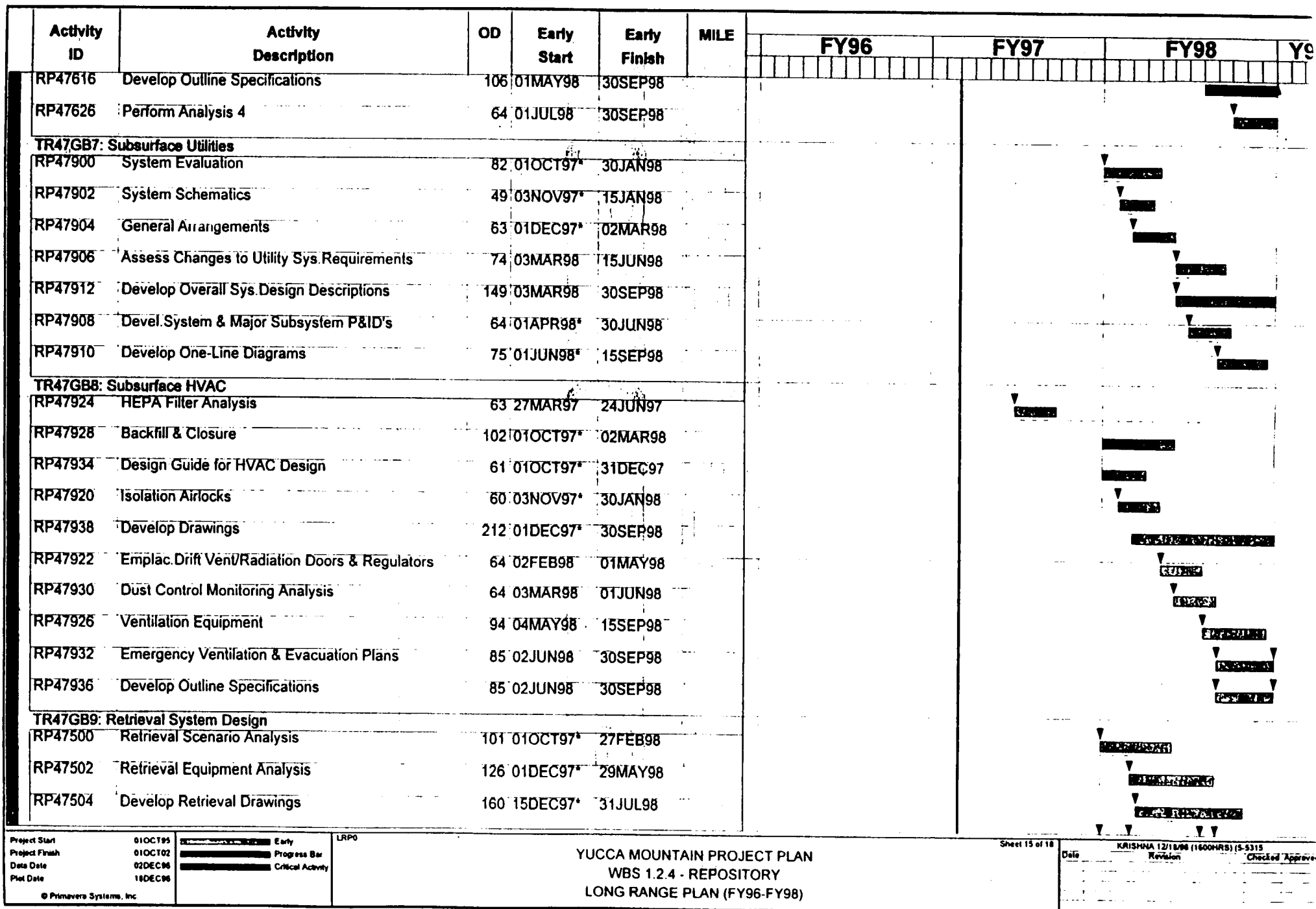
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YUCCA MOUNTAIN PROJECT PLAN  
 WBS 1.2.4 - REPOSITORY  
 LONG RANGE PLAN (FY96-FY98)

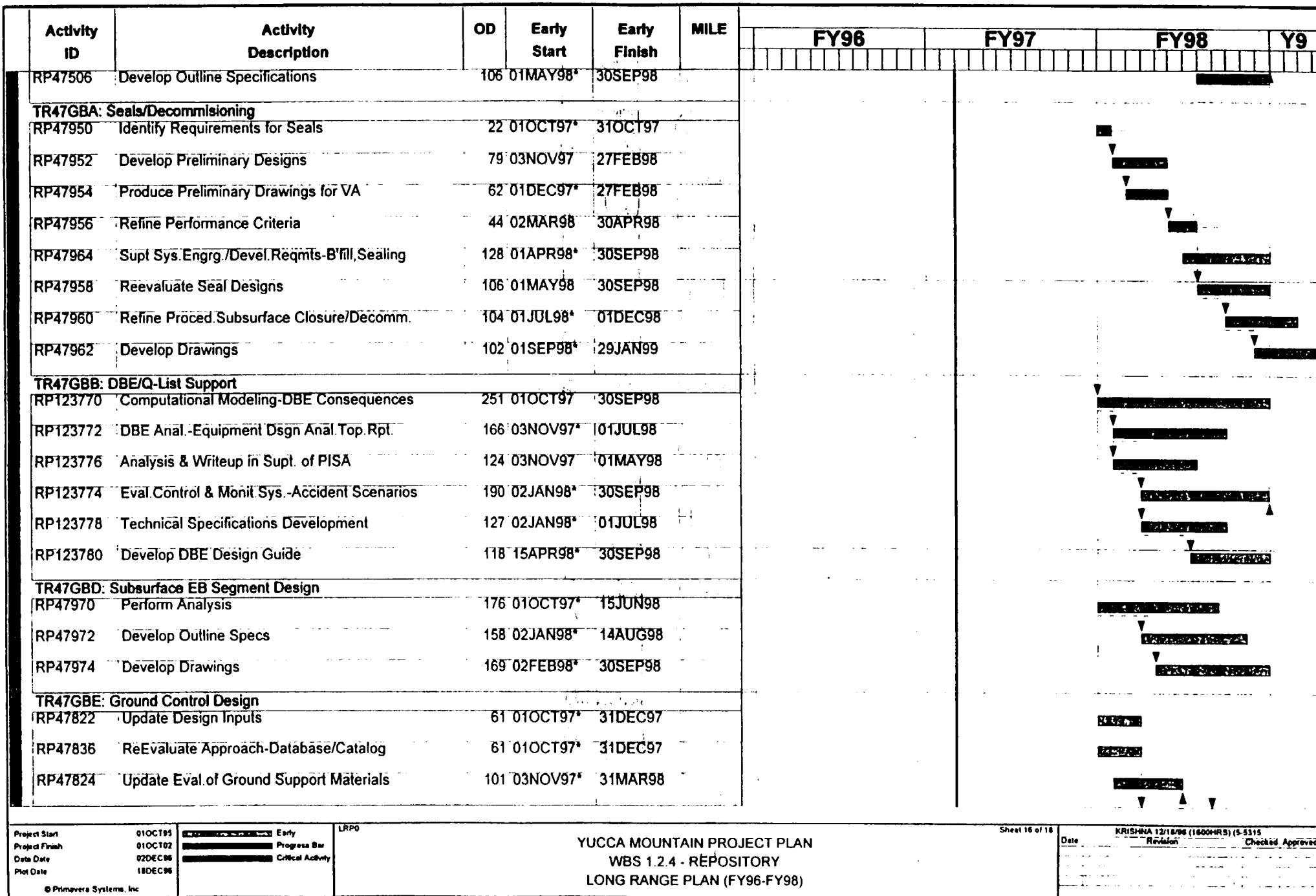
Sheet 13 of 18

KRISHNA 12/18/96 (1600HRS) (S-5315)  
 Date Revision Checked Approved









Project Start 01OCT95  
Project Finish 01OCT02  
Data Date 02DEC96  
Plot Date 18DEC96

YUCCA MOUNTAIN PROJECT PLAN  
WBS 1.2.4 - REPOSITORY  
LONG RANGE PLAN (FY96-FY98)

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KRISHNA 12/18/96 (1600HRS) (5-5315)

Date Revision Checked Approved

Activity ID	Activity Description	OD	Early Start	Early Finish	MILE	FY96												FY97												FY98												FY99
RP47820	Design Guide Development-Seismic	107	01DEC97*	01MAY98																																						
RP47826	Upgrade Thermal & Thermomechanical Anal.	170	01DEC97	31JUL98																																						
RP47832	Update List of Materials	62	02JAN98	31MAR98																																						
RP47830	Prepare Drawings	169	02FEB98*	30SEP98																																						
RP47834	Update Quantities, Charac, & Est. Service Life Matl	86	01APR98*	31JUL98																																						
<b>TR47GBF: Excavation/Muck Handling Design</b>																																										
RP47880	TBM Excavation Analysis	101	08MAY98*	30SEP98																																						
RP47882	Secondary Excavation Analysis	101	08MAY98	30SEP98																																						
RP47884	Raise Borer Excavation Analysis	101	08MAY98	30SEP98																																						
RP47892	Develop Drawings	229	10JUN98*	07MAY99																																						
RP47886	Secondary Excavation Analysis	129	01OCT98	08APR99																																						
RP47888	Muck Removal Analysis	129	01OCT98	08APR99																																						
RP47890	Develop Outline Specifications	150	01OCT98	07MAY99																																						
<b>TR47GBG: Personnel &amp; Materials Transport</b>																																										
RP47980	Perform Analyses	124	03NOV97*	01MAY98																																						
RP47984	Develop Drawings	144	03NOV97	01JUN98																																						
RP47982	Develop Equipment Description Document	128	01APR98*	30SEP98																																						
<b>TR47GBH: NEPA/Environmental Support</b>																																										
RP47870	Prepare New Engineering Files for Review	102	01OCT97*	02MAR98																																						
RP47872	Rev. & Revise Existing Engineering Files	251	01OCT97	30SEP98																																						
<b>TR47GBJ: Performance Confirmation Design</b>																																										
RP47806	Remote Handling & Control	251	01OCT97*	30SEP98																																						
RP47800	Update PC Parameters	32	01DEC97*	15JAN98																																						
RP47802	Enhance PC Data Acquisition Strategy	62	01DEC97*	27FEB98																																						
RP47804	Update PC Provisions into SubSurface Design	63	02JAN98*	01APR98																																						

