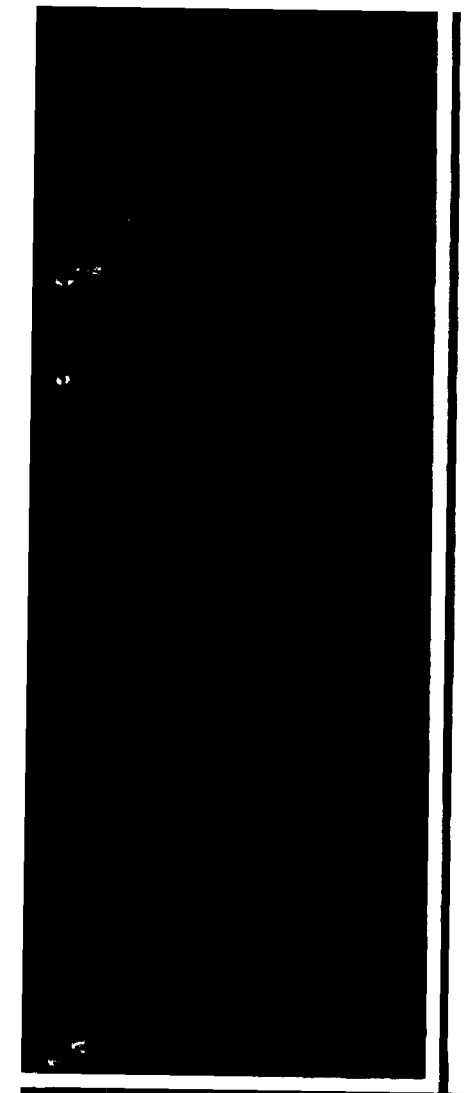
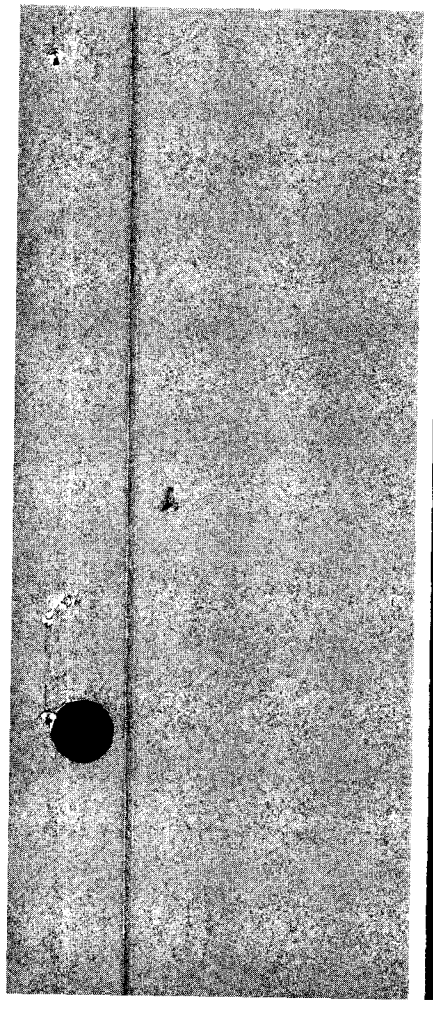


ORNL-TM-4233

PROGRAM PLAN FOR THE DEVELOPMENT OF THE BEDDED SALT PILOT PLANT



OAK RIDGE NATIONAL LABORATORY
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Contract No. W-7405-eng-26

PROGRAM PLAN FOR THE DEVELOPMENT OF THE BEDDED SALT PILOT PLANT

Staff of
Salt Mine Repository Project

OCTOBER 1973

OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37830
operated by
UNION CARBIDE CORPORATION
for the
U. S. ATOMIC ENERGY COMMISSION

PROGRAM PLAN FOR THE DEVELOPMENT OF

THE BEDDED SALT PILOT PLANT

Approved: A. L. Boch
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Date: 9-5-73

Approved: Joseph A. Lenhard
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Date: 9-10-73

Approved: Frank H. Tamm
Atomic Energy Commission - WMT

Date: 9/13/73

PROGRAM PLAN REVISION SHEET

Revision No._____ Initiated by:_____

Revisions:_____ Approved:_____ Date_____
ORNL

_____ Approved:_____ Date_____
AEC-ORO

_____ Approved:_____ Date_____
AEC-HQ

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AEC-ORO

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AEC-HQ

CONTENTS

PROGRAM PLAN FOR THE DEVELOPMENT OF THE BEDDED SALT PILOT PLANT

ABSTRACT

A program leading to the establishment in FY 1983 of a pilot plant for storing radioactive wastes in bedded salt is described. The program consists of laboratory and field investigations of factors affecting the suitability of a specific site in southeastern New Mexico; of more generally applicable problems associated with geohydrology and rock mechanics; and of considerations bearing on the operational safety of a pilot plant repository. Tasks concerned with the engineering development and design of the facility are also included.

PREFACE

The program leading to the establishment in southeastern New Mexico of a pilot plant for storing radioactive wastes in bedded salt is described below. This plan was developed with the direction and guidance of the Engineering Branch of the Division of Waste Management and Transportation, USAEC. It is based on an overall schedule of design and construction that will result in the beneficial occupancy of the pilot plant early in FY 1983. We have included all of the investigative work that we consider necessary at this time to ensure the safety and operability of the pilot plant; however, if at any time during the course of these investigations other areas requiring attention arise, they will be factored into the program plan. It is intended that this plan be kept current by periodic modifications as necessary.

The program plan is divided into four major sections. Section 1 describes the tasks required to evaluate the suitability of the specific site now under consideration for the pilot plant; sect. 2 describes the experimental and developmental work in geohydrology and rock mechanics which is largely site-independent, but nevertheless essential to the general development and operation of a pilot plant; sect. 3 contains those tasks related to the operational safety of the pilot plant; and sect. 4 encompasses the engineering development and design work that is required. Associated with each task description, and often enclosed in parentheses, are the fiscal years during which the task is scheduled to be performed. Each of these sections is followed by a schedule and description of task milestones.

1. SITE SELECTION INVESTIGATIONS

The rock salt deposits of southeastern New Mexico are significantly thicker than any other salt beds in the Permian Basin which underlies some 120,000 square miles of the stable interior portion of the North American Continent. The great vertical and lateral extent of the salt coupled with other favorable geologic and hydrologic conditions make the area a prime location for the Bedded Salt Pilot Plant (BSPP). Based on preliminary geologic and hydrologic investigations, a study area centered on Sections 10 and 11, Township 22S, Range 31E has been identified for further examination and exploration. The pertinent findings of the investigative programs to date, and an outline of the remaining tasks for evaluation of this study area are summarized in this section.

1.1 Seismicity and Tectonics

The self-healing properties of rock salt preclude the breaching of geologic containment of the buried wastes even in violent earthquakes. The susceptibility to damage of subsurface handling facilities, waste charging shafts, etc., favor a repository location in a region of tectonic stability and low seismic risk. Using generalized structural and seismic data that is available for the entire country, it has been determined that the southeastern New Mexico region lies within the central stable region of the North American Continent, and is in a seismic zone of expected minor damage. Furthermore, during historic times no major earthquakes (Modified Mercalli Intensity 5 or greater) have occurred within the New Mexico portion of the Permian Salt Basin. The epicentral locations of all historic earthquakes within 300 km of the study area have been plotted and their occurrences related to the prominent geologic structures of the region. These data corroborate the geologic evidence of quiescence of structures in the region, and verify the active nature of prominent structures that lie outside the central stable region but within 300 km of the area under consideration.

