AVLIS

Production Plant

Project Management Plan

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AVLIS Production Plant Project Management Plan

MARTIN MARIETTA
Energy Systems

Prepared by the AVLIS Program with major
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PROJECT MANAGEMENT PLAN

1. EXECUTIVE SUMMARY

1.1. INTRODUCTION AND DESCRIPTION OF AVLIS PRODUCTION PLANT PROJECT

This Project Management Plan presents detailed project execution plans. The approach, organization, interfaces, and systems that are used to manage and implement the Atomic Vapor Laser Isotope Separation (AVLIS) Production Plant Project are included. The Project Management Plan will be the basis of a Project Control Manual covering common administrative procedures under which the project will operate. It will also serve as a reference for the management systems and procedures used by subcontractors to fulfill project objectives. This document is one of a series that describes the AVLIS Production Plant. Additional information relevant to the Project Management Plan can be found in the following documents:

APP-020	AVLIS Production Plant	Work Breakdown Structure and Dictionary
APP-030	AVLIS Production Plant	Project Schedule and Milestones
APP-045	AVLIS Production Plant	Preliminary Quality Assurance Plan and Assessment
APP-050	AVLIS Production Plant	Capital Cost Summary
APP-110	AVLIS Production Plant	Operating Cost Summary
PP-040	AVLIS Industrial Access Program	Federal Plan

The purpose of the AVLIS Production Plant is to support the national policy for assuring a continuing supply of enriched uranium that meets the nation's and the free world's needs at the lowest possible cost.

The AVLIS Production Plant will be deployed in two distinct phases. The enrichment capacity for the first increment of production will be approximately 5 million swu/yr. It is anticipated that the plant capacity will be expanded by adding additional equipment and that improvements in the technology will be incorporated in the original equipment to increase the capacity, under fully activated conditions, to between 10 million and 13 million swu/yr. The AVLIS Production Plant will enrich normal assay feed (0.7% assay) to a product assay which can be blended to the utility customer's requirements.

The physical description of the project is as follows. AVLIS Production Plant's main process building contains the separator operations and laser operations areas and primary operational support areas which include the separation and laser refurbishment areas, the instrumentation and controls area, and areas for other general support.

The separator operations area, consisting of about 190,000 ft², houses the six separator modules (initial production increment) and the separator electrical and utility rooms.

The separator refurbishment area is dedicated primarily to routine refurbishing of the separator's internal components. In addition to standard mechanical and electrical shops, this estimated 120,000 ft² area provides space for disassembly stations, oxidation ovens, grit blasters, spray booths, outgassing ovens, and assembly stations for graphite components.

The laser operations area contains 100,000 ft² of floor space and houses all dye laser and copper-vapor laser equipment. The copper-vapor laser, dye laser, and optical components are refurbished in the laser refurbishment area. This area provides space for disassembly, cleaning, assembly, and hot testing of selected components, and also houses the shipping and receiving areas for laser parts. Total floor space in the laser refurbishment area is approximately 75,000 ft².

The remainder of the process building consists of approximately 75,000 ft² for control rooms, shipping, receiving, and uranium storage.

The uranium processing buildings, which are located adjacent to the main process building, include facilities for conversion of uranium hexafluoride (UF₆) to metal, conversion of the uranium metal to an alloy, conversion of

the product metal to UF_6 , blending, recovery of uranium from secondary process streams, and tails storage. The uranium processing activities will be conducted in a nine-building complex. The building area required to support the initial increment of production is approximately 190,000 ft²; however, the facilities will be expanded to a total area of between 370,000 ft and 430,000 ft² to accommodate the fully activated plant. Waste management facilities that are either planned or existing at or near the Oak Ridge Gaseous Diffusion site will be used, with minor modifications, to service the AVLIS Production Plant.

1.2 PROJECT OBJECTIVES

The major purpose of the AVLIS Production Plant Project is to build an AVLIS Production Plant to enrich uranium at costs substantially lower than the costs of enriching uranium in gaseous diffusion and centrifuge plants. The AVLIS Production Plant is to begin production in 1991 and reach full production from initial deployment in 1993. The AVLIS Production Plant Project will be deployed within the site of the Oak Ridge Gaseous Diffusion Plant located at Oak Ridge, Tennessee. The basic project requirement is that the AVLIS Production Plant be designed, constructed, and operated in accordance with applicable federal, state, and local regulations for uranium processing facilities.

The following are key technical requirements for the deployment of the AVLIS process and operation of an AVLIS Production Plant at the Oak Ridge Gaseous Diffusion Plant Site, Oak Ridge, Tennessee. Technical requirements are defined in detail in supporting classified documentation. The AVLIS Primary Criteria are:

- a) Produce UF_6 meeting isotopic and chemical specifications of the nuclear industry.
- b) Produce UF_6 at a rate defined by DOE enrichment enterprise needs.
- c) Meet DOE Oak Ridge natural-phenomena requirements for uranium facilities.

- d) Meet DOE Site Boundary requirements for release of radioactive materials for postulated design basis accidents and normal operation.
- e) Meet all DOE requirements for safeguards and security.
- f) Efficiently recover and recycle uranium scrap.
- g) Dispose of radioactive waste in compliance with DOE requirements.
- h) Implement fire-protection systems that meet DOE and Oak Ridge Site requirements.
- i) Design and construct the AVLIS Production Plant for 25-year life, and accommodate future decommissioning.
- j) Meet "as low as reasonably achievable" requirements for plant personnel.
- k) Ensure that environmental impacts from construction and operation of plant are acceptable.

The Quality/reliability requirements are to:

- a) Achieve the capacity factor required taking into account plant availability, maintenance, and refurbishment. Capacity factor is defined as the actual annual production rate divided by the nameplate annual production rate.
- b) Meet prescribed product specifications.
- c) Provide for the required acceptance and operational tests to be completed prior to AVLIS Production Plant startup. The Readiness Review prior to startup is based on DOE requirements.
- d) Provide plant-reliability database and reliability, availability, maintainability model to identify failure and repair rates and to assess availability impact of operational changes.

1.3. ORGANIZATION AND RESPONSIBILITIES

Design and construction of the AVLIS Production Plant will be accomplished under the direction of the U.S. Department of Energy (DOE), by Martin Marietta Energy Systems, Inc., and Lawrence Livermore National Laboratory (LLNL) working as an integrated team. The team will be assisted by one or more architect/engineers for facility design; a construction manager;

one or more fixed-price contractors for construction; a cost-plus-award-fee contractor for construction; and subcontractors to the operating contractors. Where feasible, procurement and construction will be awarded on the basis of advertised competitive bids.

The Project Management Plan presents the method of organization proposed for accomplishing all activities from conceptual design through operational startup. In addition, responsibilities of principal organizations and managers are described.

When designing the organization, the following key factors or assumptions affected the division of work and management responsibilities.

1. It was assumed that the plant site would be under the jurisdiction of Martin Marietta and the Oak Ridge Operations Office (e.g., Oak Ridge or Paducah).
2. It was recognized that since recent design efforts related to the AVLIS Production Plant have been focused at LLNL (with participation by LLNL, Martin Marietta, and architect/engineers), the body of expertise to give technical direction to the AVLIS Production Plant design lies predominantly with LLNL at the present time.
3. It was recognized that Martin Marietta is experienced in performing all phases of large project deployment and has resident expertise in separator and uranium processing technology.
4. To complete and execute the plant design and subsequent activities as scheduled, a larger project team must become familiar with the knowledge and expertise of the AVLIS engineering database at an early date.
5. Maximum use of the program's trained staff will be made.
6. The plant operations contractor will acquire through on-site training and experienced staff supervision sufficient expertise to operate and maintain the plant.

Therefore, a project organization led by Martin Marietta, but composed of elements of LLNL, Martin Marietta, and supporting contractors is proposed. To accelerate the preparation of a broad design force of the AVLIS Production Plant, the project office will initially be established at LLNL under the direction of the Technology Program Office. After completing the conceptual

design, and upon commencing with the capital project, the office will be transferred to Oak Ridge, where it will be under the project management direction of the Field Project Office.

The project will be organized within the existing DOE structure. Project and program interfaces upon commencement of the capital project are depicted in Fig. 1-1. Principal participants are DOE Headquarters, the DOE Oak Ridge Operations Office, the DOE San Francisco Operations Office, the Technology Program Office, and LLNL and Martin Marietta Operating Contractors.

The AVLIS Technical Program Office at LLNL receives direction from DOE Headquarters and is responsible for the technical management of the overall program. The Technical Program Office will move to Martin Marietta after completion of Title II design. The Contractor Project Organization led by Martin Marietta has the prime responsibility for executing the AVLIS Production Plant Project. The supporting technical efforts will be led by LLNL until the first plant increment is activated; thereafter, Martin Marietta will lead these activities. The memorandum of understanding which specifies these responsibilities is included in Section 1.3.1.

The organization proposed for the AVLIS Production Plant is depicted in Fig. 1-2. After the capital project has been authorized, project management will be under the direction of a project manager from Martin Marietta Energy Systems, Inc. The office will have three deputy project managers: a Deputy Project Manager from LLNL, a Deputy Project Manager for Design from LLNL, and a Deputy Project Manager for Project Operations from Martin Marietta. The project activities will be accomplished using the functional matrix depicted in Fig. 1-3.

Fig. 1-2. Organization of Project for AVLIS Production Plant.

Contractor Project Organization

Project Manager – MMES
 Deputy Project Manager – LLNL
 Deputy Project Manager for Design – LLNL
 Deputy Project Manager for Project Operations – MMES

Key:

A/E = Architect/engineer
 CPAF = Cost-plus-award-fee contractor
 FPC = Fixed-price contractor
 MMES = Martin Marietta Energy Systems, Inc.

Fig. 1-2. Contractor Project Organization for AVLIS Production Plant Project.

Fig. 1-3. Functional Implementation of AVLIS Production Plant

1.3.1 Memorandum of Understanding

The organization and responsibilities described in the previous section are based on the Memorandum of Understanding reproduced below.

MEMORANDUM OF UNDERSTANDING

This Management Agreement is executed by Lawrence Livermore National Laboratory (LLNL) and Martin Marietta Energy Systems, Inc. because of their mutual commitment to serving most effectively the U.S. uranium enrichment enterprise. This agreement summarizes the working philosophy and relationships which will guide the Atomic Vapor Laser Isotope Separation (AVLIS) program direction if AVLIS is selected by the U.S. Department of Energy (DOE) for further demonstration and deployment. The objective and scope of this joint effort is to conduct all AVLIS program activities in a manner that leads to the full realization of its technical and economic potential for low cost enrichment services. To achieve this common objective, the parties pledge to work cooperatively to support government objectives, adhering in good faith to the spirit of the following points.