Activity ID	Activity Description	OD	Early Start	Early Finish	MILE	FY96												FY97												FY98												Y9											
<b>TR47GBL: Personnel Safety &amp; Warning System Design</b>																																																					
RP47850	Eval.DBE's Devel.-VA Dsgn Activity	39	01OCT97*	26NOV97																																																	
RP47854	Devel.Asses.Plan for Each Event	53	15JAN98*	31MAR98																																																	
RP47856	Develop Recovery Plans	45	02MAR98	01MAY98																																																	
RP47860	Prepare Drawings	120	16MAR98*	01SEP98																																																	
RP47858	Prepare Documentation	64	15APR98*	15JUL98																																																	
<b>TR47GBM: Subsurface Facilities</b>																																																					
RP47404	Drainage System Analysis	82	01OCT97*	30JAN98																																																	
RP47406	Ventilation Openings Design	82	01OCT97	30JAN98																																																	
RP47410	Supplimental Thermal Analyses	165	01OCT97	29MAY98																																																	
RP47418	Shaft Headframes & Hoisting Systems	145	01OCT97*	30APR98																																																	
RP47426	Shaft Design Guide	83	01OCT97*	02FEB98																																																	
RP47420	Subsurface Construction Materials Handling Sys.	79	03NOV97*	27FEB98																																																	
RP47430	Develop Design Drawings	229	04NOV97*	01OCT98																																																	
RP47422	Personnel Support Facilities	84	01DEC97*	31MAR98																																																	
RP47408	Construction & Emplacement Schedules	84	02JAN98*	30APR98																																																	
RP47416	Ventilation Fans, Fan Hsngs, & HEPA Filter Sys.	190	02JAN98*	30SEP98																																																	
RP47402	Coordinate Geometry Calculations	86	02MAR98*	30JUN98																																																	
RP47400	Sursurface Conop Description	86	01APR98*	31JUL98																																																	
RP47414	Waste Emplacement Optimization Analysis	86	01APR98*	31JUL98																																																	
RP47424	Backfill Prep. & Handling Facilities	128	01APR98	30SEP98																																																	
RP47428	Equipment Outline Specifications	128	02APR98*	01OCT98																																																	
RP47412	Draft Thermal Management Plan	86	02JUN98	01OCT98																																																	

Project Start

01OCT95

Project Finish

01OCT02

Date Date

02DEC96

Plot Date

18DEC96

Early

Progress Bar

Critical Activity

LRP0

YUCCA MOUNTAIN PROJECT PLAN

WBS 1.2.4 - REPOSITORY

LONG RANGE PLAN (FY96-FY98)

Sheet 18 of 18

KRISHNA 12/18/96 (1600HRS) (5-5315)

Date

Revision

Checked

Approved

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## **APPENDIX L**

### **E&I INTERFACES**

The data contained in this appendix reflects the status of the Yucca Mountain Site Characterization Project as of 3/7/97. Because of the evolving conditions of the Yucca Mountain Site Characterization Project, data in this appendix is changed or updated as necessary. However, this VA Design and Review Plan will not be revised or reissued as a result of data updates. For a current status of the data in this appendix and/or a copy of the current version, contact M. Sellers. For suggested changes to the contents, contact R. Wagner.

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A preliminary checklist of the interfaces between E&I and the YMP and Program areas has been created by reviewing the data in the FY 97/98 planning database. The resulting list of summary accounts that involve interfaces with E&I are provided in the following pages. Headings are provided to identify the area that is interfacing with E&I, and the interface topic that is being addressed. The summary account title and number are provided along with the approximate time of the interface.

## **E&I DELIVERIES TO PA**

### **KEY 1997 DESIGN DELIVERIES**

#### **PERFORMANCE ASSESSMENT**

##### **PRECLOSURE**

#### **1. Description of Underground Opening Stabilization Techniques**

Delivery from Drift Stability Design TR47FB3

Materials: December

Analyses: April

Final Delivery: September

#### **2. Description of Underground HVAC**

Delivery from Subsurface HVAC TR47FB9

Analyses & equipment list: April/May

Final Delivery: September

#### **3. Location of Release Sources**

Delivery from Subsurface Layout from TR47FB5

Layout Analyses: April

Delivery from Surface DBE work from TR46FB7

Internal Events Analyses: May

Delivery from Subsurface DBE work from TR47FBD

Scenario Analyses: September

Delivery from Site Layout from TR46FB5

Updated Site Layout Drawings: September

Delivery from Nuclear Facilities Design TR46FB2

Initial Layout: July

HVAC Design: September

General Arrangements: September

Provide Data to PA: September

Delivery from Preparation of Design Guides TR42FB3

Source Term Design Guide: April

Delivery from EBS DBEs TR22FB3  
EB Seg/WP DBEs: January  
WP Off-normal & Accident Scenarios: March

#### **4. Transporter Design and Underground Operations**

Delivery from Subsurface Emplacement System Design TR47FB6  
Emplacement System Drawings: June  
Handling Equipment: September

#### **5. Retrieval Information**

Delivery from Subsurface Retrieval Design TR47FBA  
Equipment/component drawings: June

Delivery from Retrievability Study TR15FB3  
Retrievability Study: May

#### **6. Waste Handling Concepts of Operation**

Delivery from Nuclear Facility Design TR46FB2  
Waste Handling Concept: January

Delivery from Radiological Safety TR46FB3  
Waste Handling Ops Dose Assessments: September

Delivery from Subsurface Development Design TR47FB5  
Waste Emplacement Method: July

Delivery from Subsurface Interface Activities TR42FA1  
Revise subsurface con-op description: September

Delivery from Subsurface Emplacement System Design TR47FB6  
Emplacement System Drawings: June  
Handling Equipment: September

Delivery from Con-Ops Account TR12FB3  
Updates: March, August, September

Delivery from System Studies TR15FB1  
Waste Generated Study: September



## **7. Waste Receipt Schedule**

Delivery from Waste Qty Mix Throughput Study TR15FB2  
Report complete: April

Delivery from System Studies TR15FB1  
Waste Package Size Study: September

## **8. Decontamination Waste Streams**

Delivery from System Studies TR15FB1  
Waste Generated Study: September

Delivery from Nuclear Facility Design TR46FB2  
Secondary Waste Treatment Flow: June

## **9. Hot Cell HVAC**

Delivery from Nuclear Facility Design TR46FB2  
HVAC Design & Flow Diagrams: September

## **10. Concepts for Radiation Attenuation**

Delivery from Subsurface Design Documentation-TR42FB5  
Radiation Shielding Design Guide: July

Delivery from Radiological Safety TR46FB3  
Radiological Safety Design Analyses: June

Delivery from Radiological Design TR47FB7  
Radiation Shielding Analyses: September

## **POST CLOSURE**

Delivery from Requirements Documentation/Verification  
CDA Updates: March, September

### **1. Areal Mass Loading**

Delivery from Near Field Environment TR47FB2  
Near Field Design Analysis: July

Delivery from Subsurface Development TR47FB5  
Thermal Load Management Analysis: April

## **2. Waste Package Size and Spacing**

Delivery from System Studies TR15FB1

Waste Package Size Study: September

Delivery from Subsurface Development TR47FB5

Subsurface Layout Analyses: February

Thermal Load Management Analyses: April

Delivery from EB Segment Parts List TR233FB1

Technical Drawings for CF, UCF, & HLW Disposal Container Components: June

Delivery from UCF Disposal Container Design

Engineering Sketches: September

## **3. Drift Size and Excavation Method**

Delivery from Subsurface Development TR47FB5

Subsurf Construction & Development Methods: April

Excavation Methods: July

Delivery from Drift Stability Design TR47FB3

Ground Support Designs: April

## **4. Physical and Chemical Characteristics of Inverts/WP Supports**

Delivery from Subsurface EB Segment Design TR47FBI

Emplacement Drift Invert: January

WP Support System: February

Delivery from EB Segment Material Design TR22FB4

Performance & Candidate Materials - EBS Input to TSPA: April

EBS/WP Candidate Materials Selection - IOC to PA: April

Materials Selection Analyses: August

Delivery from EB Segment Parts List TR233FB1

Technical Drawings for Drift Invert Components: June

Delivery from WP Support/Invert Design TR233FB6

Invert/support Evaluations: March

Analyses/sketches: September

Delivery from EMCR Preparation TR251FB9

Provide EMCR Rev 1 Draft to PA: January

Issue EMCR Rev. 1: April

## **5. Chemical Characteristics of Other Emplaced Materials**

**Delivery from Drift Stability Design TR47FB3**

Ground Support Materials: December

**Delivery from Materials of Construction TR47FB1**

Materials of construction database & Delivery to PA: September

**Delivery from Subsurface EB Segment Design TR47FBI**

Emplacement Drift Invert: January

WP Support System: February

**Delivery from EB Segment Material Design TR22FB4**

Performance & Candidate Materials - EBS Input to TSPA: April

EBS/WP Candidate Materials Selection - IOC to PA: April

Materials Selection Analyses: August

**Delivery from EB Segment Parts List TR233FB1**

Technical Drawings for Drift Invert Components: June

**Delivery from WP Support/Invert Design TR233FB6**

Invert/support Evaluations: March

Analyses/sketches: September

**Delivery from EMCR Preparation TR251FB9**

Provide EMCR Rev 1 Draft to PA: January

Issue EMCR Rev. 1: April

**Delivery from Basket Material Models TR252FB1**

Provide Preliminary Basket Matl Performance Model to PA & Dsgn: July

**Delivery from Basket Material Testing TR252FB2**

Provide ST Basket Materials Test Data to PA: January

Provide ST Basket Materials Test Data Update to PA: July

**Delivery from EB Segment Material Models TR255FB1**

Provide Data Input to PA: June

**Delivery from EMCR Rev 1 TR251FB9**

Provide EMCR Rev 1 Draft to PA: January

Issue EMCR Rev. 1: April

## **6. EBS Enhancement Information, including backfill (if any)**

Delivery from Subsurface EB Segment Design TR47FBI  
Backfill Strategy - Preliminary Design: January

Delivery from Additional Barrier Design TR233FB5  
Engrg Evaluations/Analyses: March  
Options and sketches: September

Delivery from EBS Model Abstractions TR251FA2  
EBS Model Abstractions: September

Delivery from EMCR Rev 1 TR 251FB9  
Provide EMCR Rev 1 Draft to PA: January  
Issue EMCR Rev 1: April

## **7. Ventilation Plans**

Delivery from Subsurface HVAC TR47FB9  
Analyses & equipment list: April/May  
Final Delivery: September