Microearthquake Studies.--Ascertain through microearthquake studies the mode of occurrence (natural or induced) of the recent earthquakes along the Central Basin platform. These studies along with similar investigations of other features may also reinforce the general conclusion of tectonic stability of the area as deduced from geologic studies (FY 74-75).

Design Basis Earthquake.--Based on local and regional seismic and geologic data, establish the design-basis earthquake for the facility (FY 76).

1.2 Erosion and Denudation

In extreme cases the natural geologic processes of erosion and denudation have the potential, over long periods of geologic time, for stripping away significant quantities of overburden and subjecting wastes that are buried at shallow depths to circulating ground and surface waters. Based on knowledge of the recent geomorphic development of the Great Plains' landscape and on the sediment loads of streams that drain the province, it has been established that the rates of denudation and stream incision within the region range up to only a few hundreds of feet per million years.

Localized Erosion and Denudation.--Determine and define the rates and characteristics of past and present-day erosion in the immediate vicinity of the study area to establish the probable nature and extent of erosion during the next few hundred thousand years. In order to explain and illustrate this phenomenon, it will probably be necessary to trace and record locally the recent geomorphic development of the Pecos river (FY 74).

1.3 Potash Ore Reserves and Oil and Gas Potential

Significant quantities of potash ore and extensive deposits of oil and gas occur in selected localities of southeast New Mexico. To preclude conflicts of interest in the economic development of the region, the rocks underlying the study area should preferably have a low potential for oil and gas development and should not contain extensive, high-grade potash

ores. An appraisal of the potash resources in and around the target area utilizing existing core data indicates that some submarginal ore is present, but it is of no value under current economic conditions and has little value in the foreseeable future. Major oil and gas fields have not been discovered in the vicinity of the study area, although some localized accumulations of oil and gas are known to occur. In order to establish a meaningful hydrocarbon potential for the area, data must be obtained on the controlling structural and/or stratigraphic parameters as well as on reservoir engineering characteristics.

Refinement of Potash Reserves.--Supplement and refine the appraisal of potash resources of the study area through analysis of selected portions of the salt-core from a series of exploratory drill holes (FY 74-75).

Oil and Gas Potential Based on Geologic and Engineering Controls.--Assemble and interpret the critical structural and/or stratigraphic data and reservoir engineering parameters that control the accumulations and removal of hydrocarbons in the rocks in the area. Utilizing these and other relevant data, establish the oil and gas potential of the area of interest (FY 74).

1.4 General Geology

Well logs, drill cuttings and rock cores provide the principal means for determining such things as the depths, thicknesses, continuities and interrelationships of the critical strata underground which must be assessed prior to the final selection of a site for the pilot plant. Utilizing the available data from oil and gas test holes, potash-mining drillings, and other pertinent data, generalized structural and stratigraphic sections have been made to illustrate the nature and characteristics of the rock sequences in the study area. In addition, field mapping of the surficial rock deposits in the study area has revealed no instabilities or irregularities in the underlying salt rock and has provided critical data on geomorphic features and near-surface ground-water conditions.

Exploratory Boreholes.--Drill a series of four boreholes near the four corners of the target area. The initial hole will extend to near the base of the Salado formation or to a depth of about 3000 ft, and continuous 3 1/2 in.-diam cores will be obtained for all of the consolidated rock. The three additional holes will be drilled to a depth of about 2000 ft or a short distance below the depth of the projected disposal level. Approximately 150 ft of core will be taken at selected intervals in each of these holes. A suite of geophysical logs including Gamma-neutron, Resistivity, Sonic, and Caliper will be obtained for each of the four holes (FY 74-75).

Detailed Geologic Sections.--Based largely on data from the four exploratory drill holes, construct detailed structural and stratigraphic sections of the rocks at the study area. This information will provide the basis for heat-flow calculations and rock mechanics investigations (FY 74-75).

Lithologic and Mineralogic Analyses of Rock Cores.--Determine and define the rocks and minerals at the stratigraphic level of the projected disposal, utilizing analyses of rock cores taken in the four exploratory boreholes. These investigations will determine precisely the host rock horizon for the waste containers (FY 74-75).

1.5 Hydrology

Since circulating ground water is the principal threat to radioactive wastes placed in the rock salt medium, it is essential to determine the hydrological characteristics of the rocks that lie in close proximity to the salt. General hydrologic studies show that all drainage from the area is to the Pecos river with the target area straddling a minor subsurface drainage divide. The principal water-bearing zones above and immediately below the salt body have been identified but such things as the quantities and rates of flow of the waters in these rocks can only be determined through testing in open boreholes.

Hydraulic Testing in Open Boreholes.--Conduct hydraulic tests in the exploratory boreholes as required, utilizing inflatable packers to isolate discrete aquifers for determinations of their potential heads, transmissivities and conductivities. For the 3000-ft-deep hole, swab and/or injection tests will be made for each of the water zones above the salt while tracejector and pumping tests will be made over the combined water zones to supplement the individual tests and to ascertain that all water zones have been identified. For the 2000-ft-deep holes, only the principal water-bearing zones, such as the Culebra dolomite member, will be tested (FY 74-75).

1.6 Natural Dissolutioning of Rock Salt

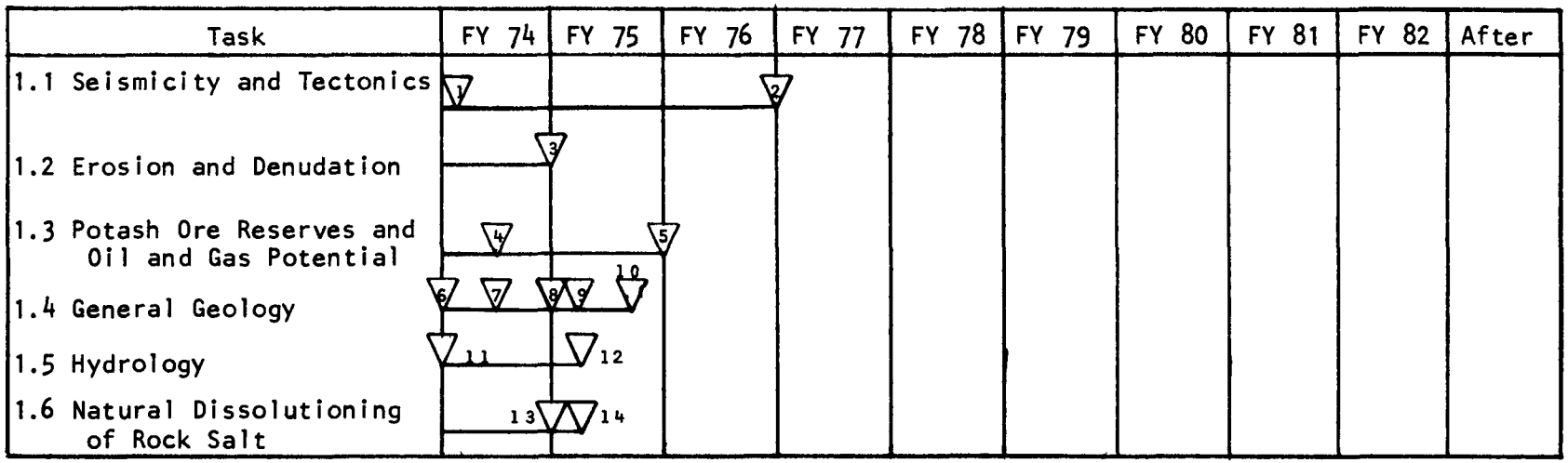
Dissolutioning of salt formations at shallow depths by circulating ground water is a common phenomenon. To ensure the long-term containment of the waste in the salt it is necessary to establish the nature and rates of salt removal within the study area. The rate of retreat of the western edge of the salt, which lies at least 15 miles west of the study area, has been found by two independent investigations to range between 0.8 to 1.6, and 6 to 8 miles per million years. Furthermore, a review of the geologic and hydrologic factors that control the dissolutioning of salt in the subsurface shows that the deeper portions of thick salt beds are essentially immune to dissolutioning for periods of a few hundreds of thousands of years. Finally, preliminary results from a detailed evaluation of the vulnerability of the area to dissolutioning from its western flank suggest that a rational basis exists for predicting future behavior of the salt body since the present and past dissolutioning of the salt has progressed in a pattern that is entirely consistent with the geologic and hydrologic conditions existing within the area.