1. Both LLNL and Martin Marietta Energy Systems, Inc. recognize that production deployment of AVLIS depends upon selection of the AVLIS process and commitment to finance the AVLIS demonstrations and production deployment by the DOE. Therefore, parts of this agreement are dependent upon actions and decisions of the DOE.
2. Prior to the process selection, LLNL and Martin Marietta Energy Systems, Inc. commit to making available resources necessary to assure that the AVLIS process makes the strongest possible case for selection based on technical and economic merit.
3. If AVLIS is selected for further demonstration and deployment under government financing, LLNL and Martin Marietta Energy Systems agree upon the following items concerning organization and responsibilities for AVLIS:
 - a. Both within the two organizations and as an integrated joint program, AVLIS will operate as a single business unit/cost center under the direction of the national program manager. The parties agree, to the extent consistent with their DOE contracts, to enable this business unit to operate as a discrete well-defined entity as regards planning, budgeting, accounting, and costing. Both parties are pledged to stressing cost-effectiveness in the management of their activities and in the acquisition and use of support services.

- b. It is recognized that the AVLIS mission objective will be to deploy AVLIS in a timely manner and in a configuration which best achieves the DOE business objectives. This will require strengths in and coordination among technology, engineering, construction, operations, project management, and economic and business assessment functions.
- c. To achieve mission success in this complex program, overall contractor management of the AVLIS National Program will be via a single, central technical program office (TPO). The TPO will provide technical direction of the entire program through the two principal program components; namely, the AVLIS Production Plant Project and the AVLIS Technology Effort. Within this joint contractor framework, a new project office will be established to lead the AVLIS Production Plant Project and a new office will be established to manage the AVLIS Technology Effort.
 - i. The Technical Program Office will be managed by a senior LLNL manager until Title II design for the AVLIS Production Plant is completed. At that time, the office will be transferred to Oak Ridge, Tennessee, and management will be assumed by a senior manager of Martin Marietta Energy Systems, Inc.
 - ii. The AVLIS Production Plant Project team will be led by MMES. This Project Office will be situated at LLNL through the conceptual design phase and moved to Oak Ridge, Tennessee, during Title I design. Upon DOE's commitment to seek congressional authorization of a line item for an AVLIS Production Plant, the project organization for the plant will be formalized under the management of Martin Marietta Energy Systems, Inc. and will be staffed with a joint organization utilizing the best available resources from LLNL and Martin Marietta Energy Systems, Inc. At this time, Martin Marietta Energy Systems, Inc. will appoint a Vice President whose responsibility will be to direct all AVLIS activities at Martin Marietta Energy Systems, Inc. and who will also assume contractor leadership of the National AVLIS Program upon completion of the Plant Title II design.
 - iii. The AVLIS Technology Effort will be directed by a senior LLNL manager, who will report to the TPO. This effort will consist of an integrated technology team from both LLNL and Energy Systems, Inc. and it will continue under LLNL management through activation of the first increment of AVLIS production capacity.

- d. While overall management of AVLIS will be through the TPO described above, each organization pledges to continue strong efforts in its area of specialization in support of the central mission:
 - i. LLNL will continue an aggressive AVLIS Science and technology program as the principal National Laboratory for AVLIS. Within the LLNL organization, all activities will continue to be consolidated under a single program manager.
 - ii. Martin Marietta Energy Systems, Inc. will provide strong support in the areas of engineering development and demonstration testing, engineering design, systems engineering and integration, and operation. Within Martin Marietta Energy Systems, Inc., all work associated with AVLIS will be consolidated into a single organization.
4. In order to maximize training and technology transfer, Martin Marietta Energy Systems, Inc. personnel will be assigned to Livermore to participate in the startup and operation of the AVLIS Full Scale Demonstration Facility (FSDF). LLNL will operate the FSDF, with assistance from Martin Marietta Energy Systems, Inc., to demonstrate prototypic separation of uranium at production plant conditions. Later, LLNL will provide support as required to Martin Marietta Energy Systems, Inc. through assignment of personnel to the AVLIS Production Plant for operations involved in its startup.
5. Consistent with current DOE guidance, LLNL and Martin Marietta Energy Systems, Inc. are pursuing this project on the basis of Oak Ridge as the production site. The parties mutually endorse and support this choice.
6. If the government decides to privatize AVLIS production, LLNL and Martin Marietta Energy Systems, Inc. will continue to cooperate to effect the best possible privatization arrangement. Martin Marietta Energy Systems, Inc., for its part, would pursue the establishment of an AVLIS enrichment company, retaining collaboration with LLNL.

We feel that this agreement will serve the best interests of the DOE enrichment enterprise.

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Director, Lawrence
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Kenneth Jarmolow
President, Martin Marietta
Energy Systems, Inc.

1.4. WORK PLAN

The work plan describes how the Contractor Project Organization will use the Work Breakdown Structure to accomplish various phases of the project. The various phases of the AVLIS Production Project for delivery of operational hardware and facilities may be generally described as consisting of the following:

- o Preconceptual design
- o Conceptual design
- o Title I design
- o Title II design
- o Procurement and Construction
- o Installation
- o Training and Startup

The above phases of the project are supported by project assessments, the National Environmental Policy Act of 1969, Safety Analysis, Quality Assurance, Safeguards and Security Analysis, by systems engineering, and by project management activities.

The project engineering group will be responsible for maintaining the overall status of the project and for properly disseminating such information as plans, schedules, budgets, estimates, and technical and management control documents. This group will prepare the project reports.

The design and systems engineering include Titles I, II, and III as well as analyses, reliability engineering, criteria verification, test plans, operability and maintainability plans, parts lists, and standardization.

Procurement and construction responsibilities include the acquisition, fabrication, installation, and some activation of the facilities and equipment. Procurement plans are described in the Industrial Access Program (PP020). Quality assurance supports these activities to enhance the success of the deployment.

Training and safety features influence the plant design, but pertain primarily to skills and procedures needed to operate the facility successfully.

The successful completion of this project will require a thorough and effective integration of these activities.

1.5. WORK BREAKDOWN STRUCTURE

The Work Breakdown Structure assists in defining, and graphically displaying the project's deliverable end items and other tasks necessary to meet project objectives. Each contractor using the Contractor Work Breakdown Structure will display, exactly, those end items he is to deliver.

1.6. PROJECT SCHEDULE AND MILESTONES

The deployment strategy for the AVLIS program has been designed to allow the initial production increment to be deployed rapidly. This is a first step in replacing gaseous diffusion with a lower-cost enrichment process. The schedule for the initial increment of production at the first AVLIS Production Plant, as well as for work in progress, is consistent with the following major milestones:

May 1985	AVLIS Process Selection
October 1985	Engineering Initiated
October 1986	Construction Authorization Initiation
October 1988	Special Equipment Installation Initiation
October 1990	Initial Operation/Production Initiated
October 1992	Full Production Capacity Achieved

1.7. COST AND MANPOWER ESTIMATES

Estimates were prepared for capital and operating costs of the AVLIS Production Plant. The disciplined estimating process followed an orderly development by using an expanded Contractor Work Breakdown Structure on the lasers and separators to level six and uranium processing facilities to level five. Estimates for certain key systems were developed to a lower level. A

detailed breakdown of the cost estimate is provided in the AVLIS Production Plant Capital Cost Summary (APP 050).

The capital costs were structured around major cost drivers, i.e., lasers, separators, and other special process equipment such as plant control data acquisition systems, power conditioning systems, and uranium processing. Cost experience from the Laser Demonstration Facility and Separator Demonstration Facility was factored into the estimate through vendor participation. The estimate was prepared by a joint project team consisting of LLNL and Martin Marietta Energy Systems, Inc. with support from Stone & Webster Engineering Corporation, and Bechtel National, Inc.

The manpower estimates were developed by performing a bottoms-up estimate. Experience gained during the development program was combined with reviews of the AVLIS Production Plant Design. The estimate was the product of a task force composed of LLNL and Martin Marietta operations, maintenance, and engineering technical support personnel.

The operating cost estimate was also developed by performing a bottoms-up estimate. The operating estimate was the product of a task force composed of LLNL and Martin Marietta operations, maintenance, engineering, and technical support personnel. Both Stone & Webster Engineering Corporation and Bechtel National, Inc. also participated in the development of the operating estimate. The estimate was again structured around major cost drivers, in this case, operational manpower and material, power, utilities, and uranium processing.

1.8. PERFORMANCE CRITERIA

The performance criteria delineated below are unclassified summaries of the primary criteria for the AVLIS Production Plant project. The success of the project will be measured against this criteria.

The AVLIS Production Plant Project will provide a long-term capability to enrich uranium obtained from various sources. Initial production will

commence in FY91; full production will be achieved in FY93. Selected principal performance criteria are to:

- o Achieve a 25-year design life.
- o Produce enriched uranium at a steady-state annual output meeting DOE requirements in terms of isotope, elemental, and throughput requirements.
- o Process UF_6 feed and produce UF_6 .
- o Optimize plant availability meeting DOE requirements in the Project Charter.
- o Meet federal, state, and local regulations for protection of public safety, environment, and special nuclear material under process.

The systems engineering approach will ensure that the total plant is designed and constructed in an integrated manner. The project will:

- o Achieve project schedule objective of production start in FY91.
- o Develop a cost, schedule, and technical baseline.
- o Control cost, schedule, and scope to that baseline.
- o Achieve project cost objectives within total projected cost and total estimated cost.

1.9. PROJECT MANAGEMENT SYSTEM

The Contractor Project Organization will employ the Project Management System to plan, monitor, control and report AVLIS Production Plant efforts. The AVLIS Production Plant Project will be a Major Systems Acquisition of DOE. Thus, the project will be executed in accordance with the requirements of DOE Order 5700.4A, "Project Management System", and DOE Order 2250.1, "DOE Cost and Schedule Control Systems Criteria for Contractor Performance Measurement".

The objectives of the Project Management System are to:

- o Furnish a formalized planning and controlling system that integrates the work performed by project participants.
- o Provide a formal plan for execution of the contract within the established Contract Work Breakdown Structure.
- o Monitor and measure cost and schedule performance against that plan.
- o Furnish a means of analyzing the effect of variations from that plan, forecast their impact, recommend corrective action, and modify the plan.
- o Provide a database that will hold all pertinent data and can be accessed by DOE.

AVLIS Production Plant Project Management System components will be integrated with the Work Breakdown Structure, the organizational structure, and with each other. The common basis of integration will be the Work Breakdown Structure element-coding identity, which ties together schedules, budget, costs, and organization.

The AVLIS Production Plant Project Management System will apply the concept of feedback control in which a plan is established, performance is measured against the plan, and action is taken when plan and performance diverge significantly. Planning consists of:

- o Defining the work to be performed (Work Definition - Work Breakdown Structure).
- o Establishing a documented technical baseline defining the project configuration.
- o Dividing the work into manageable units and assigning it to performing organizations (work logic definition).
- o Establishing a schedule for performance of assigned work (schedule control).
- o Budgeting and allocating the resources necessary for accomplishing the work (cost control, funds management).