## **8. Long-term Drift Stability**

Delivery from Drift Stability Design TR47FB3  
Materials: December  
Analyses: April  
Final Delivery: September

## **WP & MATERIALS**

### **WP MILESTONE COLLECTION POINTS**

Integrate Performance Assessment TSPA-VA TR22FA3  
Provide EBS Input to TSPA-VA: November 96  
Integrate with PA: All year - September

## **1. Thermal Hydrologic and Chemical Characteristics of EBS Materials**

Delivery from EBS Model Abstractions TR251FA2  
EBS Model Abstractions: September

Delivery from EMCR Rev 1 TR251FB9  
Provide EMCR Rev 1 Draft to PA: January  
Issue EMCR Rev. 1: April

Delivery from Tests of Metal Barriers TR251FBG  
Provide 1st Tanks 1st Specimen Results to PA: March

## **7. Technical Basis for Cladding Degradation Models**

Delivery from Cladding Degradation Modeling TR22FB2  
Submit IOC to PA: March  
Submit DBF Clad & Models: July

Delivery from Cladding Degradation Testing TR241GBC  
Perform Degradation Testing: October 97

## **8. Waste Alteration/Dissolution Rates**

Delivery from Waste Form Model Abstractions TR241FA1: September

Delivery from WFCR Preparation TR241FB2 - This is a collection point for Waste Form Models

WFCR Rev 1 Draft to PA: January  
WFCR Rev 1 Publication: April

Delivery from Process Model Development TR241FB9  
Provide Waste Form Response Model Results to PA: June

Delivery from HLW Glass Modeling TR242FB3  
Provide HWG Dissolution Rate Model Results to PA: June

## **Radionuclide Transport Through Waste Package/EBS**

Delivery from Champion Radionuclide Transport Evaluation TR22FAA  
Assessment of Work: February  
IOC to PA: September

## **Criticality Evaluations**

Delivery from Probabilistic Evaluations of WP Design  
Criticality Analyses: September

## **PA DELIVERIES TO E&I**

### **CANDIDATE DELIVERIES FROM PA TO E&I**

#### **1. PA Data Needs**

Abstraction/Testing of Waste Pkg Degradation TR542FB2  
Provide WP w/PA Data Needs: Dec 96

Near Field Environment Models TR543FB2  
Provide Facility Design w/Data Needs: Oct 96

#### **2. Support to Systems Engineering**

Support to Follow-on Performance Confirmation Study TR541FA2: September 97

Support to Waste Isolation Study TR541FA3: March 97

Support to Requirements Analysis TR541FA4: August 97

Support to Follow-on Performance Confirmation YP5XPP076: September 98

PA Support to Seals Study TR543FA1: April 97

PA Support to DBE's TR543FA2: December 96

PA Support to Classification Analyses TR543FA3: September 97

PA Support to Classification Analyses/Q-List TR543GA1  
Initial: December 97  
Follow-on: September 98

PA Support to DIE's TR547FA1: September 97

PA Support to DIE's TR547GA1: September 98

#### **3. Key Assumptions**

VA Methodology TR541FB2  
Identify Key Assumptions: August 97

#### **4. Results Feedback**

TSPA-VA Chapter 8 TR541FB3  
Present Reference Case Results: January 98  
Sensitivity Analysis Results: February 98

**Abstraction/Testing of Waste Form Degradation TR542FB1**

Cladding Sensitivity: June 97

Waste Form Degradation Sensitivity: September 97

**Abstraction/Testing of Waste Package Degradation TR542FB2**

Waste Package Degradation Sensitivities: October 97

Cathodic Protection Sensitivities: October 97

Documented Sensitivity Analyses: March 98

**Waste Form Mobilization TR542FB3**

Colloid Mobilization Sensitivity Analysis: June 97

Waste Form Mobilization Sensitivity Analysis: Oct 97

Radionuclide Solubility Sensitivity Analyses: July 97

Waste Package Scale Thermal-Hydrologic Sensitivity: September 97

Gaseous Radionuclide Mobility Sensitivity Analysis: August 97

EBS Diffusion Sensitivity Analysis: October 97

**Preclosure Performance Assessment TR543FB1**

Reference Case Results: December 97

Sensitivity/Uncertainty Analyses: February 98

**VA Near Field Environmental Models TR543FB2**

Provide Sensitivity Analyses to Design: June 98

**VA Thermal-Hydrologic Models TR543FB3**

Provide Thermal-Hydrologic Sensitivity Analyses to Design: November 97

**5. Materials Evaluations**

Consequences of Cementitious Materials TR543EB030: December 96

## **E&I DELIVERIES TO SITE**

### **CANDIDATE DELIVERIES FROM E&I TO SITE**

#### **1. E&I Data Needs**

Not explicitly identified in current schedule: June 97 and June 98

#### **2. Test Requirements**

Performance Confirmation Design TR47GBJ

Update Performance Confirmation Parameters: January 98

Project Management Control Documents TR13FB1

Draft VA Test & Evaluation Plan: August 97

VA Test & Evaluation Plan: September 97

Project Management Control Documents TR13GB1

Final VA Test & Evaluation Plan: September 98

System Studies TR15FB1

Performance Confirmation Report: September 97

Waste Isolation Study: April 97

#### **3. Radiation Transport**

Champion Radiation Transport Evaluations TR22FAA

Assessment: September 97

Radionuclide Transport Evaluation TR22GB6: July 99

#### **4. Near Field Feedback**

Near Field Environment TR47FB2

Design Analyses: July 97

Test Other EBS Segment Materials TR255FB2

Feedback to Near Field Environment: August 97

Testing Other EBS Materials TR255GB2

Feedback to Near Field Environment: September 98

Near Field Environment Impacts TR22GB7: September 98



Provide Feedback to Near Field Activities TR251GBD

Initial: December 97

Additional: September 98

## **5. Waste Form Data**

WFCR Revision 1 TR241FB2: April 97

WFCR Revision 2 TR241GB2: September 98

## **6. EB Segment Materials**

EB Segment Materials Models TR255FB1

Provide to Site: March 97

System Studies TR15GB1

Materials Study: January 98

Drift Stability Design TR47FB3

Ground Support Materials: December 96

Ground Control Design TR47GBE

Update List of Materials: March 98

## **SITE DELIVERIES TO E&I**

### **CANDIDATE DELIVERIES FROM SITE TO ENGINEERING**

#### **1. Support to System Studies/Reports**

##### **Support Systems Engrg OG39FA1D**

Performance Confirmation Follow-on Work: September 97

Support Perf Confirmation Study: September 97

##### **Suppt Sys Engrg Reports & Studies TR39BFA1D**

Prepare MGDS Cost Est: September 97

Functional/Reqmnts Analysis - Bin 3: September 97

Functional/Reqmnts Analysis - Bin 2: September 97

VA Test & Evaluation Plan: September 97

Waste Isolation Study: March 97

Seals Study: May 97

Performance Confirmation Follow-on: September 97

##### **Support DIE's TR39BFA2D: September 97**

##### **Support Systems Engrg TR39BGA1D**

MGDS Cost Estimate: September 98

PISA Chapter 11 (Conduct of Ops): April 98

Suppt Funct Analysis/Reqmnts Analysis: September 98

Finalize Bin 3 Functional Analysis/Reqmnts Analysis: September 98

Update Bin 2 Functional Analysis/Reqmnts Analysis: September 98

Develop Technical Performance Measures: September 98

Support ESF Operations: September 98

ESF/MGDS Transition Plan: September 98

E-W Drift Design Reqmnts Study: January 98

ESF Con-Ops: September 98

Decommissioning Study: September 98

##### **FY98 DIE Suppt TR39BGA2D: September 98**

##### **INO3X Account YP3XPP001**

Systems Engineering Support: September 01

Systems Functional Analysis/Reqmnts Analysis: September 00

VA & LA Test & Evaluation Plan: March 02

## **2. Seismic Design Inputs**

Conduct Prob Seismic Hazard OG32836FB1  
Seismic Workshops: December 96  
Final Report: August 97  
Seismic Design Inputs: January 98

Seismic Design Inputs TR32835FB1: September 97

## **3. Thermal Test Data/Results**

Drift Scale Test Forecast TR3E2FB23: July 97

Drift Scale Test TR3E2GB53 - Heating Phase  
Initial Results: July 98

Single Heater Test TR3E2FB2 & TR3E2FB4  
Heat-Up Results: July 97  
Cool Down Data: February 98

Final Analysis of Single Heater Test Data TR3E2GB1: June 98

Laboratory Thermal Properties TR32711FB1  
Thermal Test Report: June 97

Large Block Test Results TR3E1FB2: August 97

Near Field Environment YP3XPP058  
Large Block Test Report: April 98

## **4. Geologic/Stratigraphic Information & Models**

3-D Model TR395FB1: February 97

PISA Chapter 2.3 OG39BFB1  
Geology/Stratigraphy/Seismology/Structure Description: May 97

Geologic System Description (PISA)TR39BFB1  
Draft Description: July 97  
Final Description: September 97  
Geologic Map OG32212FB2: August 97