Incorporation of Core and Hydraulic Data from Exploratory Boreholes.--Examine the cores and logs of the four exploratory boreholes and the hydraulic-tests data for evidence of past or present dissolutioning. (FY 74-75).

Vulnerability of Site to Dissolutioning from its Northern, Eastern and Southern Sides.--Ascertain the vulnerability of the study area to dissolutioning from the northern, eastern and southern sides, which is presently judged to be much less than that from the western flank, through illustrations of the development of any solutional features existing in the salt body and with cognizance of the critical geologic and hydrologic conditions (FY 74).

1.7 SCHEDULE OF TASK MILESTONES

Site Selection Investigations



1 Determine local and regional seismicity

2 Activities of structures and design-basis earthquake established

3 History of landscape development defined

4 Hydrocarbon potential established

5 Local accumulations of ore determined

6 Start Borehole 6

7 Borehole 6 completed; start Borehole 7

8 Borehole 7 completed; start Boreholes 8 & 9

9 Boreholes 8 and 9 completed

10 Geologic section and core analyses completed

11 Hydraulic tests started

12 Hydraulic tests completed

13 Vulnerability of study area to salt erosion ascertained

14 Data from exploratory holes related to local erosion of salt

2. EXPERIMENTAL AND DEVELOPMENT STUDIES

2.1 Dissolutioning of Rock Salt Around Oil and Gas Test Holes

Oil and gas borings can provide the framework for creating subsurface solution cavities, and hence instabilities, in some salt deposits where unique geologic and hydrologic conditions prevail. Some dissolutioning of this type has developed around a few boreholes in the salt beds of Central Kansas. Cursory examinations of these features suggest that significant dissolutioning occurs only in boreholes that have been intentionally maintained free of natural closure or have been improperly plugged. In addition, copious quantities of overlying waters plus extremely permeable and porous formations below the salt appear to be essential prerequisites for this type of dissolutioning. The unique combination of these factors is not believed to exist in the study area. Early results from theoretical studies and laboratory simulations of the dissolutioning process appear to confirm the contention that relatively unobstructed holes must be maintained and that extremely permeable and porous formations exist below the salt body to foster and sustain the phenomenon.

Case Histories of Dissolutioning.--Review and assess all available evidence for salt dissolutioning around boreholes in Central Kansas (five such cases are documented) to define more precisely the geohydrologic conditions fostering this type of subsurface erosion and subsequent subsidence of the overlying rocks (FY 75).

Laboratory and Theoretical Studies.--Pursue the laboratory column and salt block tests to establish more firmly the physiochemical parameters that promote the accumulation of clay, anhydrite and other impurities in boreholes and which disrupt drastically the free flow of salt water and hence dissolutioning in the system. In addition, determine and define the effects of disposal formation characteristics on the dissolutioning process. Finally, define the previously developed mathematical models to calculate more precisely cavity shapes and sizes to describe further the flow parameters in well bores (FY 74-75).

2.2 Occurrence, Control, and Plugging of Boreholes

Since boreholes may serve to connect any or all of the rock formations and any fluids contained therein from the surface to the deepest rock units penetrated, their occurrence and control are of special concern in the development and operation of a pilot plant. Preliminary studies indicate that all drill holes within the area can be identified. An evaluation of existing materials and techniques for plugging boreholes has been initiated as the first phase of investigations leading to the selection of the most appropriate system for permanently sealing these boreholes. In addition, laboratory tests have been started to measure the permeabilities of selected plug materials to determine the effectiveness of cement-mud-rock bonds.

Characteristics of Boreholes.--Assemble all well data pertinent to permanent plugging such as geologic and geophysical logs, cemented casing, oil and gas tests and plugging materials for each of the existing boreholes in the study area. Locate all boreholes in the field (FY 74-75).

Development of Plugging Materials and Techniques.--Complete evaluations of candidate plugging materials and equipment and develop the required techniques and materials for borehole plugging (FY 74-75).

Demonstration of Borehole Plugging.--Demonstrate the effectiveness of plugging materials and procedures through laboratory and field tests. Because of the need to plug borings that penetrate thick and varied stratigraphy sequences containing differing formational fluids, the materials for plugging wells range from hard and durable to soft and plastic substances within a single hole. Thus, the demonstration test must necessarily be conducted in a variety of ways and in a series of holes with surveillance for several years to determine the effectiveness of the various sealants (FY 74-93).

2.3 Identification and Dewatering Characteristics of Hydrated Minerals and Rocks

Small quantities of hydrated minerals occur in most evaporite rock sequences. The conditions (temperatures, pressures, etc.) under which this water is released and/or perhaps recombined is of interest in the timely development and operation of the facility. Initial studies have identified the principal water-bearing minerals in evaporite rock sequences. In addition, analytical techniques have been established for separating and measuring the quantities and characteristics of these water-bearing minerals.

Core Analyses for Hydrated Minerals.--Determine through analyses of core samples the quantities, distributions and dewatering characteristics of the hydrated minerals and rocks at the disposal level in the salt at the study area (FY 74-75).

2.4 Diapirism

The integrity of the salt body should not be impaired by mass movements of salt during the effective lifetime of the wastes. Investigations of the structural characteristics of the Salado salt formation suggest that perceptible flowage has not occurred within it since its formation; however, some localized domal features have been identified within the region that possibly could be attributed to incipient diapirism.

Examination of Domal Features.--Examine through geophysical surveys and field investigations (possibly including shallow-drilling) selected domal features within southeastern New Mexico to ascertain their modes of origin (FY 74-75).

2.5 Deformational Behavior of Rocks

The operation of the pilot plant and especially an actual waste disposal facility will induce certain transient and permanent deformations in the surrounding and overlying rock materials. These deformations produce the gradual convergence and closing of the mine openings which provide the geologic containment of the wastes in an actual disposal

facility. These deformations are the consequence of the plastic behavior of rock salt under the influences of overburden, induced mining and thermal stresses and are accelerated by elevated temperatures which will be imposed on the salt formations. The objective of the programs described in this section is to predict in detail the strains, stresses and displacements which will occur. The consequences of these predicted deformations, especially as they may affect either underground operations or the long-term integrity of the waste containment, will then be evaluated by comparison with actual deformations around existing mining operations in similar conditions. For example, the predicted deformations could be compared with available underground deformation measurements obtained in the deep Saskatchewan potash mines and with available surface subsidence measurements obtained over total extraction areas in the Carlsbad potash district.

Physical Property Measurements.--Several different types of physical property measurements will be undertaken.