Performance is measured against schedules and budgets, and technical adequacy is ensured. These measurements are analyzed and reported for

management action (analysis and data utilization). Management actions are taken as necessary to bring the plan and performance into convergence, thus completing the feedback control loop.

1.10. INFORMATION AND REPORTING

The AVLIS Production Plant Project will provide formal and uniform systems and procedures for obtaining, documenting, disseminating, and controlling technical and programmatic project data and information. The AVLIS Production Plant Project Control Manual will establish detailed guidelines for implementation of project activities using correspondence, reporting, meetings and documentation.

Project documentation is defined in terms of three categories: administrative, programmatic, and technical. Administrative documents are those that establish or apply the plans, policies, and procedures to be used on the project. Programmatic documents govern the baselines scope, schedule, and budget in an integrated approach. The baseline data contained in this document will be under project-change control, along with criteria and interface data. Key technical documents of the project will provide the criteria, requirements, design, specification, analyses, operating parameters, and as-built condition needed to ensure successful project completion. These documents will form the basis of quality records to be maintained on the project.

Progress and performance on the AVLIS Production Plant Project will be reported periodically. Project reports defined below will communicate performance information required for the Contractor Project Office and DOE to effectively manage the cost, schedule, and technical aspects of the project.

The Contractor Project Office will prepare the Project Monthly Status Report that provides a concise assessment of the status of the project. It will be prepared and submitted monthly to DOE Management for monitoring and identifying of potential problem areas.

The report will address technical accomplishments, variations from established baselines and/or changes in technical approach, anticipated problems and proposed action(s) for their resolution, and a personal

assessment of the current situation by the Project Manager. Open items requiring action by the contractors and DOE will also be addressed. The AVLIS Production Plant Project Monthly Status Report will be supplemented with the following reports:

- o Milestone Schedule and Status Report
- o Cost Performance Report
- o Project Funds Status Report

Formal project review meetings will be conducted on a regular schedule, with the meeting participants may vary depending on the type and agenda of the meeting. Monthly and quarterly progress review meetings with established agendas will also be routinely held.

1.11. SUMMARY OF SECTIONS

This section contains a description of the general content of this document along with a description of how the document is organized. Each succeeding section will also be described.

1.11.1. Description of Section 2 (Introduction and Description of AVLIS Production Plant)

Section 2 provides an overview of the document and describes the features of the AVLIS Production Plant Project.

The key features of the project are described in order to acquaint the reader with the scope of the program and to establish a basis and perspective for subsequent sections. Also described is the integration of the proposed facility into DOE's enrichment program. This description includes 1) a discussion of the design capacity of the plant in terms of separative work units and product output, 2) a summary description of the proposed operations, and 3) a summary of the overall process. This section also contains a description of the facilities and major process systems. The descriptions

cover laser and separator systems, the refurbishment facility for these systems, uranium conversion facilities, and plant utilities.

1.11.2. Description of Section 3 (Project Objectives)

Described in this section are requirements of the project which pertain to technical quality, reliability, and economic factors. Objectives of the project with respect to cost and schedule are included.

1.11.3. Description of Section 4 (Organization and Responsibilities)

This section describes the organizations that will be used to design, build, and operate the facility. Each of the key participants that will be used to design, build and operate the facility are addressed, and specific responsibilities and interfaces for each of the principal participants are identified. This section describes overall organization of the Contractor Project Organization, the functions that will be performed by each of the key program participants, and the responsibilities and relationships assigned various positions in the organization.

1.11.4. Description of Section 5 (Work Plan)

Using the organization presented in section 4, the strategy that will be used to manage the design, procurement, construction and startup of the AVLIS Production Plant is discussed. Also described are supporting functions required to perform project assessments and systems engineering. This section also includes a discussion of the work assignments envisioned for the project.

1.11.5. Description of Section 6 (Work Breakdown Structure)

This section describes the Work Breakdown Structure developed as a planning tool and as a basis for the AVLIS Production Plant design-and cost-estimate documents.

1.11.6. Description of Section 7 (Project Schedule and Milestones)

This section describes the overall deployment strategy and how the AVLIS Production Plant schedule supports that strategy. The AVLIS Production Plant Project Master Schedule is presented.

1.11.7. Description of Section 8 (Cost)

This section contains summaries of capital and operating cost estimates for the AVLIS Production Plant.

1.11.8. Description of Section 9 (Performance Criteria)

This section contains the criteria by which performance of the project is measured.

1.11.9. Description of Section 10 (Management System)

Section 10 describes methods that will be used to carry out the management systems for planning, monitoring, and reporting the AVLIS Production Plant efforts. This material includes the Project Management Control System, the plan for schedule management, the plan for configuration management, and the methods that will be used to measure performance. The system described conforms to DOE Order 5700.4A for a Major System Acquisition Construction Project.

1.11.10. Description of Section 11 (Information and Reporting)

This section describes the systems and procedures used for obtaining, documenting, disseminating, and controlling administrative, technical, and programmatic data and information of the project.

2. INTRODUCTION AND DESCRIPTION OF AVLIS PRODUCTION PLANT PROJECT

2.1. OVERVIEW

This document sets forth the plans, management approach, organization, interfaces, and systems that will be used to manage and implement the AVLIS Production Plant Project. This plan also addresses the activities of the AVLIS Base Technology Program as they interact with the AVLIS Production Plant Project. The Project Management Plan represents the detailed Project baseline and execution document. The Project Management Plan will be the basis of the Project Control Manual covering the common administrative procedures under which Martin Marietta Energy Systems, Inc., LLNL, and subcontractors will operate. The Project Control Manual will serve as a reference for the management systems and procedures to be used by contractors and subcontractors to fulfill project objectives. The Project Management Plan is a controlled-issue document and shall be kept current with an annual review by the management organization to include incorporation of all approved changes during the year.* This Plan is based on Major Systems Acquisitions requirements set forth in DOE Order 5700.4A.

In the context of this Project Management Plan, the AVLIS Production Plant Project represents the total scope of work to be performed, and the term "AVLIS Production Plant" represents the facilities and processes to be provided. The following defines the AVLIS Production Plant Facilities and those existing facilities at Oak Ridge which will support it:

- o AVLIS Production Plant
 - Laser System
 - Separator System
 - Uranium Processing Facilities

* When new cost/schedule baselines are approved, they will become a part of the project cost/schedule control system database immediately and will be entered in this document.

- o Supporting Facilities
 - Toll Enrichment Facility at K-25 site
 - Waste Management Facilities at DOE Oak Ridge site
 - General Offices and Facilities at K-25 site

2.2 PROJECT DESCRIPTION

The purpose of the AVLIS Production Plant is to provide uranium enrichment at substantially lower cost than is currently available. This will enable DOE to assure a continuing supply of enriched uranium for the nation's and the free world's needs at a competitive price.

The AVLIS Production Plant deployment strategy provides that the initial increment of deployment will be rapidly deployed to displace the Gaseous Diffusion Plant with minimum technical risk. The enrichment capacity for the first increment of production will be approximately 5 million swu/yr. It is anticipated that the plant will be expanded and that improvements in the technology will be incorporated into the plant to increase the capacity, under fully activated conditions, to between 10 million and 13 million swu/yr.

Following is a description of the AVLIS Production Plant pre-conceptual design.

2.2.1. Summary Description

This section contains an overview of the AVLIS Production Plant criteria, enrichment performance, process flow, separator/laser architecture, primary special facility hardware, and equipment layouts. Summary process parameters for the initial increment of production and the fully activated plant are presented.

The artist's concept (Fig. 2-1) of the AVLIS Production Plant highlights the primary special equipment in the process building. The process building is divided into two operational areas: the separator and laser operation areas. The initial increment of production will contain six separator

Fig. 2-1. Artist's conception of the AVLIS Production Plant.

modules and three laser power amplifier modules with one laser waveform generator/booster amplifier module. Primary operational support areas include the separator and laser refurbishment area, instrumentation and controls areas, and an area for general support.

The AVLIS Production Plant enriches normal assay feed (0.7% assay) to a product assay which can be blended to the utility customer's requirements. Further, operational adjustments combined with minor cell geometry changes can cause the product assay to vary as necessary to satisfy enrichment mission requirements. The AVLIS Production Plant uranium stream and the associated uranium processing facilities are being designed to be consistent with the criterion of uranium hexafluoride into and out of the plant. This criterion requires Feed Conversion and Preparation Facilities, a Product Conversion Facility, and several related support facilities.

2.2.2. AVLIS Production Plant--Design Criteria

The design criteria for the AVLIS Production Plant accommodates the strategy for deployment of the initial production increment. However, cash flow constraints together with the desire for a rapid deployment limit the first production increment to approximately 5 million swu/yr. Longer term enrichment sales requirements will be met by plant capacity expansion to approximately 10-13 million swu/yr. The initial plant increment will be constructed to accept additional equipment and incorporate technology improvements of the process hardware that are continuing to occur in the AVLIS program.

Experience acquired from the Full-Scale Demonstration Facility will be used extensively in designing plant equipment. This approach permits utilizing design criteria for the conventional facilities based on operating experience, special equipment designs that are based on operating hardware, and special equipment procurement on a unit subsystem basis from an experienced industrial base.

The overall AVLIS Production Plant design criteria are summarized in Table 2.1. These criteria accommodate technological progress leading to performance improvements in the separator, including increased vapor density; lower cost refurbishment; improved vaporizer performance and extended operating times, as well as improvements in the laser systems, including increased power from the copper laser; improved dye laser conversion efficiency; and extended operating times.

2.2.3. AVLIS Production Plant--Enrichment Performance

Using normal assay uranium feed material (0.7% assay) the AVLIS Production Plant generates enriched product. The tails are stripped to approximately 0.2% assay. To meet the Process Selection Criteria, a blend stream of natural feed material (0.7% assay) is combined with the product stream to produce approximately one million kg/yr of product blended to 3.2% assay for the initial increment of production. For the fully activated plant, the production rate will be approximately 2 to 2.5 million kg/yr blended to 3.2% assay. This product blending over a range of assays provides flexibility in meeting enrichment customer assay specifications. The enrichment streams are summarized in Fig. 2-2.

2.2.4. AVLIS Production Plant Uranium Streams

The AVLIS Production Plant uranium streams and the associated uranium processing facilities are consistent with the criterion of uranium hexafluoride into and out of the AVLIS plant. This criterion requires that UF_6 be converted to uranium metal, fed into the separator and enriched to product assays, the product alloy and mixed assay uranium oxides converted to UF_6 product, and the UF_6 product blended to the customer's assay specification. The uranium streams for the AVLIS plant are discussed in Fig. 2-3.