3-D Site Model TR395FA1: September 97

Confirmatory Update to 3-D Site Model TR395GA1: August 98

## **5. Rock Properties/Rock Mechanics**

Rock Properties TR32222FB1

Draft Description: April 97

Final Description: September 97

T-M Changes in Rock Mass TR3C3FB8: September 97

## **6. DBE Inputs**

Volcanism Data Base TR32711FB1: September 97

Maximum Flood Information

Adverse Weather Projections

## **7. Near Field Environment Conditions**

Infiltration Model OG33121FB1: March 97

Moisture Monitoring Data in ESF OG33124FBA & TR33124FBA: March 97

Moisture Monitoring Data in ESF OG33124FBD & TR33124FBB: September 97

Chlorine-36 Data TR33122FBA: March 97

Chlorine-36 Data in ESF TR33122FBB

Data: February 97

Interpretation of Results: August 97

Percolation Flux Across Repository OG33124FB8 & TR33124FB8: August 97

Percolation Flux Across Repository TR33124GB8: September 98

NFER, Rev 1, Vol 1 TR3C5FB9: August 97

Chemical Composition of Water Before Contact w/Repository TR3C1FB1: December 96

Post-Emplacement Seepage Into Repository TR3C2FB5: July 97

Near Field/AZ Models TR3C5FB54

Report: November 97

Chemical Composition of Water Contacting Waste Packages & Waste Form TR3C5FBB

1st Batch Results: January 97

2nd Batch Results: May 97

3rd Batch Results: September 97

Near Field Environment Description (PISA) TR39BFB5: June 98

Mechanics of Waste Package Environment TR3C3GB8: September 98

Chemistry/Minerology of Waste Package Environment TR3C5GB5: September 98

Large Block Test Results TR3E1FB2: August 97

Near Field Environment YP3XPP058

Confirmatory Testing for Near Field Environment: November 98

Large Block Test Report: April 98

#### **8. Waste Form-Related Testing/Data: EBS Transport**

Neptunium Solubility TR34131FB4: June 97

Sorption & Transport TR34122FB2

Man Made Mat'ls & Rn Transport: September 97

Rn Solubility Studies TR34131FBB

Model & Experiment Data: September 97

Updates: September 98

Concentrations of Rns Leaving EBS TR3A31FB3

Limit Rn Solubility in EBS: December 96

Corrosion Transport Experiments: March 97

Transport Through Cement Materials Experiments: June 97

Models for Waste Package Hydrological TR3C2FB6: July 97

#### **9. Materials-Related Testing/Data**

Sorption & Transport TR34122FB2

Man Made Mat'ls & Rn Transport: September 97

Effects of Man-Made Mat'ls TR3C5GBB

Initial: February 98

Update: September 98

## **SITE DELIVERIES TO LA**

### **E&I TO LICENSING CANDIDATE DELIVERIES (Non-PISA Deliveries)**

#### **1. License Application Plan**

Project Management Documents TR13FB1  
Draft Compliance Plan: September 97

Project Management Documents TR13GB1  
Draft Compliance Plan Update: June 98  
Final Compliance Plan: September 98

MGDS Project Engineering TR42FA6  
Draft LA Design & Review Plan: September 97

#### **2. Progress Report Support**

Systems Integration TR142FA1  
PR 16 Input: March 97  
PR 17 Input: September 97

Systems Integration TR142GA2  
PR 18 Input: March 98  
PR 19 Input: September 98  
PR 20 Input: March 99

PR Preparation - LLNL TR21FA8: September 97

WPD PR Support TR21GA3: July 01

WPM PR Support TR21GA8: September 98

Subsurface Interface Activities TR42FA1  
Input to PR 16: March 97  
Input to PR 17: September 97

Subsurface Interface Activities TR42GA4  
Input to PR 18: March 98  
Input to PR 19: September 98  
Input to PR 20: March 99

### **3. Miscellaneous**

System Studies TR15GB1

LA Strategy for DOE SNF: April 98

Integrate Development of Licensing & Regulatory Documents TR22FA2: September 97

Regulatory & Licensing TR22GA7- Phase II

Integrate Regulatory Documents: July 99

## **E&I DELIVERIES TO PISA**

### **CANDIDATE DELIVERIES FROM E&I TO THE PISA**

#### **General Logic Flow for PISA Deliveries:**

In general, the logic flow for capturing engineering information in the PISA should begin with the work scope in each applicable engineering area with deliveries to preparation of System Description Document (SDD) sections. The SDD sections should then deliver the appropriate PISA chapter generation. The PISA chapter generation should then deliver the PISA itself in the 1.2.5 area.

#### **1. General PISA Deliveries**

SDD's (Deliver to each Design-related PISA Chapter) TR12GB1

Bin 3 SDD's: March 98

Bin 2 SDD's: June 98

Develop SDD's TR12FB1

Bin 1 SDD's: September 97

Systems Integration TR142GA2

Integrate SDD's: September 97

Systems Integration TR142GA2

Integrate SDD's: Oct 97 - July 99

Support PISA Development TR142GA4

Chapter Integration: Apr 98

Reviews & Completion: August 98

Subsurface Design Documents TR42GB2

Text & Info to PISA Chapters (2 - 11): March 98

Reviews: June 98

#### **2. PISA Chapter 1**

Support PISA Chapter 1 TR142GA3

Support Development Tasks: April 98

#### **3. PISA Chapter 3**

Classification Analyses/Q-List TR1BFB2

CA/Q-List: September 97



Classification Analyses/Q-List TR1BGB1  
CA/Q-List: March 98

Support DBE/Q-List TR46GB2  
Q-List Analyses: Oct 97 - July 99

DBE/Q-List TR47GBB: Oct 97 - Sept 98

#### **4. PISA Chapter 4**

Waste Qty, Mix, & Throughput Study TR15FB2: April 97

System Study Support to SRA/Design TR15GB1  
Decommissioning Study: April 98 - October 98

Support System Studies TR42GB3  
Decommissioning: Oct 97 - August 98

Nuclear Facility System Description TR46GBD  
Analyses: March 98  
Diagrams: Feb 98

Emplacement System TR47GB6  
Selected Drwgs: May 98

Subsurface Utilities TR47GB7  
Evaluations, General Arrangements, Schematics: March 98

Subsurface HVAC TR47GB8  
Airlocks, Closure, HVAC: March 98

Ground Control TR47GBE  
Materials: March 98  
Design Inputs: December 97

Subsurface Facilities TR47GBM  
Drainage: Jan 98  
Ventilation Openings: January 98

#### **5. PISA Chapter 5**

CF Disposal Design TR231GB1  
Design Basis Canister Selection: March 98

System Studies TR15FB1  
Waste Package Size Study: September 97

HLS Disposal Container Design TR232GB1  
Thermal, Structural, Criticality Evaluations: April 98

EBS Design Probabalistic Evaluations TR233GB7  
EBS Performance: Oct 97 - July 99  
Probabalistic Evaluations: Oct 97 - July 99

Criticality Analysis Methods TR233GB9: Dec 97

UCF Disposal Container Design TR233GBB  
Complete Development: July 98  
Design Basis SNF: July 98

Probabalistic Design Methods TR233GBC  
Criticality Methodology: August 98

Disposal Criticality Analysis Consequence Model TR233GBE: March 98  
Material Test Data (TR251GB1, TR251GB4, TR251GB5, TR251GB7, TR251GBA,  
TR251GBC): June 98

Material Degradation Models TR251GBE  
Crevice Corrosion Model: May 98

Phase Stability TR251GBK  
Accelerated Aging Studies: Jan 98

WPD Input to PISA Ch 5 & 6 TR22GB1  
Draft: Feb 98  
Final: June 98

WPM Input to PISA Ch 5 & 6 TR22GB2  
Draft: Feb 98  
Final: June 98

## **6. PISA Chapter 6**

System Studies TR15FB1  
Seals Study: May 97

WP Supports/Inverts TR233GB1  
Evaluations: April 98

Additional Barriers TR233GB2  
Drawing Input Sheets: March 98

Testing of Other EBS Materials TR255GB2  
Thermal/Chemical Tests: Oct 97 - Sep 98

Subsurface EBS Design TR47GBD  
Analyses: June 98

EBS Parts Lists, Drwgs, & Specs TR233GB4: Oct 97 - July 99

Seals/Decommissioning Drwgs & Designs TR47GBA: Feb 98

Subsurface Facilities TR47GBM  
Shaft Design Guide: Feb 98

WPD Input to PISA Ch 5 & 6 TR22GB1  
Draft: Feb 98  
Final: June 98

WPM Input to PISA Ch 5 & 6 TR22GB2  
Draft: Feb 98  
Final: June 98

## **7. PISA Chapter 7**

DBE Definition & Analysis TR1BFB1  
DBE's: September 97

PISA Chapter 7 TR1BGA2  
Chapter Development: September 98

DBE Definition & Analyses TR1BGB2: March 98

EBS DBE Evals TR233GB5  
Integrate DBE's: Oct 97 - July 99

DBE/Q-List TR47GBB: Oct 97 - Sep 98

System Studies TR15GB1  
LA Strategy for DOE SNF: April 98

DOE-Owned SNF Design TR233GB3  
Evaluations: Oct 97 - July 99

Waste Form Data (TR241GB3, TR241GB4, TR241GB5, TR241GB6, TR241GBA,  
TR241GBB, TR242GB1, TR242GB2): May, June 98

Glass Process Models TR242GB3  
Dissolution Rates: June 98

DBE/Q-List TR46GB2  
DBE Analyses: May 98

## **8. PISA Chapter 9**

System Studies TR15FB1  
Waste Generated Study: September 97

Site-Wide Systems & Structures TR46GBE  
Site Generated Waste: Feb 98

## **9. PISA Chapter 10**

DEB Def'n & Analysis TR1BFB1  
DBE's: September 97

DBE Def'n & Analysis TR1BGB2: March 98

DBE/Q-List TR46GB2  
DBE Analyses: May 98

Rad Safety Design TR46GBC: Oct 97 - July 99

Radiation Safety TR47GB4: Oct 97 - April 01

DBE/Q-List TR47GBB: Oct 97 - September 98

## **10. PISA Chapter 11**

MGDS Con-Ops TR12FB3  
MGDS Con-Ops Revision 1: September 97

MGDS Con-Ops TR12GA2  
Maintain MGDS Con-Ops: September 98

Support PISA Chapter 11 Development TR142GB1  
Complete PISA Chapter 11: April 98

Safeguards & Security TR18FB2: June 97

Subsurface Interface Activities TR42FA1  
Revise Con-Ops: September 97

**Waste Handling Systems TR46GB3**  
**Update Config Analyses: Mar 98**

**Personnel Safety & Warning System TR47GBL**  
**Immediate Response Plans: Feb 98**

**VA Site-Wide Systems & Structures TR46GBE**  
**Safety & Security Systems: February 98**

## **LA DELIVERIES TO E&I**

### **LICENSING TO E&I CANDIDATE DELIVERIES**

#### **1. Criticality Topical Report**

TR524FA1 Support Draft Criticality Control Topical Report: August 97

TR524FA2 Final Topical Report: September 97

TR524GA4 Final Topical Report: August 98

#### **2. LA Plan Delivery to Guide Future Design**

Prepare LA Plan TR524FB5

Submit Final LA Plan: September 97

License Application Plan YP5XPP089

Finalized: August 98

#### **3. RIB & Genesis Data**

RIB Maintenance TR533FB1

Waste Package Materials Properties Data in RIB: July 97

Waste Form Characteristics Data in RIB: August 97

Genesis Data Base Maintenance TR536FB1

EBS Phase I Data: September 97

Repository Phase I Data: September 97

## **MGDS COST ESTIMATES**

### **MGDS COST ESTIMATE CANDIDATE DELIVERIES (Non-TSLCC)**

#### **1. Systems Engineering Cost Estimate Preparation**

MGDS Cost Estimate TR17FB1

All Activities (MGDS Cost Estimate)