(1) Pillar Model Tests.--Fabricate and creep-test model pillars of rock salt from cores of the disposal horizon at the temperatures and pressures to be encountered in the disposal facility. These tests yield input to the semiempirical model analysis and provide the first point of reference comparing the New Mexico salt with the known behavior from other locations (FY 74-75).

(2) Thermal Property Tests.--Using specimen material from the cores, measure thermal properties of salt and other rocks (conductivity, diffusivity, coefficient of thermal expansion, anisotropy) for use in the thermal analysis and rock mechanics analysis programs (FY 74-75).

(3) Deformational Properties.--Using material from the cores, perform laboratory tests to obtain the rock property parameter values needed as input values in the finite-element analysis (FY 74-75).

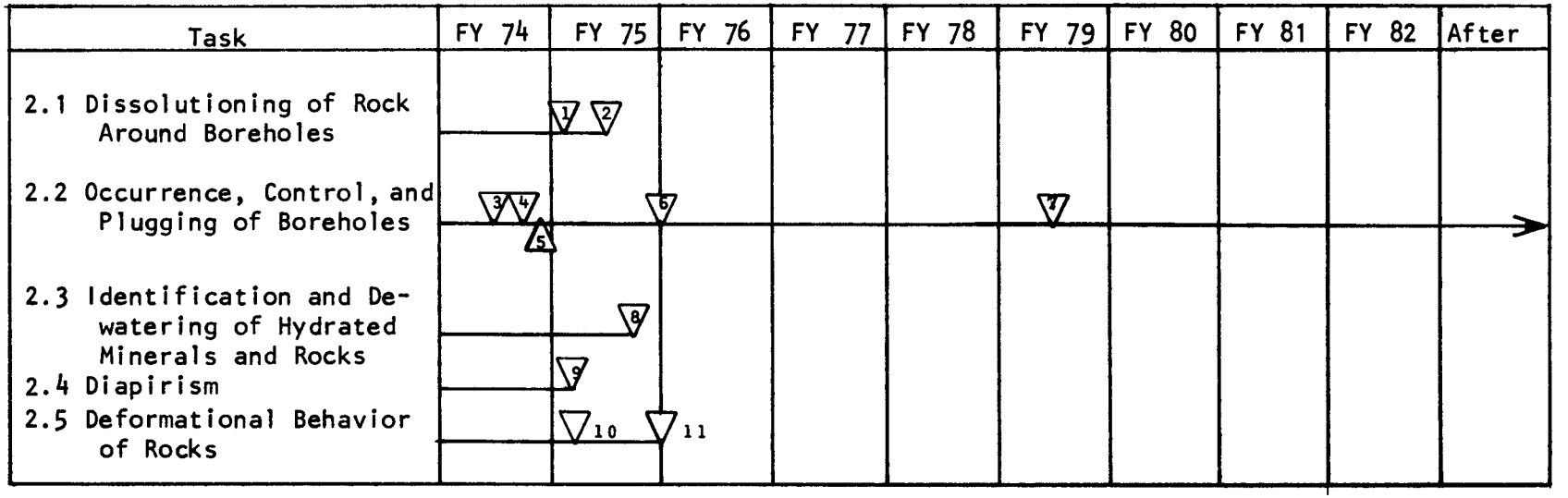
(4) Strength and Failure Properties.--Extend the appropriate tests performed under item 3 above to obtain estimates of the ultimate strengths of the various rock types for use in interpreting the results of the computer model predicted deformations (FY 74-75).

Rock Mechanics Analysis.--Using the semiempirical model of rock deformations, along with three-dimensional space and time referenced operating conditions, calculate the general outline of the deformations throughout the affected section resulting from both pilot plant and repository operations. Using the finite-element model, calculate the detailed stresses, strains and displacements for the various rock types at the critical locations and times determined from the semiempirical model (FY 74-75).

Evaluations.--Evaluate the consequences of the predictions (both underground stability and long-term integrity) by comparison with strength data and comparable field data assembled for this purpose (FY 75).

2.6 SCHEDULE OF TASK MILESTONES

Experimental and Development Studies



1 Laboratory and theoretical investigations completed

2 Case histories reviewed

3 Boreholes located

4 General techniques and materials for plugging established

5 Initial field demonstrations of plugging conducted

6 Preliminary findings reported

7 Specifications established for plugging boreholes

8 Analyses of cores from exploratory holes completed

9 Examination of domal structures completed

10 Measurements of physical and thermal properties of rocks completed

11 Rock deformations using semiempirical and finite-element models calculated and these predicted deformations compared with field data

3. OPERATIONAL SAFETY

The objective of these investigations is the acquisition and analysis of all information that is needed to ensure the safety of pilot-plant operations, both to operating personnel and to the environs. Thus, considering the nature of the wastes, their canisters, and the mine environment into which they are placed, all mechanisms that could lead to the dispersion of radionuclides must be characterized, the consequences evaluated, and appropriate remedial measures developed as necessary.

3.1 Packaging and Acceptance Criteria

Since pilot-plant operations are based on maintaining the wastes in a readily retrievable condition, criteria for the wastes and specifications for the canisters that can be accepted are of special significance to the design of the facility as well as to safety considerations. This task interfaces with similar requirements imposed on industry by the Retrievable Surface Storage Facility (RSSF).

Waste packaging and acceptance criteria which are specific for the pilot plant will be developed, and overall waste acceptance criteria will be reviewed to assure that they do not preclude acceptance of the canisters at any future salt-mine repository (FY 74-75).

3.2 Radiation Effects

The release of energy, stored as crystal defects and lattice displacements in solid materials exposed to radiation, could conceivably result in temperature excursions sufficient to cause melting, and in mechanical fracturing of the salt in the neighborhood of the waste canisters. Experimental investigations of stored energy in salt and the conditions under which it can be annealed showed that only a negligibly few calories per gram can be stored, and that virtually none will be stored in repository salt at temperatures in excess of 150 to 160^{o}C (FY 72-73).

Tests will be made with New Mexico salt to confirm the applicability of existing information to that material (FY 74), and confirmatory data will be acquired during pilot-plant operations (FY 83 and thereafter).

3.3 Thermal Analysis

The transient thermal conditions within and surrounding the pilot plant which will result from the heat generation characteristics of anticipated wastes must be established for use in the evaluation of geophysical and environmental effects, and to ensure safe and economical operation of the facility.

Calculations will be made to help evaluate the suitability of the study area (FY 74); for the design and analysis of in situ experiments (FY 74-76); for use in determining geophysical and environmental effects (FY 74-75); and in the design, operation, and analysis of the pilot-plant verification program (FY 83 and thereafter).

3.4 Ecological Investigations

Information on ecosystem processes and related radionuclide behavior must be developed for the assessment of the fate of either chronic or acute releases of radioactivity from pilot-plant operations.

Information on surface features, soils, and plant-animal communities at the study area will be gathered, and the number of ecosystems and processes that influence radionuclide behavior in the study area will be determined; models will be designed and used to predict the behavior of key radioisotopes in the environment (FY 75). A program will be developed to establish the ecological baseline (FY 76); and the ecological reference baseline will be established prior to the start of construction (FY 79).

3.5 Monitoring

An overall monitoring program for all aspects of pilot-plant operation (except on-site radiological health) must be established. This program will consist of: (a) routine monitoring for radioactivity of the air, soil, and water of the site and its environs; (b) surveillance of off-site and on-site geological (thermal probes), hydrological (well water levels and water chemistry), and geophysical (surface levelings, seismometry) characteristics which bear on geologic containment; and (c) periodic sampling of key biological indicators.