- Pod refurbishment stream is approximately 10% of the product stream

Fig. 2-2. AVLIS Production Plant-enrichment streams.

Fig. 2-3. AVLIS Production Plant-uranium streams.

Table 2-1. AVLIS Production Plant - design criteria.

-
- o Initial production increment based on FY84 Reference Design (UCID-20097)
 - o Plant designed to accommodate rapid capacity expansion
 - Operations area will accept additional modules
 - Special equipment will support FY84 Reference Design and future production expansion
 - Refurbishment utilization factors 50% for initial increment
 - Sitting location selected to allow plant expansion
 - o Production capability:

Initial Increment	Fully Activated
5M swu/yr	10 to 13M swu/yr
1 M kg U/y (3.2%)	2 to 2.6 M kg U/yr (3.2%)
 - o Plant special equipment designs to rely extensively on designs for the full-scale demonstration facility
 - o Feed and product; accepted and provided as UF₆
 - o Initial production increment to be rapidly deployed
-

Feed cylinders containing natural assay UF_6 are received, sampled and certified at the existing K-1423 toll facility. The cylinders containing UF_6 are then transferred to the Feed Facility where UF_6 is vaporized and fed to the Feed Conversion Facility. The Feed Conversion Facility converts the UF_6 to uranium metal in the form of derbies. Formation of these derbies involves two processes 1) hydrogen reduction of UF_6 to UF_4 and 2) magnesium reduction of UF_4 to metallic uranium. Following the magnesium reduction process the derbies are sent to the Feed Preparation Facility where they are converted to an alloy in an induction furnace. The alloy is then cast into a form that can easily be introduced into the separator module.

The Product Conversion Facility receives enriched uranium alloy billets and mixed assay uranium oxide from separator refurbishment. The uranium in each stream is converted to UF_6 , purified, and then blended to the 3.2% assay product.

2.2.5. Separator/Laser Architecture

The AVLIS Production Plant is constructed from uranium separator modules and laser electro-optic modules which are also constructed from modular subsystems. The baseline design for the initial increment of production, 5 million swu/yr, will contain six separator modules (space for eight), three laser power-amplifier modules (space for four) and one laser waveform generator/booster amplifier module as shown in Fig. 2-4. For the fully activated plant, at 10 to 13 million swu/yr, the full eight separations and four power amplifier modules will be used.

Enrichment, the primary plant mission, takes place in each of the six separator modules. Each separator subsystem is comprised of a separator vessel, material feed systems, extractor systems, material withdrawal systems, and a set of folding optics. Uranium enrichment is accomplished in the separator modules, one of which is illustrated in Fig. 2-5. Uranium metal alloy billets are fed into the module where the billets are melted and vaporized by an electron beam as is common in industrial metal refining and plating. The metal vapor then streams up through an extractor structure. In

Fig. 2-4. AVLIS Production Plant-separator/laser architecture.

AVLIS separator module

**6 separator modules
(initial deployment)**

**3 power amplifier modules &
1 WFG/booster amplifier module
(initial deployment)**

Fig. 2-5. AVLIS Production Plant-process building primary special equipment/systems.

the extractor laser, light containing colors (frequencies) precisely tuned to the absorption frequencies of the ^{235}U atoms in the vapor is shined through the vapor stream. The ^{235}U atoms absorb the laser light which causes them to eject an electron and become positively charged. These ions are drawn from the vapor streams onto the oppositely charged extractor plates. The ^{238}U absorption pattern does not match the laser frequency pattern, and the ^{238}U passes through the extractor without effect to be condensed as liquid on the tails collector above.

The precisely tuned laser frequencies are generated and amplified in dye lasers. The dyes absorb light from a pump light-source and convert the pump light to the characteristic color of the dye. This beam is then increased in power when directed into a sequence of dye laser amplifiers, this combination forming a master-oscillator/power-amplifier chain. The pump light to drive the dye lasers is generated by a second laser system which uses copper vapor lasers also arranged in master-oscillator power amplifiers chains.

The laser system is grouped into modules comprised of a large number of copper-vapor/laser master-oscillator-power amplifiers which pump the several dye laser master-oscillator-power amplifiers. A single laser system module will drive two separator modules.

Both the separator and laser module subsystems are being phototyped, integrated, and operated in the Full-Scale Demonstration Facility. This system will be partially constructed and begin operation in FY85. The first full scale enrichment runs will occur at the end of FY86 or in FY87.

2.2.6. AVLIS Production Plant--Functional Layout

The AVLIS Production Plant main process building consists of separator and laser operations areas, separation and laser refurbishment areas, the instrumentation and controls area, and areas for other general support. A functional equipment layout is provided as Fig. 2-6.

The conventional facilities accommodate the FY84 reference design equipment and systems as well as anticipated improvements to be incorporated in the upgraded facility.

Fig. 2-6. AVLIS Production Plant-functional layout.

The separator operations-area, consisting of about 190,000 ft², houses the eight separator modules (six initial plus two added later) and the separator electrical and utility rooms. The electrical area houses the tetrodes and filament power supplies for the module vaporizer system. The separator area provides ample aisle space for the insertion and removal of separator internal components using floor-based handling equipment. Concrete bases are provided for vibrational isolation of separator optics. The utilities distribution, power supplies, and local controls are located in a basement area directly under the separator operations area. Adequate space is provided for two additional (future) separator modules that are required for the fully activated plant.

The separator refurbishment area is dedicated primarily to the routine refurbishing and maintenance of separator internal components. In addition to standard mechanical and electrical shops, this estimated 120,000 ft² area provides space for disassembly stations, oxidation ovens, grit blasters, spray booths, outgassing ovens, and assembly stations for graphite components. Space is provided for test stations that perform a final checkout for separator internals prior to being returned to the process floor.

The laser operations area contains 100,000 ft² of floor space and houses all dye laser and copper-vapor laser equipment. The dye laser operations area provides vertical mount surface for the dye amplifier chains in a two-floor arrangement. Separate corridor areas are provided for each laser power-amplifier module and the respective dye laser systems. The copper laser operations area is a two-story arrangement, with copper lasers stacked three high on each floor. The copper laser mounting structures are located adjacent to the dye corridors and are arranged to permit copper laser power that pumps the waveform generator, the booster amplifier module, and the individual power amplifier modules to be located adjacent to the associated dye systems. Adequate building area is provided for a future power-amplifier module that will supply power for separator modules 7 and 8. Each laser power amplifier module provides adequate laser power for two separators.

As with separator components, the laser equipment must be serviced and maintained on a routine basis. The laser refurbishment area serves this function for copper-vapor laser, dye laser, and optical components. It

provides space for disassembly, cleaning, assembly, and hot testing of select components. This area also houses the shipping and receiving areas for laser parts. Total floor space in the laser refurbishment area is an estimated 75,000 ft².

The remainder of the process building consists of approximately 75,000 ft² for control rooms, shipping, receiving, and uranium storage. Heating, ventilating, and air conditioning equipment as well as the corridor system for power and utility distribution are incorporated.

2.3. SUPPORT FACILITIES IN OAK RIDGE

The AVLIS Production Plant will be supported by a number of existing facilities at the K-25 site in Oak Ridge, Tennessee. The following facilities, therefore, are not to be provided by the project, although some modifications in them may be required.

Site Improvements

- Rail connections
- Parking lots
- Perimeter security surveillance system
- Environmental monitoring equipment

Structures and Laboratories

- AVLIS division development facilities (Bldg. K-1037)
- Medical facilities
- Health physics facilities
- Training and safety facilities
- Laundry
- Cafeteria
- Administrative support offices

- Microwave communication facilities
- Maintenance shop
- Firehall with fire equipment and ambulance
- Materials warehouses
- Uranium receiving, storage, and shipping facilities
- Assay laboratories
- Uranium recovery facilities

Process, Mechanical, and Electrical Support

- Firewater storage tanks
- Water supply systems
- Cooling tower and pumping system
- Electrical transmission supply systems
- Steam supply system
- Compressed air supply system

Waste Management

- Sanitary waste plant
- Process water treatment facility
- Chemical waste treatment facility
- Uranium-contaminated waste treatment facilities
- Sanitary waste landfill
- Solid waste burial facilities for chemical and U-contaminated wastes

2.4. AVLIS BASE TECHNOLOGY

AVLIS Technology and engineering design basis is described in document EBO20. Summarized are the historical development and present status of the technology.

LLNL has been actively pursuing the AVLIS process since 1973, with the active participation of Martin Marietta Energy Systems, Inc. (then Union Carbide Corp.) since 1975. In the early years, 1973-1979 (Fig. 2-7), the

Fig. 2-7. AVLIS Program Development overview.

major AVLIS issues were to identify an economically attractive uranium enrichment process through spectroscopic modeling and demonstrations and to select the corresponding scalable hardware. The objectives were to achieve both high process separative work performance at low optical power and hardware performance, efficiency, and an operating life that could meet criteria for attractive enrichment cost in the range of \$20-40/swu. By the end of this period the program had essentially selected, from many attractive options, our current baseline process characteristics and hardware technologies.

The AVLIS Program continued to develop in phases. The mainline process selection for the AVLIS program is complete, while the technology, hardware, and systems demonstrations are nearing phase completion. The lasers, separators, and integrated demonstrations have progressed so that they will be operated at plant scale by FY86 in the Full-Scale Demonstration Facility. The Full-Scale Demonstration Facility will be used to increase the component and subsystem lifetimes, reduce hardware costs, improve component reliability and maintainability, and optimize plant-scale system performance.

2.4.1. Separator Development and Status

Separator technology has evolved from small-scale to full-scale components: from 1/8 scale EB-1 to the 1/2 scale Mars, to the full-scale materials-handling demonstration module and the Full-Scale Demonstration Facility separator. Technological achievements range from material selection and development through process integration and enrichment performance demonstration. Progressive development of the principal components (i.e., vaporizers, materials, handling systems, extractor collectors, and control systems) constitutes the development of the AVLIS pod. All major technical issues with the separator have been resolved. Consequently, the separator development status is such that a full-scale prototype AVLIS pod and its containment can be demonstrated in the Full-Scale Demonstration Facility.

2.4.2 Laser Development Status

From the inception of the AVLIS program, it has been clear that lasers must meet three requirements prior to their deployment. First, they must be technically capable of producing sufficient light of the proper quality to achieve projected plant performance. Second, they must meet rigid industrial and economic requirements. In the industrial context, the laser system must be rapidly deployable using conventional practices of the existing U.S. industrial base and available labor force. Finally, from an economic standpoint, the specified optical power must be achievable with low capital and operating cost.

During the past decade of development, the AVLIS program has addressed and met each of these requirements. The technical, industrial, and economic criteria have all been satisfied. All the major laser-engineering issues of an AVLIS plant have been resolved. No further breakthroughs are necessary for the successful operation of an AVLIS plant, although ongoing engineering efforts will continue to improve system performance and decrease its cost.