MGDS Cost Analysis TR17GB1

Cost Models Update: Dec 97

Draft Estimate: Jan 98

Update VA Estimates: Feb 98

Final VA Estimates: Jul 98

Final VA Cost Report & Documentation: August 98

#### **2. Waste Package/Engineered Barrier System Cost Estimate Support**

EBS Cost Estimate TR234GB4: September 98

Complete Phase I EBS Cost Estimate TR234FB1

Prepare & Provide Cost Estimates: September 97

Obtain Vendor Verification of Material Prices: June 97

Cost of Pedestals & Supports: September 97

Closure Weld Costs: September 97

#### **3. Repository Cost Estimate Support**

Cost Estimating TR46FA1: September 97

Cost Estimating TR46GA2

Refine Cost Estimates: Mar 98 - July 99

Cost Estimating TR47FAF: September 97

Cost Estimating TR47GAF: September 98

#### **4. Non-E&I Cost Estimating Support**

Support Systems Engineering Reports & Studies TR39BFA1D

Prepare MGDS Cost Estimate: September 97

Support Systems Engineering TR39BGA1D

MGDS Cost Estimate: September 98

## **E&I DELIVERIES TO NEPA**

### **CANDIDATE DELIVERIES FROM E&I TO NEPA**

#### **1. Transportation Work**

Transportation Studies (All Activities) TR15FB4: September 97

System Studies TR15FB1

Rapid Response: September 98

NV Transportation Policies: November 98

DOE Transportation Meetings: November 98

Nevada Transportation (All Activities) TR46FB1: September 97

Nevada Transportation TR46GBL: April 01

#### **2. Safeguards & Security, Land Withdrawal**

MGDS Safeguards & Security (Land Withdrawal) TR18FB2: June 97

#### **3. Waste Package Support**

Integrate Environmental Assessment Performance TR22FA1: September 97

Environmental Assessment Performance TR22GA5: July 99

#### **4. Repository Support**

Develop Alternatives Data for NEPA TR46FB8

Engineering Files: March 97

Engineering Files Updates: August 97

Support NEPA Process TR46GA3: July 99

NEPA/Environmental Support TR47FBH

Drawings: June 97

Engineering Files: August 97

NEPA/Environmental Support TR47GBH

New Engineering Files: March 98

Revised Engineering Files: September 98



## **E&I PROGRAM INTERFACES**

### **PROGRAM INTERFACES WITH WASTE PACKAGE**

1. Data provided by Waste Package Development to Nuclear Regulatory Commission  
Summary Account TR233FB9  
WP150A3 Disposal Criticality Technical Report, Rev. 01 04Sep97  
  
Summary Account TR233GBD  
WP100A3 Disposal Criticality Topical Report 30Aug98
2. Data received by Waste Package Development from various utilities and labs  
Summary Account TR233FBE  
WP233A04 Acquire benchmark critical data 29Nov96  
WP233A18 Acquire CRC data - BWR & PWR Fuel 14Mar97  
  
Summary Account TR233FBF  
WP233A51 Acquire chemical assay data 30Jun97
3. Data received by Waste Package Development from various materials suppliers  
Summary Account TR234FB1  
WP234704 Obtain verification of materials prices used in cost estimates 27Jun97
4. Data provided by Waste Package Materials on waste form materials testing and modeling to the Nuclear Waste Technical Review Board, the Nuclear Regulatory Commission, the State of Nevada, and other users  
Summary Account TR241FB2  
WP0035A3 Issue Waste Form Characteristics Report Revision 1 03Apr97
5. Data provided by Waste Package Materials on engineered materials testing and modeling to the Nuclear Waste Technical Review Board, the Nuclear Regulatory Commission, the State of Nevada, and other users  
Summary Account TR251FB9  
WP15A10 Issue Engineered Materials Characteristics Report Revision 1 01Apr97

## **E&I PROGRAM INTERFACES**

### **PROGRAM INTERFACES WITH SYSTEMS ENGINEERING**

#### **1. Data received by Systems Engineering from DOE/EM, RSA, or WAST/PM&A**

Summary Account TR12FB2: Requirements Documentation/Verification

SE422700 Maintain Top Level Requirements 01Oct96, 30Sep97

SE422705 Update CDA 01Oct96, 31Mar97

SE422710 Update CDA 01Apr97, 30Sep97

Inputs from Program Level Requirements if changes occur.

Flow down of requirements from higher level documents controlled by WAST or PM&A.

Newly imposed requirements on MGDS system such as Other Waste Forms, Waste Acceptance modifications, etc.

Modification of Assumptions to accommodate newly imposed constraints (if any) on system.

Potential Originating Organizations: DOE/EM, RSA, or WAST/PM&A

Data Flow: EM or RSA to WAST/PM&A to DOE/YMP to M&O or WAST/PM&A to M&O/WM&I to M&O/MGDS

Feedback to EM or RSA or WAST/PM&A regarding our assumptions might occur through DOE/YMP to WAST/PM&A.

Summary Account TR12FB3: MGDS Concept of Operations

SE400705 Update Con-Ops 02Dec96, 31Mar97

SE400715 Update Con-Ops 01Jul97, 29Aug97

Inputs from WAST/PM&A or RSA could impact receipt of waste operations or waste processing operations. EM inputs (if any) could affect waste receipt/waste handling operations, requiring adjustments to Con-Ops Document.

Data Flow: EM or RSA to WAST/PM&A to DOE/YMP to M&O, or WAST/PM&A to M&O/WM&I to M&O/MGDS

Summary Account TR12GA1 MGDS Concept of Operations (Post VA)

SE400800 Maintain MGDS Con-Ops 30Nov98, 29Nov99

See TR12FB3. Sufficient time to better plan interface points and need dates (if any) to support LA Design.

Summary Account TR12FB1 Develop System Description Documents

SE405705 Develop Bin 3 SDD's 01Oct96, 30Sep97

SE410700 Develop Bin 2 SDD's 07Apr97, 30Sep97

SE415700 Develop Bin 1 SDD's 01Apr97, 30Sep97

Inputs (if any) from DOE/EM, WAST/PM&A, or RSA could impact receipt of waste operations, waste processing operations, or waste receipt/waste handling operations, requiring adjustments to requirements sections in SDD documents.

Data Flow: EM or RSA to WAST/PM&A to DOE/YMP to M&O, or WAST/PM&A to M&O/WM&I to M&O/MGDS; Data may flow through MGDS RD to SDDs.

Summary Account TR12GB1 System Description Documents (may not support VA)

SE520805 Requirements Analysis (Bin 3 SDDs) 02Jan98, 31Mar98  
 SE521805 Requirements Analysis (Bin 2 SDDs) 01Apr98, 30Jun98  
 SE522810 Requirements Analysis (Bin 1 SDDs) 01Jul98, 30Sep98  
 See TR12FB1. Sufficient time to better plan interface points and need dates (if any) to support LA Design.

Summary Account TR12GB2 Requirements Documents (probably does not support VA)  
 SE580800 Maintain CDA Document 01Oct97, 30Sep98  
 SE530800 Maintain Top Level Requirements Docs 26Nov97, 25Nov98  
 See TR12FB2.

Summary Account TR13GB1: Program and Project Management & Controls (non-VA)  
 SE450800 Prepare Draft Risk Management Plan 28Jan98, 21Sep98

Input from EM, RSA, and WAST/PM&A in risk areas associated with inputs which will affect MGDS Design or License Application. Plan will lay out approach for managing risks critical to MGDS success.

Data Flow: EM or RSA to WAST/PM&A to DOE/YMP to M&O, or WAST/PM&A to M&O/WM&I to M&O/MGDS

Summary Account TR15FB1: System Studies Support to SRA/Design  
 SE460700 Research for Waste Package Size Study 27May97, 25Jun97  
 Input desired from WAST, DOE/EM, Navy on sizes/shapes of commercial (odd-ball) and other waste forms and any potential impacts to WP Size.

Summary Account TR15FB4: Transportation Studies  
 SE456750 System Support to NEPA Activity (non-VA) 01Oct96, 30Sep97  
 Support to Engineering Files and EIS Transportation work. Input from EM, Navy, Other Waste Orgs via DOE/WAST/PM&A or DOE/YMP to M&O. Output goes to Jason via DOE/YMP.

SE457705 Transportation Support (Rapid Response) 01Oct96, 30Sep97  
 Inputs from RSA via DOE/WAST/PM&A and DOE/YMP necessary to support interface definitions (in 1.2.1.6). Inputs from Transportation portion of WAST with potential impacts to MGDS or Nevada Transportation.

Summary Account TR15GB1: System Studies Support to SRA/Design  
 SE457755 Transportation Support (Rapid Response) 01Oct97, 30Sep98  
 See TR15FB4, SE457705.

SE516802 ID Issues for LA Strategy for DOE SNF (non-VA) 03Nov97, 14Nov97  
 Input/Output with EM, Navy, and other Waste Form orgs.  
 Data Flow is from EM/Navy/Others to DOE/WAST/PM&A or DOE/YMP to M&O.

Summary Account TR16FA1 Interface Management

SE426700 Develop Bin 3 Interfaces	01Oct96, 30Jun97
SE426705 Develop Bin 2 Interfaces	01Oct96, 30Jun97
SE426710 Evaluate Interfaces	01Oct96, 30Jun97

Inputs desired from DOE/EM, DOE/WAST/PM&A, RSA, and Navy to support the evaluation of parameters at the MGDS to Waste Form or MGDS to Transportation interface.

Outputs to these organizations in the form of interfaces reflective of current MGDS capabilities/envelopes. Waste Acceptance Criteria Document developed based on current MGDS capabilities to be added in FY97 Supplemental Funding (TR16FB1) with a draft on June 30, 97 (Level 4) and a Revision 0 on 9-30-97 (Level 3).

Data flow is via DOE/YMP or M&O/WM&I.

Summary Account TR16GA1 Interface Management

SE532810 Update Bin 3 SSC Interface Requirements	01Oct97, 30Jun97
SE532815 Update Bin 2 SSC Interface Requirements	01Oct97, 30Jun97
SE532820 Evaluate Interfaces	01Oct97, 30Jun97

See TR16FA1. Adjustments to Interfaces probable as a result of negotiations with external organizations (through DOE/YMP) in order to accommodate larger percentage of fuels. Potential impacts to design to be reflected in LA design (not VA). Take credit for capability to handle fuel by showing we have approach at VA, but not yet incorporated into design. A continuation of account TR16FB1 added via FY97 Supplemental funding will also likely be required.