The requirements for a monitoring program will be established and the participants identified in FY 75. Those portions of the overall monitoring program which require several years of baseline data for proper interpretation will be identified, and the collection of those data will be initiated in FY 76. The radiological baseline will be established prior to beneficial occupancy of the site (FY 83).

3.6 Design Confirmation Studies

Two sets of design confirmation experiments are required before operation of a full-scale repository can proceed. Nonradioactive, in situ experiments carried out in an existing mine near the proposed site of the Bedded Salt Pilot Plant are needed to verify those physical, chemical, and thermal characteristics of the salt formation that directly affect the design of the pilot plant; and pilot plant experiments, carried out with actual wastes in a new mine especially excavated for the purpose, are required to confirm the validity of the concept for storing wastes permanently in salt, and of all aspects of the design that bear on the safety of operations.

The in situ experiments will provide preliminary information on hydrogen generation, brine migration, accuracy of the thermal calculations, integrity of waste cans and hole liners, and rock mechanics. The experiments will be designed in FY 73-74, and the experimental facilities will be installed in a mine in FY 75. Data will be accrued principally during FY 76; however, certain phases of this work (e.g., stability tests of candidate sleeve materials and waste cans) may extend through the startup of pilot plant operations in FY 83.

The pilot plant program will procure all possible confirmatory information bearing on the suitability of bedded salt formations for use as a final repository for solidified high-level radioactive wastes. The program will consist of demonstrations and experiments associated with the handling and burial of waste packages; retrieval of the wastes; verification of predicted thermal transients; generation and migration of hydrogen and other noxious gases; migration of the native brine inclusions through the salt; movement of radioisotopes throughout the repository; permeability of the salt formation to the radioactive species in the wastes; and rock mechanics. Experiments will be initiated in FY 83, and the program is expected to have a duration of 5 to 10 years.

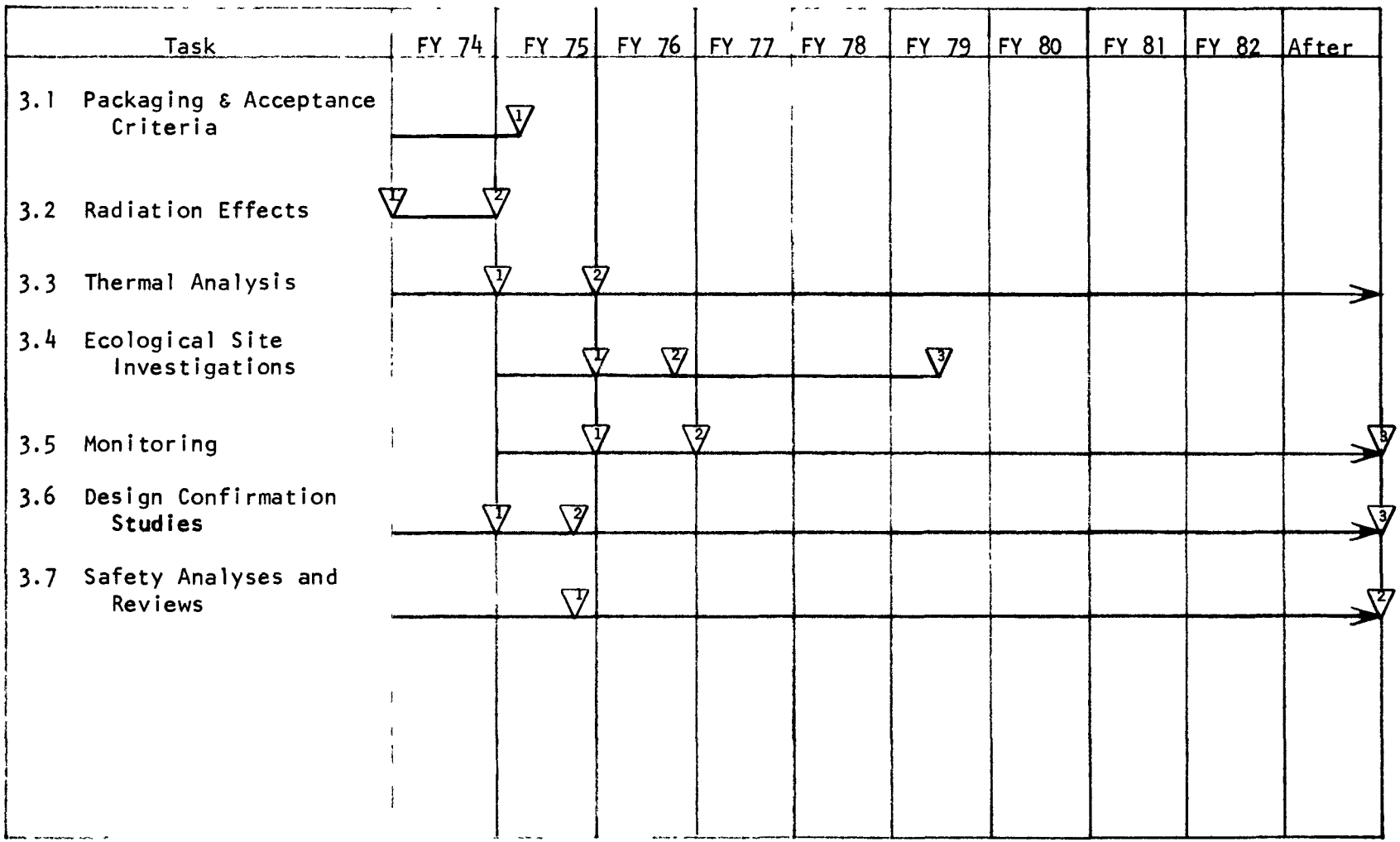
3.7 Safety Analyses and Reviews

A preliminary safety analysis and a draft environmental impact statement must be prepared and subsequently amended as required by on-going reviews and design changes. Pertinent results from all other programmatic tasks will be used as input data for these analyses to arrive at final assessments of operational and long-term safety, and environmental impact.

Drafts of a PSAR and an EIS will be submitted in FY 75, and revised as required in FY 76. Continued analysis and review of long-term geologic containment aspects of the site, the safety of routine operations, the consequences of accidents, and contingency plans will extend through the design and construction phases of the pilot plant, and a final SAR will be issued prior to radioactive operations in FY 83.

3.8 SCHEDULE OF TASK MILESTONES

Operational Safety



Description of Milestones

3.1 Packaging and Acceptance Criteria

1. Final pilot-plant criteria issued

3.2 Radiation Effects

1. Report on energy storage in salt published
2. Energy storage and brine composition of New Mexico salt measured

3.3 Thermal Analysis

1. Complete calculations for suitability of study area
2. Complete calculations for evaluation of geophysical and environmental effects

3.4 Ecological Investigations

1. Ecosystems identified; behavior of key radioisotopes predicted
2. Program to establish ecological baseline developed
3. Ecological baseline established

3.5 Monitoring

1. Future program defined and participants identified
2. Acquisition of long lead-time baseline data started
3. Radiological baseline established

3.6 Design Confirmation Studies

1. In situ experiments designed
2. In situ experiments installed; operations begun
3. Pilot plant experiments begun

3.7 Safety Analyses and Reviews

1. Draft PSAR and EIS submitted
2. SAR issued

4. ENGINEERING DEVELOPMENT AND DESIGN

The objective of these efforts is to provide overall technical direction, planning, evaluation, and coordination of the Bedded Salt Pilot Plant project, including all investigative tasks outlined in this document; to maintain technical direction of the architect-engineer (A-E) during all phases of design and development; to maintain technical liaison with the operating contractor during design, procurement, construction and facility startup; to provide detailed engineering and procurement services for certain specialized facility equipment items; to establish and maintain an overall project schedule for activities funded under both capital and operating; to make arrangements for removal of Government-owned material from the Carey Salt Company mine at Lyons; and to assist the operating contractor during operator training and the demonstrational phase of operations.