For the AVLIS process, dye lasers optically pumped by copper lasers provide the photons that ionize the selected isotope in the separator chamber. Both dye and copper lasers are configured in laser chains of oscillators followed by several amplifiers. All the laser components in this system have undergone extensive design and engineering development during the past decade.

Since the mid 1970s, dye oscillators have been developed from modified commercial units to reliable and stable AVLIS plant prototype oscillators to be demonstrated in the Full-Scale Demonstration Facility within a year. Dye amplifiers have evolved from the first LLNL low power dye amplifier to an advanced high-power AVLIS production plant prototype dye amplifier to be demonstrated in the Full-Scale Demonstration Facility in FY85.

The AVLIS dye lasers are pumped by light from copper lasers. The first copper lasers used in AVLIS were capable of producing approximately 1 watt. The lifetime of these lasers was about four hours. Careful technology and engineering development during the past ten years have resulted in the current generation of reliable copper lasers for the Full-Scale Demonstration

Facility, each of which will operate with maximum extractable power of 500 watts and a lifetime in excess of 1000 hours. Advanced technologies that will boost the extractable power to 1000 watts are under active investigation.

2.4.3. Integrated Process Demonstration Status

Integrated process demonstrations of combined laser and separator systems operations were initiated in the AVLIS program in 1976. For the next several years the principal goals of these demonstrations were to collect small samples and performance data necessary to scale hardware.

These subscale experiments evolved into a 1982 demonstration series in which approximately 1/4-scale hardware that was plant prototypic in configuration was used to verify overall enrichment performance and detailed physics models.

Interim phases of the integrated process demonstrations were performed in the Mars and Venus Program in the early 1980s. The final phases of enrichment demonstrations were initiated this year and include Demo'85 in a half-scale separator (MARS) leading to full-scale operation of the Full-Scale Demonstration Facility in 1987. Toward the end of the demonstrations the Full-Scale Demonstration Facility's full-scale hardware will be operated for a period equaling AVLIS Production Plant requirements and will accumulate significant life-test data. These latter demonstrations will provide a sound basis for operating the initial production plant increment.

Total enrichment material quantities have progressed dramatically over the years. In 1977, enriched product was produced using a resistively heated tungsten oven and several 5-watt copper lasers to pump early dye lasers. The significance of this separation run lay not in the quantity of material produced but in the clear demonstration of the simultaneous performance of most of the subsystems and components required for economic laser enrichment of atomic uranium.

Subsequent 1/4-scale demonstrations were done in the Regulus EB-1 e-beam vaporizer system. Importantly, this series of 1/4-scale demonstrations thoroughly verified the enrichment performance models. Additionally, two

subsequent demonstrations proved that adding alloy feed and collecting the product in the liquid phase did not modify enrichment performance.

Integrated process demonstrations planned for Demo '85 are intended to further substantiate full-scale and near full-scale AVLIS laser-separator system performance and life tests. The Full-scale Demonstration Facility will demonstrate full-scale integrated process systems and components prototypic of the AVLIS Production Plant design described in this report.

2.4.4. Uranium Processing Technology Status

The processes required to convert UF_6 to metal for feed to the separator and subsequently to convert metal to UF_6 are well established. Almost all of the steps required have been practiced for decades at the industrial scales required for AVLIS. Additional principal development requirements are to confirm methods of purifying the product.

2.4.5. Waste Management Technology

Methods are available for properly managing all AVLIS wastes; therefore, there are no significant development requirements in waste management.

2.5. PROJECT ASSUMPTIONS/CLARIFICATIONS

The following project assumptions have been made.

2.5.1. Project Functional Support

The AVLIS Production Plant Project will receive essential functional support from existing Oak Ridge Gaseous Diffusion Plant Facilities. Detailed requirements for these functions will be provided by the AVLIS Production Plant Project. Funding for the services and required upgrades is incorporated in the budget of the AVLIS Production Plant total project cost, unless other funding has been provided.

2.5.2. AVLIS Process Deployment

1 Uranium processing, laser, and separator equipment will be installed in new facilities meeting all DOE design requirements.

2.5.3. Final Environmental Impact Statement

A Final Environmental Impact Statement will be prepared for the AVLIS Production Plant. The Final Environmental Impact Statement will be approved prior to initiation of construction or initiation of long-lead procurement. No Environmental Impact Statement will be prepared by the AVLIS Production Plant Project for supporting facilities.

2.5.4. DOE Requirements for Natural Phenomena

The AVLIS Production Plant Processing Facility will meet requirements for natural phenomena per DOE Order 6430.1.

2.5.5. Operational Safeguards and Security System

The AVLIS Production Plant operational safeguards and security system will employ a double-fenced area with complete internal and external safeguards and a security system for the special nuclear materials being processed. The system will meet DOE orders regarding physical safeguards and accountability.

2.5.6. Feed and Product

The delivered feed material will be UF_6 . The product will be UF_6 , meeting isotopic and chemical specifications currently met by the product of gaseous diffusion plants.

2.6. KEY PROJECT DOCUMENTS

Key AVLIS Production Plant Project documents are listed and described in Sec. 11. The AVLIS Production Plant Project key documents are categorized into three main groupings: administrative, programmatic, and technical documents. In addition to the three categories, these key documents are delineated by a matrix as to the responsible agents for preparation, review, concurrence, and approval of each.

3. PROJECT OBJECTIVES

3.1. PURPOSE OF THE AVLIS PRODUCTION PLANT PROJECT

The major purpose of the AVLIS Production Plant Project is to build an AVLIS Production Plant to enrich uranium at costs substantially lower than the costs of enriching uranium in gaseous diffusion and centrifuge plants. The AVLIS Production Plant is to begin production in 1991 and reach full production from initial deployment in 1993.

3.2. PROJECT REQUIREMENTS

The AVLIS Production Plant Project will be deployed within the site of the Oak Ridge Gaseous Diffusion Plant located at Oak Ridge, Tennessee. The basic project requirement is that the AVLIS Production Plant be designed, constructed, and operated in accordance with applicable local, state, and federal regulations for uranium processing facilities.

3.2.1. Technical Requirements

The following are key technical requirements for the deployment of the AVLIS process and operation of an AVLIS Production Plant at the Oak Ridge Gaseous Diffusion Plant site, Oak Ridge, Tennessee. Technical requirements are defined in detail in supporting classified documents.

AVLIS Primary Criteria

- a) Produce UF_6 meeting isotopic and chemical specifications of the nuclear industry.
- b) Produce UF_6 at a rate defined by DOE enrichment enterprise needs.
- c) Meet DOE Oak Ridge natural-phenomena requirements for uranium facilities.

- d) Meet DOE site boundary requirements for release of radioactive materials for postulated design basis accidents and normal operation.
- e) Meet all DOE requirements for safeguards and security.
- f) Efficiently recover and recycle uranium scrap.
- g) Dispose of radioactive waste in compliance with DOE requirements.
- h) Implement fire-protection systems that meet DOE and Oak Ridge site requirements.
- i) Design and construct the AVLIS Production Plant for 25-year life, and accommodate future decommissioning.
- j) Meet "as low as reasonably achievable" requirements for plant personnel.
- k) Ensure that environmental impacts from construction and operation of the plant are acceptable.

3.2.2. Quality/Reliability Requirements

- a) Achieve the capacity factor required taking into account plant availability, maintenance, and refurbishment. Capacity factor is defined as the actual annual production rate divided by the nameplate annual production rate.
- b) Meet prescribed product specifications.
- c) Provide for the required acceptance and operational tests to be completed prior to AVLIS Production Plant startup. The Readiness Review prior to startup is based on DOE requirements.
- d) Provide plant-reliability database and reliability, availability, maintainability model to identify failure and repair rates and to assess availability impact of operational changes.

3.3. SYSTEMS OBJECTIVE

The overall systems objective of the AVLIS Production Plant is to receive the UF_6 feed, convert this material into a uranium alloy form for the AVLIS process, perform enrichment, and produce a UF_6 product suitable for transfer to DOE customers.

The systems' functions include:

- a) UF_6 receipt, assay, and storage.
- b) Uranium metal production.
- c) Uranium alloy preparation.
- d) Uranium enrichment in the separator system.
- e) Provision of tuned light from the laser system.
- f) Product conversion from metal of UF_6 .
- g) Product handling, assay, storage, and shipping.
- h) By-product treatment, assay, and storage.
- i) Uranium scrap and waste treatment.
- j) Uranium scrap recycling.
- k) Component refurbishment, maintenance, and decontamination.
- l) Disposal of failed components.

3.4 ECONOMIC OBJECTIVES

Work is in progress at LLNL and Martin Marietta to develop the technology to enrich the ^{235}U content of uranium to commercial grade levels by laser separation of isotopes. Timely deployment of the AVLIS process and technology will allow enrichment of uranium at lower cost by achieving a prescribed target cost per Separative Work Unit for the AVLIS Production Plant.

3.5. SCHEDULE OBJECTIVES

The overall schedule objective is to have the AVLIS Production Plant successfully achieve production in the first module by October 1991, and reach full production in October 1993. The prototype demonstration to precede production operations will be performed beginning in FY86.

The current project schedule is based on initiation of conceptual design in late FY85, the start of site preparation in FY87, and initiation of equipment procurement in FY88. To achieve the overall project objective, controlled milestones have been established for the AVLIS Production Plant Project, as noted in Sec. 7. The schedule and milestones are commensurate with budget levels shown in Sec. 8. The major milestones as shown in Fig. 3-1

have been defined in the AVLIS Production Plant Project Plan and are controlled by the DOE Headquarters Program Office.

3.6. COST OBJECTIVES

The overall capital and operating costs for the AVLIS Production Plant Project are given in Sec. 9. All dollars are escalated to the year of expenditure.

AVLIS Production Plant project major milestones

1. Approve Project Plan	10/84
2. Complete Draft Environmental Impact Statement for public distribution and publish notice in Federal Register	5/85
3. Record of decision for Environmental Impact Statement issued in Federal Register	11/85
4. Initiate Special Isotope Separation Production Plant construction	1/86
5. Initiate plant operations	4/91

Fig. 3-7. AVLIS Production Plant Project summary project schedule and major milestones.

4. ORGANIZATION AND RESPONSIBILITIES

The design and construction of the Atomic Vapor Laser Isotope Separation (AVLIS) Production Plant will be accomplished under the direction of the U.S. Department of Energy (DOE) by Martin Marietta Energy Systems, Inc. and Lawrence Livermore National Laboratory (LLNL) working as an integrated team. The team will be assisted by one or more architect engineers for facility design, a construction manager, one or more fixed-price-contractors for construction, a cost-plus-award-fee contractor for construction, and subcontractors to the operating contractors for major procurements. Where feasible, procurement and construction will be awarded on the basis of advertised competitive bids.