2. Data received by Systems Engineering from M&O/WM&I

Summary Account TR13FB1 Program & Project Management & Controls

SE449700 Support TMIP Development	02Dec96, 30Sep97
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Requires participation (input) from M&O/WM&I to develop/update this document.

Minimum participation consists of review, comment, and sign-off on final product.

External interfaces involving DOE to other agencies will need to be documented in another forum (IMP?).

Feedback could be provided to M&O/WM&I to provide documented management process for interfacing between East and West.

SE418710 Prepare Draft VA T&EP Plan	01Apr97, 01Aug97
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Input from Test Evaluation Master Plan (TEMP) which was received from M&O/WM&I.

Summary Account TR13GB1: Program and Project Management & Controls (non-VA)

SE419710 Develop Preliminary Draft LA T&EP	01Apr98, 14Aug98
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Input from M&O/WM&I for any changes/update to TEMP. Incorporation of Other Waste Forms, and RSA Interfaces into test requirements (weak relationship).

Summary Account TR15FB1: System Studies Support to SRA/Design

SE436700 Research for Waste Generated Study	01Apr97, 15May97
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Input from M&O/WM&I on Waste Stream Characteristics (already received) - may have implications on type, rate, and qty of waste generated.

Summary Account TR15FB2: Waste Qty, Mix, Throughput Study  
SE200710 Identify Waste Receipt Schedules 19Nov96, 28Feb97  
Inputs received from M&O/WM&I regarding Waste Stream Characteristics (rates and potential surges). Results of study likely to be fed back to M&O/WM&I.

Summary Account TR15GB3 Thermal Management Technical Analysis (non-VA)  
SE900102 Identify Issues 16Apr98, 15May98  
Input from WAST/PM&I via M&O/WM&I on waste receipt schedules and modifications and storage information. Inputs will need to be considered in the context of thermal management.

Summary Account TR17FB1: MGDS Cost Analysis  
SE124720 Preliminary Draft MGDS-VA Cost Est. Rpt. 18Mar97, 06May97  
Input from M&O/WM&I regarding anticipated assumptions for TSLCC and MGDS Cost Estimate planned for FY98. Desired input from EM and others (via DOE/WAST/PM&A or DOE/YMP) regarding incorporation of costs associated with other fuels into the baseline & design.

Summary Account TR17GB1: MGDS Cost Analysis (Schedule being revised)  
SE124800 Develop VA Case Assumptions 01Oct97, 03Nov97  
SE124805 Develop 98 TSLCC Assumptions 06Oct97, 14Nov97  
Inputs from M&O/WM&I regarding agreements on assumptions.  
Incorporation of Comments June 98, July/Aug 98  
Input from M&O/WM&I regarding TSLCC Comments (possibly from ICE). Also provides opportunity to incorporate Design generated adjustments.

Summary Account TR18FB2: Perform MGDS Safeguards & Security Eval  
SE500700 Perform Safeguards & Security Eval 02Jan97, 25Apr97  
Inputs desired from EM & Navy regarding characteristics of other waste forms which may have Safeguards & Security implications. Inputs regarding Pu desired.  
Data Flow via DOE/YMP or DOE/WAST/PM&A through M&O/WM&I

Summary Account TR18GA3: Safeguards and Security  
SE730A Provided Safeguards, Security to SRA/Design 01Oct97, 26Jul99  
See TR18FB2.

Summary Account TR1BFB1: DBE Definition and Analysis  
SE310700 DBE FY'97 (1ST HALF) 01Oct96, 31Mar97  
SE310705 DBE FY'97 (2ND HALF) 01Apr97, 30Sep97  
Input desired from EM, Navy, and other waste forms to consider in DBE analyses. Inputs concerning Pu desired for evaluation also.  
Data Flow via DOE/YMP or DOE/WAST/PM&A through M&O/WM&I.

Summary Account TR1BGB2: DBE Definition and Analysis  
SE310800 DBE FY'98 (1ST HALF)  
SE310805 DBE FY'98 (2ND HALF)  
See TR1BFB1.

03Nov97, 03Apr98  
01May98, 02Nov98

3. Data provided by Systems Engineering to WAST/PM&A or WM&I

Summary Account TR15GB3 Thermal Management Technical Analysis (non-VA)

SE125AM3 Thermal Management Technical Analysis 30Sep98

Potential Output to WAST via DOE/YMP regarding thermal management techniques to be employed during waste acceptance or storage. Output could affect RSA or ISF constraints.

Summary Account TR17FB1: MGDS Cost Analysis

SE124AM3 Submit Cost Estimate 30Sep97

Output to M&O/WM&I stating assumptions to be used in MGDS contribution to TSLCC and for MGDS and LA Plan Cost Estimates.

Summary Account TR17GB1: MGDS Cost Analysis (Schedule being revised)

SE124805 Develop 98 TSLCC Assumptions 06Oct97, 14Nov97

Cost Input to TSLCC March 98

Output to M&O/WM&I to support TSLCC

Output to M&O/WM&I reflecting revisions resulting from comment incorporation.

TR42 Requirements and Design Basis (continued)

repository. These activities do not individually warrant separate level three activity bars, since the effort attributed to each is small. These activities include: Waste Quantity, Mix, and Throughput study; Generated Waste Disposal study; Waste Isolation Requirements study; Waste Package Size Determination. In addition to support for the above mentioned studies, the repository design group will provide level of effort support for the development of the Viability Assessment Test and Evaluation Plan and the Regulatory Compliance Plan.

← TR42FA3 - SUPPORT SRA - RSD PH I

Provide support to Systems Engineering to complete the functional analysis, develop the system architecture, identify SSCs, prepare the concept of operations, ensure that interfaces are described, maintain/update the requirements documents and the CDA document, and support the preparation of the criteria section of the SDDs, and support the preparation of the regulatory compliance plan. Development of assumptions, requirements and criteria will entail: identifying where functional requirements, performance requirements, and regulatory requirements are in conflict or have multiple solutions to which trade or engineering studies can be applied to resolve options; assuring that all performance requirements are identified and their bounding criteria are quantifiable and measurable to designers, reviewers, and verifiers; assuring that all regulatory requirements have been allocated to the proper physical systems and that their bounding criteria are quantifiable and measurable to designers, reviewers, and verifiers; and mapping the requirements to the appropriate standards or design guides that will satisfy them. It is expected that surface design will be part of an integrated work team under the guide of Systems Engineering. Support for systems studies is addressed in activity RP2405B. Note: providing input to the design and operations description sections of the SDDs is covered under the surface design tasks addressing the system designs.

← TR42FA4 - INTERFACE ACTIVITIES - RSD PH I

Provide support to a variety of project/program related activities that require input from and/or coordination and integration with repository design. These activities include the preparation of documents such as the semi-annual NRC progress reports, license application plan, PISA plan, TMIP, BCPs and procedures. This activity also includes interactions with outside agencies such as the NWTRB, EPA, and NRC. Support activities include the reviews, participation in meetings, and preparation of written input, review comments and presentations. Routine project management interface work (e.g., status presentations for DOE) is covered in the summary account for repository management and integration. The MGDS Project Engineering Office will serve as a point of contact between the DOE and Design. The Office will be responsible for Engineering and Integration Operations deliverable performance, integrity, and effectiveness of Design products. The Office will assure the integration of those products within Engineering and Integration Operations and with the other elements of the Program (i.e., Scientific Programs, Site Construction, Regulatory & Licensing, Support Operations, and Waste Management & Integration). The Office will participate in the development of budgets, work scope and schedules for Design products. This activity will include the identification of issues and facilitate the resolution of issues. This activity will be responsible to management in monitoring, reviewing and coordinating the products of Design to insure consistency with the other elements of the Program. The Office will organize and facilitate management review sessions for significant Design products and will coordinate budget, schedule, and deliverable status reviews. The MGDS Project Engineering Office will organize and coordinate interactions with the Repository and Waste Package Consultant Boards. The Office will coordinate and lead special assignments as needed, and will coordinate and/or generate white papers and recommendation letters as required. The Project Engineering Office will coordinate and integrate the generation of a Viability Assessment Design and Review Plan and a Draft License Application Design and Review Plan. The VA Plan will describe those design-related topics/issues important to the Viability Assessment, the required progress toward resolution of each issue at the time of the Viability Assessment Design completion, which products will be generated, and how these products will illustrate that necessary progress has been accomplished. The plan will include a review checklist to support completion of the Phase I design and a preliminary review checklist to support the completion of the Viability Assessment Design. The plan will include a schedule for completion of design activities which support the VA commensurate with the level of design schedule detail contained in the FY97 Annual Plan. Interfaces between Design and other Project and Program areas will be defined and coordinated. The Plan will be reviewed internal to the M&O prior to delivery to YMSCO.

TR42FA6 - MGDS PROJECT ENGINEERING - REPOSITORY PHASE I

The Draft License Application Design and Review Plan will describe those design-related topics/issues important to the License Application, the required progress toward resolution of each at the time of License Application Design completion, which products will be generated, and how these products will illustrate that necessary progress has been accomplished. The plan will include preliminary review checklists to support completion of the Phase II design and completion of License Application Design. The plan will be coordinated with and consistent with the Regulatory Compliance Plan developed in 1.2.1 and the License Application Plan developed under 1.2.5. The plan will include a schedule for completion of design activities which support the LA commensurate with the level of detail contained in the Long Range Plan. Interfaces between Design and other Project and Program areas will be defined. The Plan will be reviewed internal to the M&O prior to delivery to YMSCO. Develop repository design guides. In FY97, design guides will define design methodology for selected design topics, mostly topics important to radiological safety and waste management (e.g., source terms, secondary waste and remote operations). The activity includes reviewing existing NRC Regulatory Guides, ANS standards, ANSI nuclear safety standards, design safety related NUREGs, and AE design standards (e.g., Fluor Daniel,

TR42FB3 - PREPARE DESIGN GUIDES

RSP PH I

## TR42 Requirements and Design Basis (continued)

MK and DESI); and translating the most appropriate standards into design guides. New guides will be written where existing documents cannot be adapted. The level of detail provided in guides translated from existing standards will be consistent with the source documents. The level of detail provided in newly written guides will be appropriate to facilitate the Phase I or II design process, or the NRC license review. The level of detail will be expanded as needed in Phase II to facilitate the detail design process planned to begin in Phase III. The product checking group will coordinate design guide development. The purpose of the guides is to establish consistent methods for repetitive design activities that are acceptable to the NRC. The existing Reg. Guides are traceable to 10CFR50 via the NUREG 0800, Standard Review Plan for the Review of SARs for Nuclear Power Plants, and they are based on years of reactor experience. Where possible NRC Regulatory Guides for nuclear power plants will form the foundation for the design guides because these design methods will be most readily accepted by the NRC. Each design guide is expected to address: applicability, relevant RDRD requirements, design objectives, design parameters (e.g., source terms), acceptable analytical methods and sizing basis, recommended design solutions, design product format requirements with examples, and a check list for confirming the quality of the design product. Applicable codes and standards will be quoted or referenced as appropriate. A design guide preparation plan will be developed early in FY97 to establish the format and content of the guides, identify existing standards, and establish a prioritized production schedule.