To achieve the stated objectives, the following subtasks will be undertaken as indicated.

4.1 Process Design Studies

Studies, initiated with an A-E in FY 73, will be continued in conjunction with pre-Title I conceptual design by an A-E (see 4.2 below). These studies will be concerned with such problems as refinement of the flow diagram for the site-generated waste collection, concentration and solidification system; mechanical handling and storage of solidified site-generated wastes; layout of cask handling and cooling systems in the waste receiving building; development of improved cask-to-cell sealing techniques; and adaptation of existing recanning equipment designs available at other sites and at ORNL to the BSPP transfer cell application (FY 75).

4.2 Facility Design

A conceptual facility design description (CFDD) will be completed which will describe the conceptual design of a pilot plant (FY 74).

Criteria will be provided for the A-E to complete a facility conceptual design under the technical direction of ORNL. Following

completion of the conceptual design, the CFDD will be updated and modified as required and a Schedule 44 construction data sheet will be prepared for FY 77 capital project funding (FY 75).

Technical direction of the A-E will be provided during Titles I and II engineering (FY 77-79) and technical assistance will be provided the A-E and AEC during construction, procurement and inspection (Title III) phase of the project (FY 78-82).

4.3 Liaison with Other Agencies

Contact will be maintained with other agencies whose activities will interface with the BSPP design. In particular, the design of the RSSF will be reviewed periodically to coordinate waste canister and shipping cask acceptance criteria for the two repository facilities. Design assistance to the RSSF project will be provided, particularly in the field of waste canister connection design and testing (FY 74-77).

4.4 Project Schedule

A generalized overall project schedule was prepared in FY 73; this schedule will be updated as required and will be expanded to include all identifiable tasks included in the developmental, design, construction, procurement and operational phases of the program (FY 74-82).

4.5 Carey Salt Company Mine

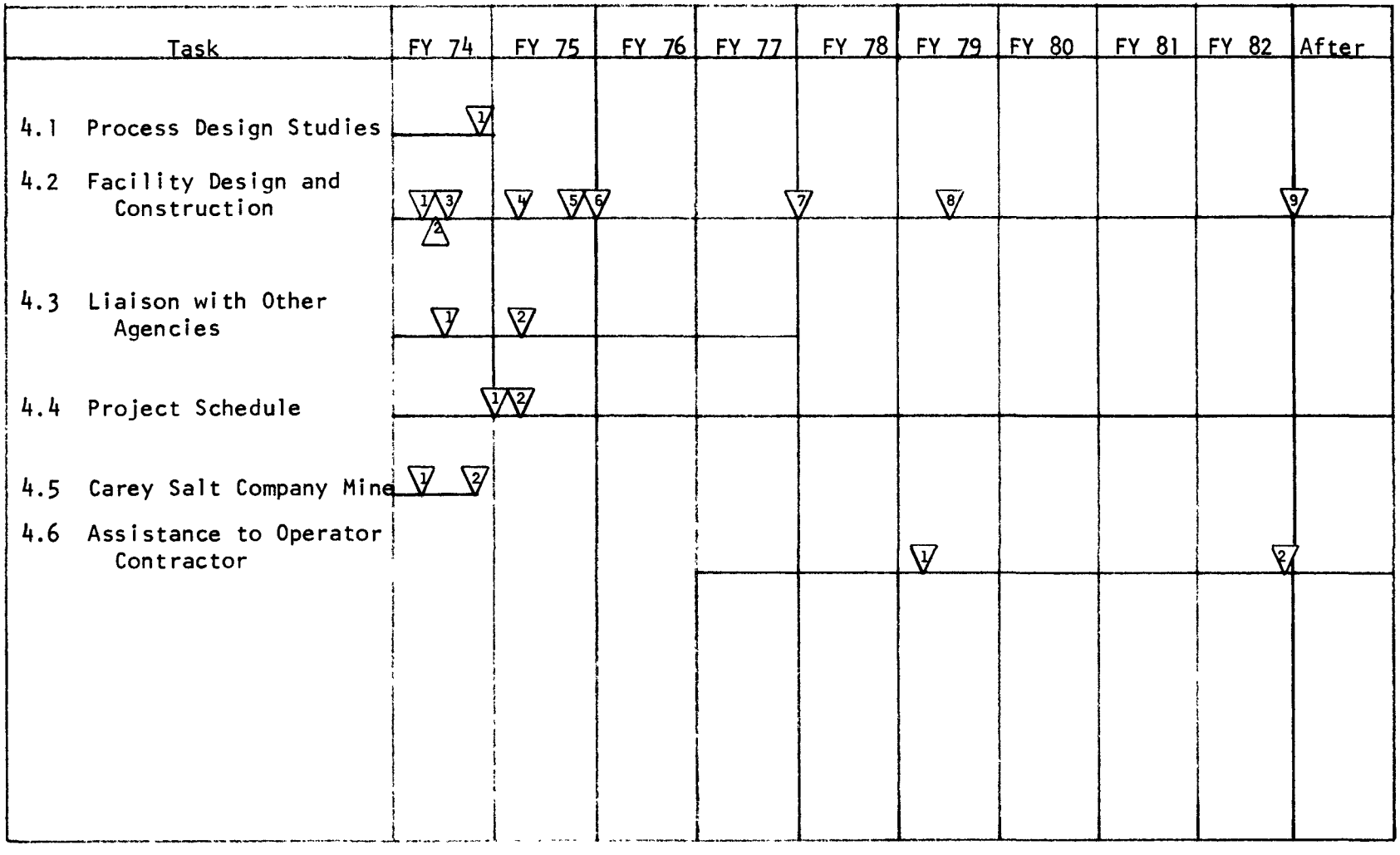
An inventory of all Government-owned equipment remaining in the Cary Salt Company mine at Lyons, Kansas, was conducted in FY 73 and some of the equipment was removed and put into storage at AEC sites. Removal of equipment will be continued, following upgrading of the mine hoist to enable removal of heavy loads, and rental of the mine will be discontinued (FY 73-74).

4.6 Assistance to Operating Contractor

Liaison will be maintained with the BSPP operating contractor during design phases of the project (FY 77-79), and assistance will be given him during preparation of operating and maintenance procedure manuals and during pre-operational testing and startup.