The provisions of the DOE Major System Acquisition policy and guidelines will be followed in the project. The overall objectives of the project management system are to achieve excellence in the results of all project activities and to minimize costs. This must be achieved through a project organization that integrates diverse resources effectively, minimizes procedural requirements, and preserves accountability, objectivity, and stewardship of resources.

This part of the Project Management Plan presents the method of organization which we propose for accomplishing all activities from conceptual design through operational startup. In addition, responsibilities of principal organizations and managers are described.

In designing the organization, the following were key factors or assumptions which affected the division of work and management responsibilities.

1. It was assumed that the plant site would be operated by Martin Marietta under the jurisdiction of the DOE Oak Ridge Operations Office.
2. It was recognized that since recent design efforts related to the AVLIS Production Plant have been focused at LLNL (with participation by LLNL, Martin Marietta, and architect/engineers), the body of expertise to give technical direction to the AVLIS Production Plant design lies predominantly with LLNL at the present time.

3. It was recognized that Martin Marietta is experienced in performing all phases of large project deployment and has resident expertise in separator and uranium processing technology.
4. To provide sufficient and timely design capability, the engineering team must be enlarged at an early date and the knowledge and expertise to execute a detailed plant design must be provided.
5. Experience gained from the design of the Laser Demonstration Facility and the Separator Demonstration Facility will be used to the maximum extent.
6. The trained staff of the present program must be utilized to the maximum extent.
7. That the plant operations contractor acquire sufficient trained personnel to operate and maintain the plant in a routine manner must be assured.

Therefore, a project organization, having a Contractor Project Office under management direction of the Oak Ridge Operations Office and under technical direction of the Technical Program Office, is proposed. The Contractor Project Office will be led by Martin Marietta, but composed of elements of LLNL, Martin Marietta, and supporting contractors. To facilitate the preparation of a broad design force for the AVLIS Production Plant, the project office will initially be established at LLNL. After completion of the conceptual design, and upon commencement of the capital project, the Contractor Project Office will be transferred to Oak Ridge, Tennessee where it will be under the project management direction of the Field Project Office.

The project will be organized within the existing DOE structure. Project and program interfaces upon commencement of the capital project are depicted in Fig. 4-1. Principal participants are DOE Headquarters, the DOE Oak Ridge Operations Office, the DOE San Francisco Operations Office, the Technology Program Office, and the Operating Contractors LLNL and Martin Marietta Energy Systems Inc.

Fig. 4-1. Organization of Project for AVLIS Production Plant.

DOE Headquarters provides development program goals and objectives and oversees budget, technical schedule costs, and key program milestones. It provides guidance through the appropriate field office, either San Francisco Operations Office or Oak Ridge Operations Office, to the AVLIS Technical Program Office located at Lawrence Livermore National Laboratory and at Martin Marietta Energy Systems, Inc. upon completion of Title II design of the AVLIS Production Plant. The Oak Ridge Operations Office provides management oversight for work that is accomplished under the AVLIS Field Project Office located within Oak Ridge Operations. The Contractor Project Office is responsible for the negotiation, execution, administration, and completion of contracts and other procurement actions necessary to accomplish program and project objectives.

Resources for support of the AVLIS Production Plant Project and development program for the technology and support efforts at LLNL and Martin Marietta Energy Systems will be maintained as separate entities, with separate funding and separate management and control. The construction project for the plant will include all funding for the Contractor Project Office, for Title I, II, and III, for the procurement of components, and for the construction of facilities. The development program's operating budget will continue to fund conceptual design work for the plant, and the technological development of the AVLIS process. As required, some of these activities will support the design and construction of the first AVLIS plant.

The Technology Program Office implements and manages all research and development within the AVLIS program and is responsible for the technical basis and content of the AVLIS Production Plant. The Contractor Project Organization has the prime responsibility for execution of the AVLIS Production Plant project. Reporting to the Contractor Project Office are components of LLNL and Martin Marietta, architect/engineers, cost-plus-award-fee contractor, and fixed-price contractors.

In addition, a Project Review Board composed of representatives of Martin Marietta Energy Systems, Inc. and LLNL oversees the general performance and configuration of the AVLIS Production Plant project. Technology and support groups under the Technology Program Office provide general support to the activities of the AVLIS Production Plant project. The responsibilities for

preparation, review, approval, and concurrence of the project documents are described in Section 11.1.

4.1. PROJECT ORGANIZATIONAL STRUCTURE

The contractor organization proposed for the AVLIS Production Plant Project is depicted in Fig. 4-2. Project management will be accomplished by a project manager from Martin Marietta Energy Systems, Inc. The office will have three deputy project managers: a Deputy Project Manager from LLNL, a Deputy Project Manager for Design from LLNL, and a Deputy Project Manager for Project Operations from Martin Marietta Energy Systems, Inc. The managers of various project functions will be selected from Martin Marietta Energy Systems, Inc. and LLNL staffs as indicated in Fig. 4-2.

As can be seen in the organizational diagram the project has all elements required to place the plant into operation. Functions of the various departments under the project office are given in Fig. 4-3. Figure 4-4 presents visually the method intended for implementation of work within the organization. Basically, the work from design through obtaining operating systems in the plant will be driven by the process systems: lasers, separators, and uranium process. The other functions, shown vertically in the organizational chart, cut across the process functions to support them in various ways, depending upon the work to be performed. Two groups, project engineering and systems engineering, are responsible for total project integration. Work assignments have been examined for the participants in greater detail; these assignments are discussed in Sec. 5.

4.2. RESPONSIBILITIES OF PARTICIPATING ORGANIZATIONS

Definitions of the responsibilities and authorities of the principal participants in the project are given below.

Fig. 4-2. Contractor Project Organization for AVLIS Production Plant Project.

Key:

EIS = Environmental Impact Statement
 QAA = Quality Assurance Assessment
 RAM = Reliability, Availability, and Maintainability
 SAR = Safety Analysis Report

Fig. 4-3. Contractor Project Organization - Project Function Chart

Fig. 4-4. Functional Implementation of AVLIS Production Plant Project.

4.2.1. DOE Headquarters

- a) Establishes project objectives, schedules, and budget strategies.
- b) Concurs in project plans and schedules.
- c) Analyzes and approves project budget submissions.
- d) Secures sufficient funding and allocates resources to assure successful completion of the project.
- e) Approves the Project Management Plan, which delineates cost, schedule, and performance threshold values, major procurements, and key systems specifications.
- f) Approves updated Conceptual Design Report and design criteria and concurs with major changes to these documents.
- g) Concurs with performance measurement systems.
- h) Reviews AVLIS Production Plant project costs, including contingency allocations, project master schedules, and project status.
- i) Interfaces with the public/private sector on project matters.
- j) Coordinates program/project activities with other Headquarter's organizations.

4.2.2. DOE Oak Ridge Operations/Field Project Office

- a) Manages for DOE the major systems acquisition of the AVLIS Production Plant through the Field Project Office.
- b) Implements the budgets, policies, and programmatic guidance provided by DOE Headquarters.
- c) Administers design and construction project to provide an AVLIS Production Plant within schedule, budget and performance targets.
- d) Approves performance measurement systems prepared by the Contractor Project Office.
- e) Approves major changes to project milestones and funding.
- f) Approves the Project Plan, the Project Management Plan, and the Project Control Manual prepared by the Contractor Project Office.
- g) Approves plan for use of contingency through the duration of the project.

- h) Reviews project plans and schedules related to procurement, technology, engineering and construction.
- i) Assures implementation of a Quality Assurance program and assures its implementation by all contractors.
- j) Issues directives for Martin Marietta's major procurements for construction, equipment, and services at the levels required under DOE procedures.
- k) Reviews procedures for Quality Assurance, health protection, safety, security, and acceptable environmental impact.
- l) Reviews and approves Environmental Impact Statement for construction project.
- m) Serves on the AVLIS Production Plant Project Review Board.

4.2.3. DOE San Francisco Operations Office

- a) Implements the budget, policies and programmatic guidance provided by DOE Headquarters.
- b) Concurs in the Project Management Plan prepared by the Contractor Project Office.

4.2.4. AVLIS Technical Program Office

- a) Establishes AVLIS Production Plant baseline design and configuration and reviews and approves major technical changes thereto as contained in the following baseline documents: Point Design, Engineering Design Basis, and Interface Control Plans.
- b) Coordinates all development program activities in support of the design and operation of the AVLIS Production Plant.
- c) Reviews and concurs with Project Management Plan and concurs with the staff selected for leading the project.
- d) Provides technical support for startup, training, operation, and/ maintenance of the AVLIS Production Plant after project completion.

- e) Reviews and concurs with Conceptual Design Report, design criteria and Title I design package.
- f) Appoints the chairman of the Project Review Board.

4.2.5. AVLIS Production Plant Project Contractor Organization

- a) Manages all phases of the AVLIS Production Facility project from conceptual design through plant startup as delineated in Fig. 4.3.
- b) Reviews and approves all project documents.
- c) Arranges and supervises procurement of services and equipment for the project.
- d) Develops and implements performance measurement systems.
- e) Recommends major changes to project milestones and funding.
- f) Prepares the Project Management Plan.
- g) Provides the plan for the use of contingency through the duration of the project.
- h) Approves project plans and schedules related to procurement, technology, engineering and construction.
- i) Develops and implements a Quality Assurance program.
- j) Procures construction, equipment, and services.
- k) Develops and implements procedures for health protection, safety, security, and acceptable environmental impact.
- l) Prepares Environmental Impact Statement for construction project.

4.2.6. Project Review Board

- a) Chaired by a Technical Program Office Appointee; composed of the project manager, the deputies from the Contractor Project Office, and one representative from each of the following organizations: Technology Program Office, Field Project Office, LLNL AVLIS, and Martin Marietta AVLIS program.
- b) Reviews cost and schedule performance of the project through periodic meetings with the project organization.

- c) Approves, by concurrence of its members, the Conceptual Design Report, design criteria, Title I and Title II design packages, and any significant configuration change.

4.2.7. Operating Contractor

- a) Provides technical and engineering support to the AVLIS Production Plant project activities by assigning personnel to the project organization.
- b) Performs technical review of project designs and documents in support of the Technical Program Office.

4.3. RESPONSIBILITIES OF KEY POSITIONS IN THE AVLIS PRODUCTION PLANT PROJECT ORGANIZATION

4.3.1. AVLIS Production Plant Project Manager

- a) Manages and coordinates all activities of the AVLIS Production Plant project for all phases (Conceptual Design Report through startup).
- b) Allocates budgets for the various AVLIS Production Plant project activities.
- c) Implements systems for control of schedules, costs, and scope of the AVLIS Production Plant.
- d) Implements systems to assure that actions and decisions of the project have the concurrences of organizations having technical and administrative control of the AVLIS Production Plant.
- e) Serves as a member of the Project Review Board.