*TR 42-134 - SUPPORT SYSTEMS STUDIES - RSD PH I*

Provide input/support for a variety of System Engineering studies. Preparation and coordination of the studies are the responsibility of Systems Engineering. Repository design will work with Systems Engineering as members of an integrated team to assess the impacts of alternatives on the surface design, and to provide descriptive material for the report. The relationship of each study to surface design is provided in the descriptions below.

~~RP2405B1~~ Waste Quantity, Mix, & Throughput; Level 3 Task SE200A - Prepare surface design data for establishing requirements for the quantity, mix, and throughput of HLW waste at the repository. This activity includes analyzing the impacts to surface design from various scenarios. The scenarios are expected to include primarily uncanistered spent nuclear fuel with lesser quantities of vitrified HLW, other DOE-owned waste forms, and naval fuel. This study will finalize the scenario. FY96 study Uncanistered Fuel Receipt and Handling Analysis, will be based on a preliminary best-guess waste scenario. The Waste, Quantity, Mix, and Throughput Study will establish the final waste form scenario requirements for the phase II design.

~~RP2405B2~~ Retrieval Study; Level 3 Task SE502 - Prepare design data for developing a waste package retrieval strategy for the surface facilities. This activity includes analyzing the impacts to surface facilities from alternate retrieval strategies. Concepts may be required for adding or modifying facilities to cut open waste packages, repack the waste for shipment or remediation, or process the waste for recovery of a valuable resource. The impact from the addition or expansion of lag storage facilities will be assessed.

~~RP2405B3~~ Seals Study, Level 3 Task SE506 - Prepare surface design data for establishing backfill/seal requirements for subsurface openings including ramps shafts and boreholes. This activity includes analyzing the impacts to surface design from alternate sealing technologies and materials. Surface design impacts are expected to be related to providing the appropriate materials to the sealing locations.

~~RP2405B4~~ Safeguards, Security to SRA/Design; Level 3 Task SE730 - Prepare design data for developing surface design requirements for safeguards and security. This activity includes analyzing the impacts to surface facilities from various S&S concepts. Concepts may include delay features (e.g., hardened walls and fighting stations), intrusion detection systems (i.e., PIDAS), MC&A access control and tracking, and IAEA inspection facilities.

~~RP2405B5~~ Waste Package Size Study; Level 3 Task SE460 - Prepare design data for establishing an economic waste package size. This activity includes analyzing the impacts to surface facilities from various waste package configurations. Waste package size has a significant impact on the number of units packaged and the design of the in the waste handling facilities.

~~RP2405B6~~ Waste Generated Study; Level 3 Task SE436 - Prepare design data for determining where low-level waste will be disposed (e.g., on-site facility, NTS facility, off-site facility). This activity includes developing a concept and costs for an on-site storage facility.

~~RP2405B7~~ Test Evaluation Plan; Level 3 Task SE504 - Prepare design data for developing requirements for the surface design features needed to verify that the systems will perform during preclosure as designed.

~~RP2405B8~~ Performance Confirmation Follow-on Work; Level 3 Task SE050B - Prepare surface design data for developing detailed performance confirmation requirements. This activity includes analyzing the impacts to surface facilities from alternate

*9-25-96 RHC 9/26/96 RAL 9/26/96*



TR42 Requirements and Design Basis (continued)

confirmation strategies. Strategies may consider alternative testing frequencies, and various sampling and testing approaches. This study is a continuation of SE050A.

← TR42 FBS - SUBSURFACE DESIGN DOCUMENTATION 10/9/2001

10/9/2001 10/9/2001 10/9/2001 10/9/2001

Develop preliminary design guides for various aspects of design that are not currently covered by a prescribed set of codes and standards or a specific design guide. Design guides that are currently accepted by the NRC will be reviewed for completeness and application to this project.

Wherever possible, existing material that is acceptable will be modified to incorporate new material that is site specific and design specific. Design guides must be developed in time for license application, but do not necessarily need to be completed prior to performing design as long as the design conforms to the constraints specified in the design guide. FY 97 activities will be limited in the design guide development arena, but will increase in FY98 and 99.

Tasks included in this activity are as follows:

-The purpose of the proposed Radiation Safety Design Guide is to document the methodology used in Radiation Safety for subsurface design. The guide will describe in detail, the exact procedures used to generate shielding analysis, for example. Generation of such a document ensures the long term survivability of the information basis for the safety as well as satisfying the documentation requirements of the licensing body which governs the process.

- "Drift Design Methodology and Preliminary Application for the Yucca Mountain Site Characterization Project", by SNL (Dec, 1991), needs review, update, or new version to be applicable to current design concept. This document will be the basis for development of the drift design guide for LAD. (4/15/97 - 9/30/97)

- The development of System Design Description (SDD) documents will be continued in FY1997. SDDs include the specific system design criteria and description and show how the criteria are satisfied by the design. This criteria will be developed and controlled prior to drawing development. SDDs for FY97 will be developed to the extent specified during meetings between the M&O and DOE in FY96. The structure is envisioned at this time to be comprised of six chapters plus a summary and appendices. A preliminary SDD will be produced for all identified systems, but the quantity of material in each chapter will vary with the maturity of design. All SDDs produced in FY97 will have (at least) a summary section, with some (Bin 3) SDDs containing some information through chapter 3. The SDDs will continue to be supplemented as design progresses on that system. Repository design will provide that portion of the SDD content which deals directly with the design for which the repository design department is responsible. This repository SDD development task supports work described within the systems engineering area. Examples of subsurface related SDDs expected to be started during the FY97 are given below:

1. Ground Control System
2. Underground Facility portion of the Engineered Barrier System
3. Subsurface HVAC System
4. Subsurface Waste Package Handling System
5. Performance confirmation Monitoring System
6. Seal System
7. Subsurface Repository Area
8. Subsurface Accesses
9. Retrieval System
10. Backfill Emplacement System (if needed)
11. Subsurface electrical Power Distribution System
12. Subsurface Fire Detection/Suppression System
13. Subsurface Radiation Monitoring System
14. Excavation/Muck Handling System

The exact titles and starting date for the above mentioned SDDs are subject to change during the FY 97 as the planning process for SDDs continue to evolve.

Two FY1997 milestones are also supported in this effort. They are:

- o EISE405BM3 Draft SDD Status Report
- o EISE405M3 Phase I SDD Status Report

Product production support is provided by the Product Checking Group as a direct component of quality procedure steps involving product checking. In this capacity, the group will provide the technical check and compliance check on drawings, analyses, and

Deliv ID	Description/Completion Criteria	Due Date
RP120M3H	<p>Design Guides</p> <p>Criteria - Letter of transmittal from the M&amp;O to DOE/Engineering, with attached M&amp;O approved design guides prepared with the appropriate DOE review participation. Documents or cover letter may point to applicable backup documents which provide additional detail and/or supporting information. Included are the following design guides: - Source terms design guides - Remote operations design guid - Drift design guide - Radiation safety design guides</p>	30-sep-1997
RP120MG1	<p>VA Design &amp; Review Plan</p> <p>Criteria - The deliverable contains a description of those design-related topics/issues important to the Viability Assessment (as derived by the M&amp;O and coordinated with DOE Engineering), <u>a description of the planned progress toward resolution of each issue at the time of the Viability Assessment Design completion (which will be defined in this plan)</u>, a listing of which products will be generated, and <u>a description of how these products will illustrate that necessary progress has been accomplished.</u> <u>The deliverable contains a review checklist to support completion of the Phase I design and a preliminary review checklist to support the completion of the Viability Assessment Design with appropriate DOE review involvement.</u> The deliverable contains a schedule for completion of design activities which support the VA. The level of detail of this schedule is commensurate with the level of design schedule detail contained in the FY97 Annual Plan. <u>The deliverable identifies interfaces between Design and other Project and Program areas.</u> The deliverable has been reviewed internal to the M&amp;O prior to delivery to YMSCO. The deliverable is signed and transmitted by the Engineering and Integration Operations Manager. This is a non-Q product. The deliverable is considered complete upon transmittal to YMSCO with the contents as described herein.</p>	31-dec-1996

TR42 Requirements and Design Basis (continued)

DELIVERABLES

Deliv ID	Description/Completion Criteria	Due Date
RP120MG2	<p>Draft LA Design &amp; Review Plan</p> <p>Criteria - The deliverable contains a description of those design-related topics/issues important to the License Application (as derived by the M&amp;O and coordinated with DOE Engineering), a description of the required progress toward resolution of each issue at the time of License Application Design completion, a preliminary listing of which products will be generated, and how these products will illustrate that necessary progress has been accomplished. The deliverable contains a preliminary review checklist to support completion of the Phase II design and completion of License Application Design. The deliverable contains a schedule for completion of design activities which support the LA, including M&amp;O and DOE reviews. The level of detail of this schedule is more detailed than the level of design schedule detail contained in the Project Long Range Plan. The deliverable identifies interfaces between Design and other Project and Program areas. The deliverable has been reviewed internal to the M&amp;O and DOE Engineering prior to delivery to YMSCO. The deliverable is signed and transmitted by the Engineering and Integration Operations Manager. This is a non-Q product. The deliverable is considered complete upon transmittal to YMSCO with the contents as described herein.</p>	30-sep-1997