4.7 SCHEDULE OF TASK MILESTONES

Engineering Development and Design



Description of Milestones

4.1 Process Design Studies

1. Study of site-generated waste system, cask handling and cooling systems, cask-to-cell sealing techniques and recanning equipment completed

4.2 Facility Design and Construction

1. Complete draft of CFDD
2. Complete AEC review of draft
3. Issue final CFDD
4. Complete preparation of criteria for A-E
5. Complete conceptual design (A-E)
6. Complete preparation of draft conceptual design report; prepare Schedule 44 construction data sheet
7. Complete Title I engineering (A-E)
8. Complete Title II engineering (A-E)
9. Complete construction (CSC); complete Title III inspection

4.3 Liaison with Other Agencies

1. Complete evaluation of impact of RSSF design on BSPP
2. Complete re-evaluation of RSSF and BSPP designs and waste cask and package interface criteria

4.4 Project Schedule

1. Complete update of generalized project schedule
2. Complete preparation of detailed project schedule

4.5 Carey Salt Company Mine

1. Complete preparations to disassemble, move, and store large equipment
2. Complete large equipment removal and storage; terminate mine contract

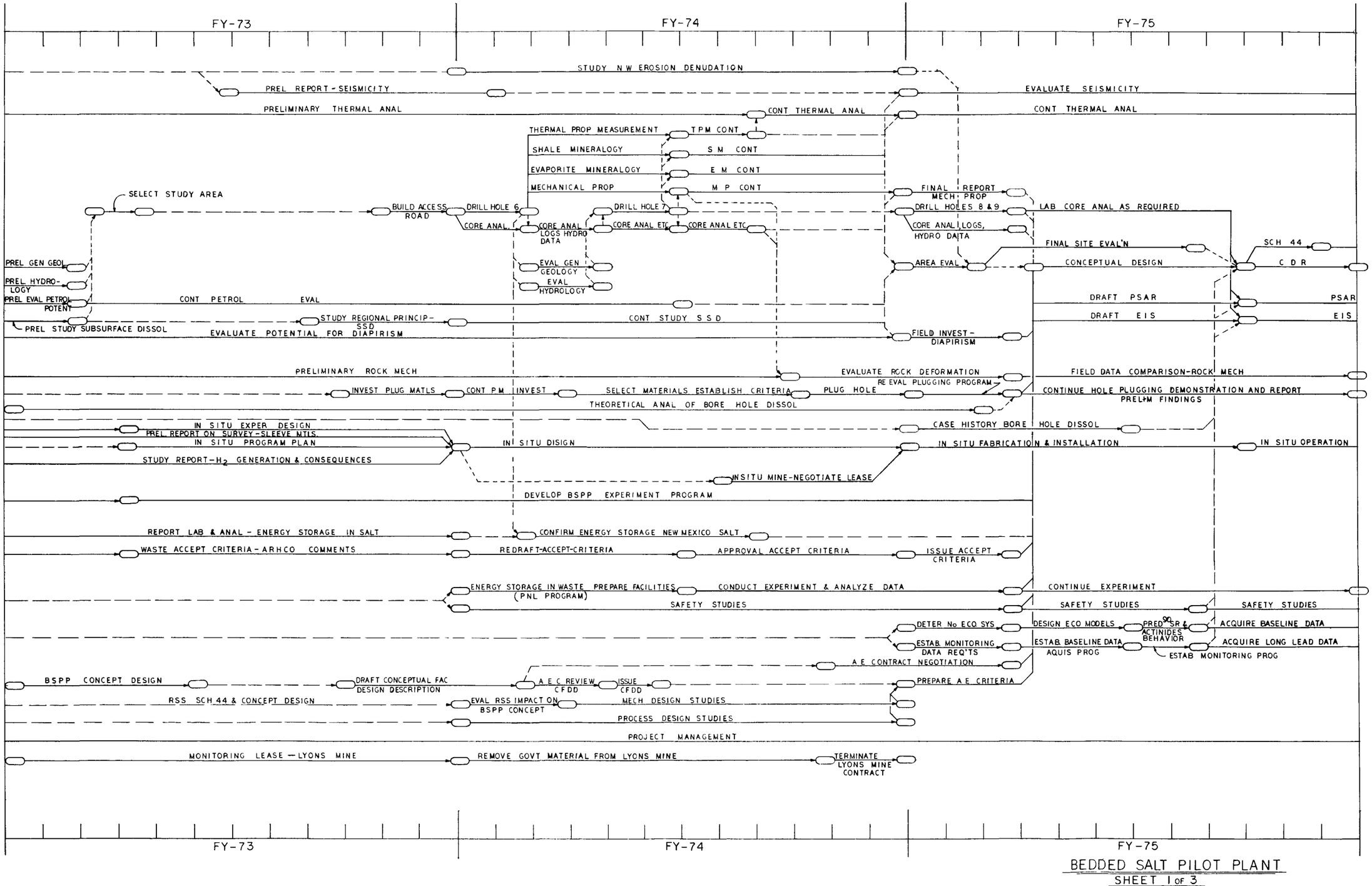
4.6 Assistance to Operating Contractor

1. Complete design liaison with operating contractor
2. Complete assistance in preparation of operating and maintenance manuals

APPENDIX A. Correlation of Site Selection Factors with Program Plan

Site Selection Factors (ORNL-TM-4219)		Program Plan Items to Provide Necessary Information Pertaining to that Factor
1.	GEOLOGIC - STRATIGRAPHIC	
1.1	Thickness of Salt Formation	1.4 General Geology
1.2	Thickness of Salt above Disposal Horizon. . .	1.2 Erosion and Denudation; 1.4 General Geology; 1.6 Natural Dissolutioning of Rock Salt
1.3	Purity of Salt Formation.	1.4 General Geology; 2.3 Identification and Dewatering Characteristics of Hydrated Minerals and Rocks
1.4	Detailed Stratigraphy in Disposal Horizon . .	1.4 General Geology; 2.3 Identification and Dewatering Characteristics of Hydrated Minerals and Rocks
1.5	Detailed Stratigraphy in Mining Horizon . . .	1.4 General Geology; 2.3 Identification and Dewatering Characteristics of Hydrated Minerals and Rocks
1.6	Vertical Isolation of Wastes from Aquifers. .	1.4 General Geology; 1.5 Hydrology; 1.6 Natural Dissolutioning of Rock Salt
1.7	Depth to Disposal Horizon	1.4 General Geology; 1.6 Natural Dissolutioning of Rock Salt
2.	GEOLOGIC - STRUCTURAL	
2.1	Attitude of Salt Formation.	1.4 General Geology
2.2	Incipient Diapirism	2.4 Diapirism; 2.5 Deformational Behavior of Rocks
2.3	Regional Structural Framework	1.1 Seismicity and Tectonics; 2.5 Deformational Behavior of Rocks
2.4	Tectonic Stability.	1.1 Seismicity and Tectonics; 2.5 Deformational Behavior of Rocks
3.	GEOLOGIC - HYDROLOGIC	
3.1	Ground Water.	1.2 Erosion and Denudation; 1.4 General Geology; 1.5 Hydrology; 1.6 Natural Dissolutioning of Rock Salt
3.2	Surface Water	1.5 Hydrology; 1.6 Natural Dissolutioning of Rock Salt
3.3	Horizontal Extent of Salt Deposit	1.2 Erosion and Denudation; 1.4 General Geology; 1.6 Natural Dissolutioning of Rock Salt
4.	GEOLOGIC - MINERAL DEPOSITS	
4.1	Mineral Production History and Potential. . .	1.3 Potash Ore Reserves and Gas Potential
4.2	Mining Operations	1.3 Potash Ore Reserves and Gas Potential; 2.2 Occurrence, Control, and Plugging of Boreholes
4.3	Existing Boreholes.	1.5 Hydrology; 2.1 Dissolutioning of Rock Salt Around Oil and Gas Test Holes; 2.2 Occurrence, Control, and Plugging of Boreholes