4.3.2. AVLIS Production Plant Deputy Project Manager (LLNL)

- a) By delegation from the Project Manager, assists the Project Manager in managing the project organization.

- b) Selects, in cooperation with the Project Manager, Technology Program Office and LLNL management, the personnel and organizations of LLNL that are to be utilized in the project organization.
- c) Integrates schedules and plans for LLNL participation with those of the project office.
- d) Participates in review of major documentation.
- e) Serves as a member of the Project Review Board.

4.3.3. AVLIS Production Plant Deputy Project Manager for Design (LLNL)

- a) By delegation from the Project Manager, manages and coordinates all design activities of the project organization.
- b) Manages and coordinates activities of the managers for lasers, separators, uranium processing facilities, and systems engineering.
- c) Selects, in cooperation with the Project Manager and LLNL and Martin Marietta management, personnel and organizations of LLNL and Martin Marietta Energy Systems, Inc. that are to be utilized.
- d) Participates in review of major engineering documentation.
- e) Serves as a member of the Project Review Board.

4.3.4. AVLIS Production Plant Deputy Project Manager for Project Operations Martin Marietta Energy Systems, Inc.

- a) By delegation from the Project Manager, manages and coordinates project engineering and business functions of the project organization.
- b) Manages and coordinates the activities of the managers for project engineering, project assessment, procurement, and construction and installation.
- c) Selects, in cooperation with the Project Manager and LLNL and Martin Marietta Energy Systems, Inc. management, personnel and organizations of LLNL and Martin Marietta that are to be utilized.

- d) Integrates schedules and plans for participation of Martin Marietta and LLNL engineering groups with those of the project office.
- e) Participates in review of major engineering documentation.
- f) Serves as a member of the Project Review Board.

5.0 WORK PLAN

5.1. INTRODUCTION

The following work plan describes how the Contractor Project Organization will be integrated with the Work Breakdown Structure to accomplish the various phases of the project (See Figs. 4.2 and 4.3 in Sec. 4). The plan is related directly to level 3 of the Work Breakdown Structure as shown in Fig. 5-1. The various phases of the AVLIS Production Plant Project for delivery of operational hardware and facilities may be generally described as consisting of the following:

- o preconceptual design
- o conceptual design
- o Title I design
- o *Title II design*
- o Procurement and construction
- o Installation
- o Training and startup

The above phases of the project are supported by project assessments (National Environmental Policy Act of 1969, Safety Analysis, Quality Assurance, Safeguards and Security Analysis), by systems engineering, and project management.

The timing of the activities discussed in this section is depicted in the project schedule. (See Sec. 7.)

5.2. DELIVERY OF OPERATING HARDWARE AND FACILITIES

Discussed below is the work plan for the project phases.

5.2.1. Preconceptual Design Phase

The preconceptual design phase of the AVLIS Production Plant project, now nearing completion, has coincided with the process selection process of DOE.

Fig. 5-1. AVLIS Production Plant work breakdown structure.

It is not anticipated that significant additional work will be done on the design until after DOE has decided in May 1985 which of the processes it will deploy.

The preconceptual design phase is producing a complete set of baseline documents and a cost estimate to serve as a basis for process evaluation by the DOE, the National Environmental Policy Act of 1969 process, and site selection.

5.2.2. Conceptual Design

Assuming selection of the AVLIS process and commitment of DOE to its early deployment, the conceptual design phase will commence during the latter part of FY85 and will continue into FY86, with completion of conceptual design. Early in the conceptual design phase, documentation for seeking Title I and Title II engineering funds will be prepared. Complete funding for construction will be sought after completion of the conceptual design.

Conceptual design will be the prime responsibility of the Project Design Manager utilizing design teams under the leadership of design managers for lasers, separators, uranium processing, and facilities.

5.2.3. Titles I, II, and III Activities

Title I, II, and III design activities will be carried out by the Contractor Project Office with the assistance of engineering services contractors and the staffs of Martin Marietta and LLNL. Work to be performed during these phases of the project include the following:

- o Title I - which includes the preparation of preliminary drawings, layout plans, estimates, equipment lists, etc., as necessary to show characteristics of the proposed design.
- o Title II - which includes the preparation of drawings, estimates, and specifications for construction and procurement.
- o Title III - which includes field engineering and Quality Assurance for compliance with approved drawings and specifications.

The Project Design Manager will be the principal manager of these activities. The design managers for lasers, separators, uranium processing, and facilities will manage these activities for their respective systems and facilities.

5.2.4. Construction

Construction includes all site preparation, utility installation, building erection, process systems installation, and construction acceptance testing. It also includes the installation of equipment and components procured by other organizations.

Under the direction of Manager of Construction/Installation, the Contractor Project Office, the majority of the construction work will be accomplished by a major construction manager under a cost reimbursable contract with provisions for award fee.

In general, all of the elements of the work that will be defined in accordance with the requirements for competitively bid, fixed-price contracting will be accomplished by subcontractors. Most of the project can be constructed on a firm fixed-price basis, and efforts will be directed accordingly. The construction manager will also develop and administer a Small Business and Minority Contractors subcontracting program.

Those elements of the work for which the technical and cost uncertainties are unusually large will be accomplished by the construction manager/constructor on a force-account basis.

The construction manager will procure long lead time or specialized items of equipment as assigned. These items will be installed by subcontractors or by the construction manager's own forces, as appropriate and consistent with Davis-Bacon decisions.

A generalized listing of the role of the construction manager includes the following:

- o Support during the design phase, including constructibility reviews; cost estimating; work packaging; and sequencing.
- o Establishing and operating common facilities such as warehousing; materials inventory; equipment pool; construction security;

emergency facilities; housekeeping; development and maintenance of minority business enterprise registers; and development and maintenance of a skills bank for area unemployed and minority job applicants.

- o Developing and administering a quality control program applicable to assigned procurements and construction activities, either subcontract or force-account.
- o Establishing a project labor agreement applicable to the construction work force.
- o Establishing and maintaining the detailed project construction schedule and providing progress and status information to the AVLIS master control and reporting system.
- o Providing representation at project management meetings where attendance is required of all principal project participants.

All activities relating to a specific construction work package, from start of construction up to a beneficial occupancy date, are under the jurisdiction of the Contractor Project Office Construction Installation Manager. During the period between the beneficial occupancy date and the final acceptance of construction date, a combination of construction activities and the operator's plant startup activities will take place. During this interim period, the responsibilities of both construction and operations will be clearly defined.

5.2.5. Procurement

The acquisition of equipment for the AVLIS Production Plant involves managing the procurements of standard materials, services, and equipment. The procurement strategy is described in detail in the Industrial Access Program Document (PPO40). The procurements involve some raw materials and equipment which may convey classified restricted data and, consequently, will require that security plans be developed by the procuring organization and approved by DOE. Procurement activities for the project will be managed by the Manager of Procurement, Contractor Project Office.

5.2.6. Installation of Equipment

Process Equipment will be installed under the direction of the operating contractor, Martin Marietta Energy Systems, Inc., with the services of a cost-plus-award-fee contractor and support of the Martin Marietta/LLNL staff.

All installation activities will be managed by the Contractor Project Office Manager, Construction and Installation.

5.2.7. Training and Start Up

Training shall be required at the necessary levels to ensure that all personnel associated with this project will have the expertise and ability to perform their assigned tasks. These tasks should be accomplished in such a manner as to provide that quality necessary for the proper start up and operation of the AVLIS Production Plant. All training and startup activities will be managed by the Plant Operations Manager.

In order to maximize available time, full advantage will be taken of the existing laser and separator demonstration facilities. Design and operating personnel from Martin Marietta are currently working as integrated members of the team that is developing the design for the AVLIS Production Plant. They are also involved in the design, construction, and activation of the Separator Demonstration Facility (Livermore), the Laser Demonstration Facility (Livermore), and the Materials Handling Demonstration Module (Oak Ridge). Each of these facilities contains equipment whose design and function is similar to that which will be installed in the AVLIS Production Plant. This integration of Martin Marietta personnel into the design, construction and operations of these facilities will result in an early transfer of the technology to the operating contractor. In addition, it is expected that some activation and operations tasks (optics handling and electrical equipment maintenance) could be performed by subcontractors as is the current practice at Livermore. In this case, the subcontractor will qualify by virtue of his existing expertise, but in addition, will receive final training at Livermore or at Oak Ridge. Experienced Martin Marietta personnel will be responsible, with assistance by LLNL personnel, for developing the training program that

will ensure that the number of operating personnel required for the AVLIS Production Plant is provided. In order to develop an effective training program Martin Marietta personnel will 1) work with the various design teams to develop operating manuals and procedures and 2) develop training programs for future plant workers. Additional workers and subcontractors will be brought in for training as needed.

The fabrication of the separator pod and laser components required for initial operation of the AVLIS Production Plant will require knowledge and skills identical to those required during normal operation. For this reason the project schedule calls for the completion of the laser and separator refurbishment areas prior to plant start up. The refurbishment facilities will be used to fabricate and assemble the initial laser and separator components. As such these areas will also serve as training facilities for plant operators. Subsequent to receiving training at one or more of the demonstration facilities supervisors and lead operators will be assigned to work in one of the AVLIS Production Plant refurbishment facilities, either to receive more direct training or to direct the training of additional workers.

In order to become proficient in the start up and operation of the production facility, procedures and methods will be written and specific training will be given on all production equipment. Specific training includes on-line experience in demonstration facilities and plant refurbishment areas using the same manuals prepared for the production equipment. Instructor manuals, participant manuals, and visual aids will be developed for all systems and equipment.

Based on extensive past experience, final training and orientation efforts for start up of the AVLIS Production Plant will be accomplished during the engineering checkout of actual equipment and systems. Operational/maintenance personnel working with engineering direction during the checkout activities will become familiar with various components and subsystems of the AVLIS Production Plant as well as perform actual hands-on installation and start up work.

The years during which the laser and separator demonstration facilities have been operating, prior to the AVLIS Production Plant's activation, ensure that adequate training time and facilities are available. In addition, the

1
natural extension of the current programs with involvement of Martin Marietta personnel in the design and operation of the demonstration facilities will ensure that an adequate operating and maintenance staff is available for the AVLIS Production Plant activation and start up.

5.2.7.1. Plant Operating and Maintenance Procedures

Procedures required for plant operation and maintenance will be prepared as a part of the process for training plant personnel. Existing Martin Marietta procedures and policies for gaseous diffusion plants will be utilized extensively to establish AVLIS Production Plant general operating procedures. These will be modified and supplemented as required for the AVLIS process.