Approvals

JN BAKER  
Preparer - print name

9/25/96  
Date

R. J. Craun  
Technical Reviewer - print name

9/26/96  
Date

Richard A. Kettell  
QA Reviewer - print name

9/26/96  
Date

J. Baker  
Preparer - signature

R. J. Craun  
Technical Reviewer - signature

Richard A. Kettell  
QA Reviewer - signature

8. Describe the steps in a process that the project will use to bring closure on this issue:

No.	Title	Description	Summary Account #
1	Develop Materials of Construction Database (RP500705, RP1206M3, RP47832)	Determine design parameters and properties of selected materials (e.g., concrete and steel) for the expected range of mechanical loads, temperature, and other conditions. Level 4 milestone to deliver engineering data to PA (9/30/97).	TR47FB1 TR47GBE
2	Identify Ground Support Materials (RP506705, RP47824)	Complete assessment and selection of appropriate materials with input from PA studies. Supports level 4 milestone to deliver data to PA.	TR47FB3 TR47GBE
3	Perform thermal/mechanical analysis (RP506710, RP47826)	Complete analysis of alternative ground support methods for thermal/mechanical, seismic, and in-situ load cases. Includes FY98 update to incorporate added data.	TR47FB3 TR47GBE
4	Develop Ground Support Designs (RP506715)	Present three ground support design options based on results of analysis and criteria/constraints developed from findings from PA and PC studies.	TR47FB3
5	Preparation of Drawings (RP506720)	Level 3 milestone for FY97: Drawings - Emplacement Drift Ground Support (09/30/97)	TR47FB3
6	Update Ground Support Design (RP47830)	Reevaluate FY97 work using latest information and results from PA and PC to update emplacement drift ground control and select a reference option.	TR47GBE
7	Near Field Environment (RP510710)	Assess emplacement drift environment conditions under a range of thermal conditions and ventilation scenarios.	TR47FB2
8 <sup>(1)</sup>	Near field environment PA study (Not identified)	Work on cementitious materials is not an identified task but is being included in the activity dealing with evaluation of near-field environmental models for VA. Deliverables are (1) documentation of a workshop on near-field models (6/30/97) and (2) documentation for near-field models for VA (4/2/98).	TR543FB2
9 <sup>(2)</sup>	Development of mapping strategy (SE050705, SE050710)	Identify requirements, needed geologic parameters, level of confidence needed for data, and predicted data distributions. Develop a mapping strategy and document requirements for mapping.	TR15FB1
10	Select Candidate Materials for WP Support & Invert (WP220746)	Identify candidate materials that are compatible with WP design, and are acceptable for WP support and emplacement drift invert design. (11/1/96 - 4/1/97)	TR22FB4

9. Provide a rough schedule of when this issue will be resolved for VA:

			-----FY97-----												-----FY98-----											
			--																							
No	POC (Name/Phone)	Date	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S
1	R. Nolting/5-4450	10/01/96 - 09/30/97 01/02/98 - 03/31/98																								
2	R. Nolting/5-4450	10/01/96 - 12/31/96 11/03/97 - 03/31/98																								
3	R. Nolting/5-4450	10/14/96 - 04/10/97 12/01/97 - 07/31/98																								
4	R. Nolting/5-4450	10/14/96 - 04/01/97																								
5	R. Nolting/5-4450	02/03/97 - 09/30/97																								
6	R. Nolting/5-4450	02/02/98 - 09/30/98																								
7	R. Nolting/5-4450	10/01/96 - 07/31/97																								
8 <sup>(1)</sup>	Sassani/5-4635	10/01/96 - 06/30/98																								
9 <sup>(2)</sup>	Memory/5-3938	03/00/97 - 07/00/97																								
10	D. Stahl/5-4383	11/01/96 - 04/01/97																								

10. **Describe a process that will be used to measure performance towards closure:**  
Performance will be measured in accordance with the process documented in the VA Monitoring Plan.
11. **Describe how status will be reported during the process of closing this issue:**  
Status will be reported in accordance with the process documented in the VA Monitoring Plan.

## NOTES:

### 1 Further explanation of Step 8 (Near-field environment PA study), Paragraph 8:

- A report will be issued by PA on 6/30/97 documenting the results of "near-field" model studies that are being done as part of the Introduced Materials program at LLNL. Including in this report will be an assessment of the long-term postclosure behavior of concrete and a determination of the importance of certain concrete characteristics, such as pore solution pH, to the emplacement drift environment.
- A statement of work is being submitted this month (3/97) outlining a 6-month testing program to investigate certain key mechanisms in concrete that will determine the long-term pH of the drift environment. Results of this testing will be available by the first quarter FY98.
- A report will be issued by PA on 4/2/98 to complete the documentation of the near-field model studies at LLNL. Results of these and other tests will provide the basis for a final assessment of concrete pH.

### 2 Further explanation of Step 9 (Development of mapping strategy), Paragraph 8:

- An initial consensus will be developed by the end of April FY97 on a geologic mapping strategy. This strategy will provide a focus for continued assessment through the end of FY97.
- In early FY98 discussions will be held with the NRC in order to fully understand the regulatory requirements regarding geologic mapping before finalizing a strategy.

## **DRAFT DISCLAIMER**

This contractor document was prepared for the U.S. Department of Energy (DOE), but has not undergone programmatic, policy, or publication review, and is provided for information only. The document provides preliminary information that may change based on new information or analysis, and is not intended for publication or wide distribution; it is a lower level contractor document that may or may not directly contribute to a published DOE report. Although this document has undergone technical reviews at the contractor organization, it has not undergone a DOE policy review. Therefore, the views and opinions of authors expressed do not necessarily state or reflect those of the DOE. However, in the interest of the rapid transfer of information, we are providing this document for your information.





TRW Environmental  
Safety Systems Inc.

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Las Vegas, NV 89134  
702.295.5400

WBS: 1.2.4.7

QA : N/A

CONTRACT #: DE-AC01-91RW00134  
LV.RD.RS.7/97.031

July 30, 1997

Dr. Stephan J. Brocoum  
Assistant Manager for Licensing  
Yucca Mountain Site Characterization Office, MS 523  
U.S. Department of Energy  
P.O. Box 30307  
Las Vegas, NV 89036-0307

Attention: Technical Publications Management

Dear Dr. Brocoum:

Subject: Transmittal of Deliverable "Subsurface Development Design"  
Deliverable RP120M3, WBS 1.2.4.7

Enclosed with this letter are 15 engineering drawings submitted to satisfy the acceptance criteria for the deliverable RP120M3, due to YMSCO on July 31, 1997. The drawings listed below, were developed, reviewed, and approved by the M&O with appropriate participation by YMSCO personnel. These drawings were produced under Summary Account TR47FB5 "Subsurface Development Design."

1. Repository Siting Volume - Plan  
BCA000000-01717-2700-81022 Rev 00
2. Repository Siting Volume - Cross Sections  
BCA000000-01717-2700-81023 Rev 00
3. Subsurface Repository VA Design Layout Plan  
BCAA000000-01717-2700-81024 Rev 00
4. Usable Emplacement Area for 70,000 MTU Plan  
BCAA000000-01717-2700-81025 Rev 00
5. Available Emplacement Expansion Areas w/Geology Lower Block Plan  
BCAA000000-01717-2700-81026 Rev 00
6. Available Emplacement Expansion Areas w/Geology Upper Block Plan  
BCAA000000-01717-2700-81027 Rev 00

7. Drainage Patterns VA Design Layout Plan  
BCAA00000-01717-2700-81028 Rev 00
8. Typical Ramps and Mains Const/Develop Modes Sections  
BCAA00000-01717-2700-81029 Rev 00
9. Typical Ramps and Mains Emplacement Mode Sections  
BCAA00000-01717-2700-81030 Rev 00
10. Emplacement/Development Shafts and Access Drifts Plans, Elevs, Section  
BCAA00000-01717-2700-81031 Rev 00
11. Operational Alcoves and Support Facilities Plans, Elevations, Sects  
BCAA00000-01717-2700-81032 Rev 00
12. 7.62 m TBM Assembly and Disassembly Chambers Plans, Sections  
BCAA00000-01717-2700-81033 Rev 00
13. Performance Confirmation Facilities for VA Design Plan, Section  
BCAA00000-01717-2700-81034 Rev 00
14. Typical Emplacement Drift and Ventilation Raise Sections, Elevations  
BCAA00000-01717-2700-81035 Rev 00
15. Emplacement Drift Turnouts Plans, Sections  
BCAA00000-01717-2700-81036 Rev 00

Six design analyses were also prepared as a part of this workscope. These analyses provided the primary input for the drawings listed above. The analyses are:

1. Determination of Available Volume for Repository Siting  
BCA000000-01717-0200-00007 Rev 00
2. Repository Thermal Loading Management Analysis  
B00000000-01717-0200-00135 Rev 00
3. Subsurface Repository Slopes  
BCAA00000-01717-0200-00007 Rev 00
4. Repository Subsurface Layout Configuration Analysis  
BCA000000-01717-0200-00008 Rev 00
5. Subsurface Construction and Development Schedule Analysis  
BCA000000-01717-0200-00013 Rev 00
6. Subsurface Construction and Development Analysis  
BCA000000-01717-0200-00014 Rev 00

Members of your staff were involved in appropriate reviews of all drawings and analyses listed above as required in the Deliverable Acceptance Criteria. Controlled or Information copies of these documents are available through the Document Control Center. Informal "Information Only" copies may also be obtained by contacting the personnel listed below.

July 30, 1997

Page 3

If you or your staff have any questions regarding these deliverables please contact Dr. Kalyan K. Bhattacharyya, Repository Design Manager, at 295-4414.

Sincerely,



Richard D. Snell, Manager  
Engineering and Integration Operations  
Management & Operating Contractor

Enclosures:

1. YAR for Deliverable RPI20M3
2. Participant Planning Sheet For Deliverable RP120M3
3. Subsurface Development Design (15 Drawings)

cc w/o enclos:

W.E. Barnes, DOE\YMSCO, Las Vegas, NV  
H.A. Benton, M&O, Las Vegas, NV  
V.A. Dulock, M&O, Las Vegas, NV  
L.D. Foust, M&O, Las Vegas, NV  
J.T. Gardiner, DOE\YMSCO, Las Vegas, NV  
J.A. Gonzales, DOE\YMSCO, Las Vegas, NV  
P.G. Harrington, DOE/YMSCO, Las Vegas, NV  
B.D. Rhoads, M&O, Las Vegas, NV  
J.T. Sullivan, DOE\YMSCO, Las Vegas, NV  
B.J. Verna, DOE\YMSCO, Las Vegas, NV  
R.C. Wagner, M&O, Las Vegas  
S.L. Klapproth, M&O, Las Vegas, NV  
K.K. Bhattacharyya, M&O, Las Vegas, NV *KB.*  
D.G. McKenzie, M&O, Las Vegas, NV  
R.S. Saunders, M&O, Las Vegas, NV  
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