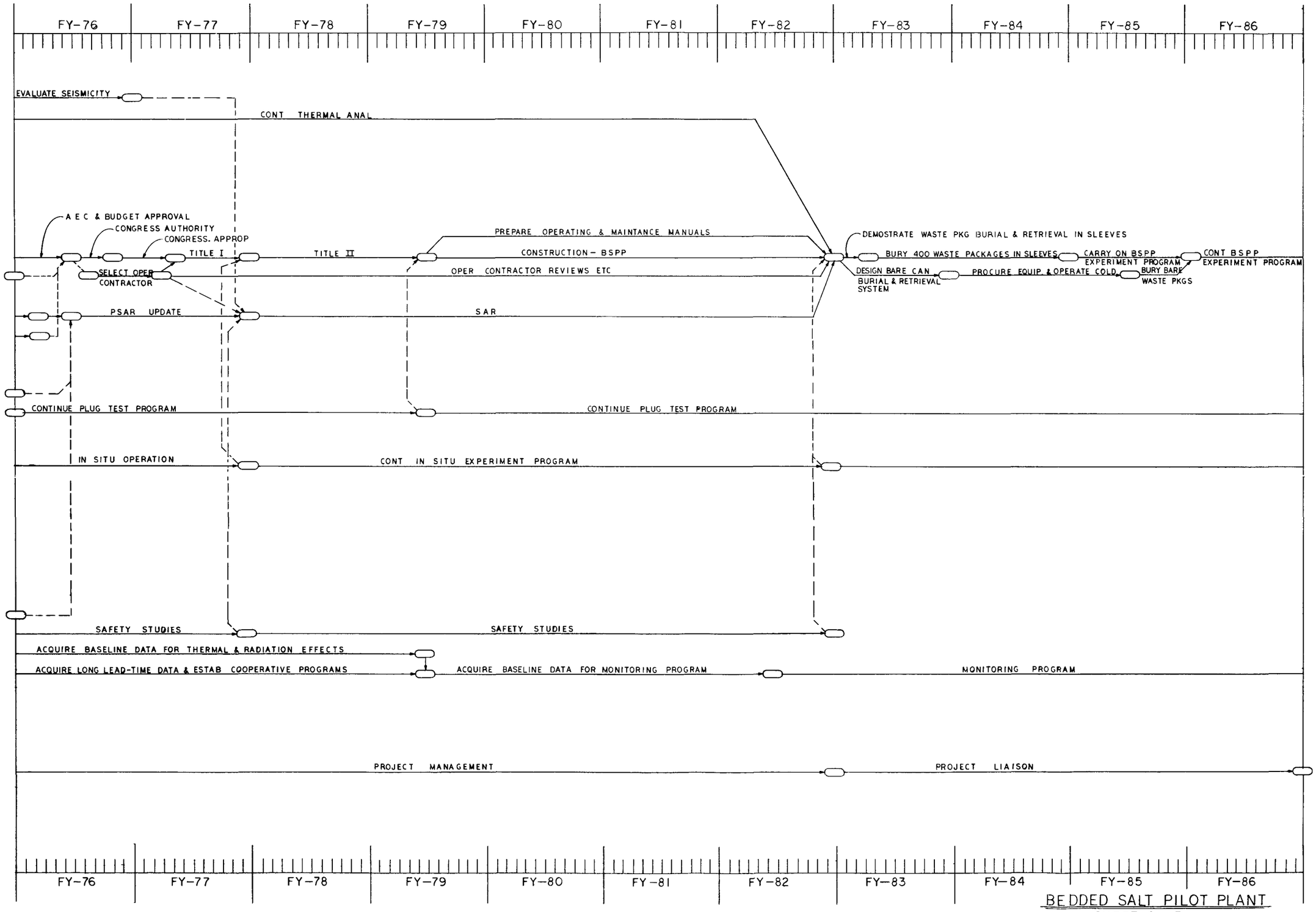
APPENDIX B. PERT Diagram of Program Tasks



BEDDED SALT PILOT PLANT

SHEET 1 OF 3

5-29-73



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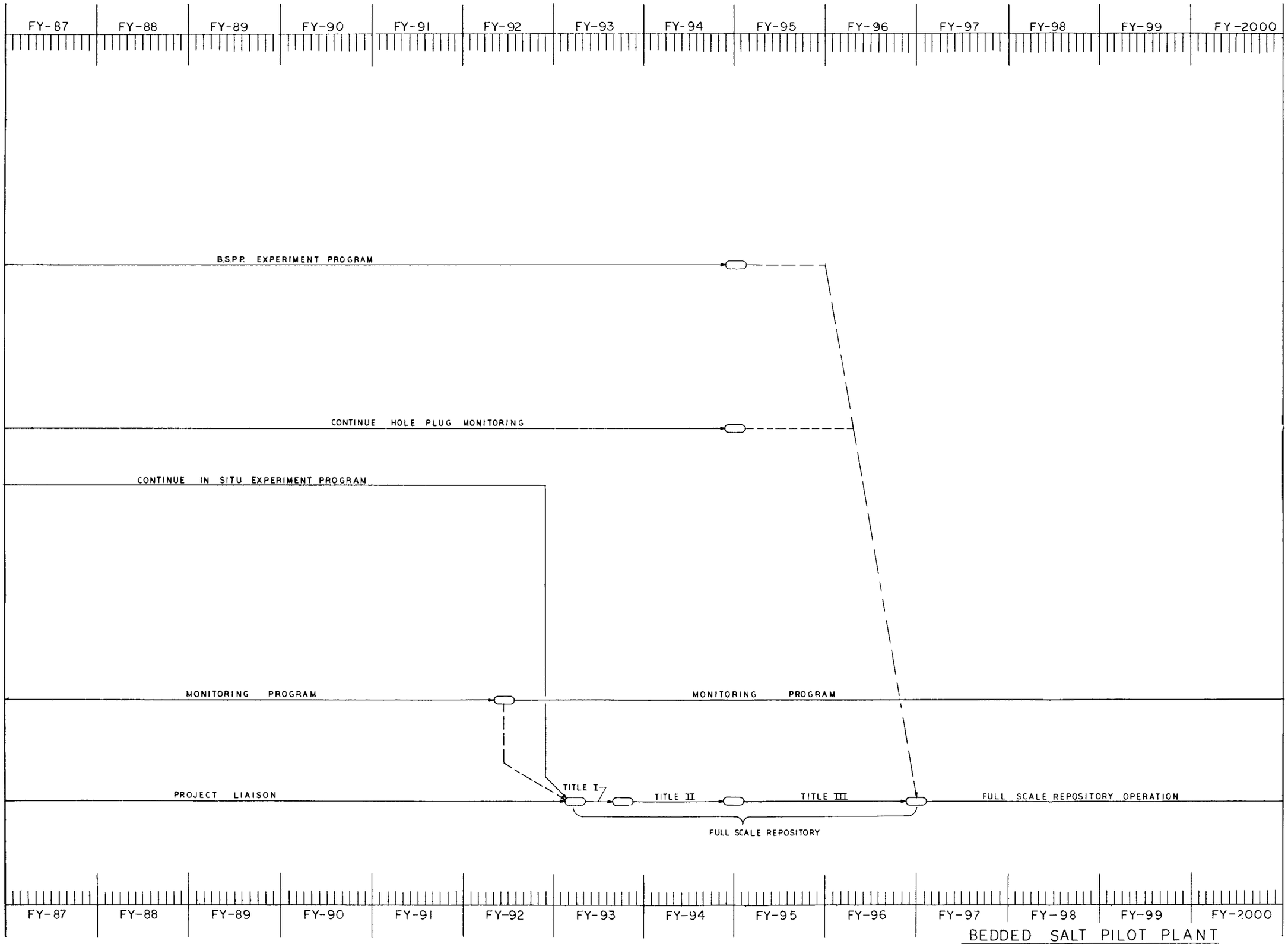
SHEET 2 OF 3

5-29-73



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