5.2.7.2. Health and Safety Training

The project will provide health and safety training for its employees. The function of such training is to impart the necessary knowledge that will enable employees to recognize the risks associated with their job activities and to make an informed judgement before assuming such risks. Instruction in health and safety procedures, operating procedures, and recognition of potential hazards are important elements of this program.

5.2.7.3. Emergency Planning

Emergency planning becomes an important element should an accident occur due to a program failure. Emergency plans establish lines of authority, responsibility, and general procedures to be implemented in response to an emergency. Formal emergency plans will be required for AVLIS Production Plant facilities/operations.

Training programs will be conducted to educate personnel about emergency plans and procedures. Drills to test the plans, training, and equipment will be conducted, as appropriate, based on the degree of risk, changes in personnel, or changes in facilities or operations.

A program to maintain all emergency equipment is essential. Records of

the maintenance should be regularly reviewed. An inspection program will exist to verify maintenance of critical emergency equipment.

5.2.8. Work Assignments for Design and Delivery of Operating Hardware and Facilities

The work assignments have been examined to Work Breakdown Structure Level 2 (or 3). This level is indicated in Fig. 5-1 and consists of the principal systems that constitute the plant. Tables 5-1 through 5-8 show how the responsibility for delivering products or services to the project will be assigned. As can be seen in these tables, activities leading up to the commencement of the capital project are included--that is, the activities from the conceptual design report through the establishment of final design criteria. Final design will be based on the performance of the modified components in the Full-Scale Demonstration Facility. All subsequent activities, Title I through completion, are a part of the capital project.

For each principal system delineated in Tables 5-1 through 5-8, teams will be organized from the staffs of LLNL, Martin Marietta, the architect/engineer, and the construction manager. The composition of the teams will vary as the work progresses. However, continuity, through completion of the project, will be ensured by holding the designer responsible until the particular system is operating successfully. In addition, each of these teams is accountable to the appropriate overall manager (Section 4). This also gives continuity and accountability for delivery of finished operating systems meeting the basic criteria and objectives.

Tables 5-1 through 5-8 represent the general approach to be taken in composing the various teams. The specifics of assignments will depend on availability of qualified personnel in the various organization at the time a particular task must be undertaken.

In Tables 5-1 through 5-8, the notation "P" means that management responsibility for the activity will be assigned to a member of that organization. Usually, the managing organization will provide staff to perform the work involved in the activity. However, staff may be assigned from other functional groups.

Table 5-1. Laser Systems - Work Assignments

	MMES				LLNL			Sub-Cntr.	
	DES	TECH	PCI	OPER	DES	TECH	OPER	A/E	CM
Engineering									
Conceptual Design	E			R	PE	R	R		
Final Design Criteria	E			R	PE	R	R		
Title I	E			R	PE	R	R	E	
Title II	E			R	PE	R		E	
Title III	E			R	PE	R		E	
Procurement									
Vendor Qualification	E				PE	R			
Specification Preparation	E			R	PE	R		E	
Procurement Administration			PE						
Vendor Schedule Verification			PE						
Vendor Quality Verification	E				PE	R			
Equipment Warehousing/Delivery			PE						
Installation and Activation									
Test of Equipment Received	R		PE	R	R	R	E		
Assembly and test	R			PE	R	R	E		
Installation			PE	R	R	R			E
Activation	R			PE	R	R	E		
Special Alignment/Adjustment	R			E	R	R	PE		

Nomenclature

MMES - Martin Marietta Energy Systems, Inc.
 LLNL - Lawrence Livermore National Laboratory
 DES - Organization for Design Engineering
 TECH - Organization for Development and Technical Support
 E - Executes assigned work
 R - Performs technical review
 PCI - Organization for Procurement, Construction and Installation
 OPER - Organization for Operations and Maintenance
 I - Performs review for interfacing with other plant systems
 A/E - Architect/Engineer
 CM - Construction Manager
 P - Has primary responsibility for delivery of product service

Table 5-2. Laser Refurbishment Systems - Work Assignments

	MMES				LLNL			Sub-Cntr.	
	DES	TECH	PCI	OPER	DES	TECH	OPER	A/E	CM
Engineering									
Conceptual Design	E			R	PE	R	R	E	
Final Design Criteria	E			R	PE	R	R		
Title I	E			R	PE	R	R	E	
Title II	E			R	PE	R		E	
Title III	E			R	PE	R		E	
Procurement									
Vendor Qualification	E				PE	R			
Specification Preparation	E			R	PE	R	R	E	
Procurement Administration				PE					
Vendor Schedule Verification				PE					
Vendor Quality Verification	E			R	PE	R	R		
Equipment Warehousing/Delivery				PE					
Installation and Activation									
Test of Equipment Received	R			PE	R	R	E		
Assembly and test	R			PE	R	R	E		
Installation				PE	R	R	R		E
Activation	R			PE	R	R	E		
Special Alignment/Adjustment	R			E	R	R	PE		

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 OPER - Organization for Operations and Maintenance
 I - Performs review for interfacing with other plant systems
 A/E - Architect/Engineer
 CM - Construction Manager
 P - Has primary responsibility for delivery of product service

Table 5-3. Separator Pod Systems - Work Assignments

	MMES				LLNL			Sub-Cntr.	
	DES	TECH	PCI	OPER	DES	TECH	OPER	A/E	CM
Engineering									
Conceptual Design	E	R		R	PE	R	R		
Final Design Criteria	E	R		R	PE	R	R		
Title I	E	R		R	PE	R	R		
Title II	E	R		R	PE	R			
Title III	E			R	PE		R		
Procurement									
Vendor Qualification	E	R			PE	R			
Specification Preparation	E	R		R	PE	R			
Procurement Administration				PE					
Vendor Schedule Verification				PE					
Vendor Quality Verification	E	R		R	PE	R			
Equipment Warehousing/Delivery				PE					
Installation and Activation									
Test of Equipment Received	R	R	PE	R	R	R	E		
Assembly and test	R	R	PE	PE	R	R	E		
Installation	R	R	PE	R	R		R		E
Activation	R	R		PE	R	R	E		
Special Alignment/Adjustment	R	R		E	R	R	PE		

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- A/E - Architect/Engineer
- CM - Construction Manager
- P - Has primary responsibility for delivery of product service

Table 5-4. Separator Vessel Systems - Work Assignments

	MMES				LLNL			Sub- Cntr.
	DES	TECH	PCI	OPER	DES	TECH	OPER	A/E CM
<hr/>								
Engineering								
Conceptual Design	E	R		R	PE	R	R	E
Final Design Criteria	E	R		R	PE	R	R	
Title I	PE	R		R	E	R	R	E
Title II	PE	R		R	E	R		E
Title III	PE			R	E		R	E
Procurement								
Vendor Qualification	PE	R			E	R		E
Specification Preparation	PE	R		R	E	R		E
Procurement Administration				PE				
Vendor Schedule Verification				PE				
Vendor Quality Verification	PE	R		R	E	R		
Equipment Warehousing/Delivery				PE				
Installation and Activation								
Test of Equipment Received	R	R	PE	R	R	R	E	
Assembly and test	R	R		PE	R	R	E	
Installation	R	R	PE	R		R	R	E
Activation	R	R		PE	R	R	E	
Special Alignment/Adjustment	R	R		E	R	R	PE	

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 OPER - Organization for Operations and Maintenance
 I - Performs review for interfacing with other plant systems
 A/E - Architect/Engineer
 CM - Construction Manager
 P - Has primary responsibility for delivery of product service

Table 5-5. Separator Refurbishment - Work Assignments

	MMES				LLNL			Sub- Cntr. A/E CM
	DES	TECH	PCI	OPER	DES	TECH	OPER	
Engineering								
Conceptual Design	E	R		R	PE	R	R	E
Final Design Criteria	E	R		R	PE	R	R	
Title I	PE	R		R	E	R	R	E
Title II	PE	R		R	E			E
Title III	PE			R	E			E
Procurement								
Vendor Qualification	PE	R			E			E
Specification Preparation	PE	R			E			
Procurement Administration				PE				
Vendor Schedule Verification				PE				
Vendor Quality Verification	PE	R			E			
Equipment Warehousing/Delivery				PE				
Installation and Activation								
Test of Equipment Received	R	R		PE R	R		E	
Assembly and test	R	R		PE	R		E	
Installation				PE R				E
Activation	R	R		PE	R		E	
Special Alignment/Adjustment	R	R		PE	R		R	

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 A/E - Architect/Engineer
 CM - Construction Manager
 P - Has primary responsibility for delivery of product service

Table 5-6. Uranium Processing Systems - Work Assignments

	MMES				LLNL			Sub-Cntr. A/E CM
	DES	TECH	PCI	OPER	DES	TECH	OPER	
Engineering								
Conceptual Design	PE	R		R	I	R	R	E
Final Design Criteria	PE	R		R	I	R	R	
Title I	PE	R		R	I	R		E
Title II	PE	R		R	I			E
Title III	PE	R		R	I			E
Procurement								
Vendor Qualification	PE	R						
Specification Preparation	PE	R			I			E
Procurement Administration				PE				
Vendor Schedule Verification				PE				
Vendor Quality Verification	PE	R						
Equipment Warehousing/Delivery				PE				
Installation and Activation								
Test of Equipment Received	R	R	PE	R			I	
Assembly and test	R	R		PE			I	
Installation			PE	R			I	E
Activation	R	R		PE			I	
Special Alignment/Adjustment	R	R	PE	PE				

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 R - Performs technical review
 PCI - Organization for Procurement, Construction and Installation
 OPER - Organization for Operations and Maintenance
 I - Performs review for interfacing with other plant systems
 A/E - Architect/Engineer
 CM - Construction Manager
 P - Has primary responsibility for delivery of product service

Table 5-7. Central Instrumentation and Control - Work Assignments

	MMES				LLNL			Sub- Cntr. A/E CM
	DES	TECH	PCI	OPER	DES	TECH	OPER	
Engineering								
Conceptual Design	E	R		R	PE	R	R	E
Final Design Criteria	E	R		R	PE	R	R	
Title I	PE	R		R	E	R		E
Title II	PE	R		R	E	R		E
Title III	PE			R		R		E
Procurement								
Vendor Qualification	PE	R			E	R		
Specification Preparation	PE	R			E	R		E
Procurement Administration				PE				
Vendor Schedule Verification				PE				
Vendor Quality Verification	PE	R			E	R		
Equipment Warehousing/Delivery				PE				
Installation and Activation								
Test of Equipment Received	R	R		PE	R			
Assembly and test	R	R		PE	R			
Installation				PE	R		R	E
Activation	R	R		PE	R		R	
Special Alignment/Adjustment	R	E		PE		E	R	

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 I - Performs review for interfacing with other plant systems
 A/E - Architect/Engineer
 CM - Construction Manager
 P - Has primary responsibility for delivery of product service

Table 5-8. Conventional Facilities - Work Assignments

	MMES				LLNL			Sub- Vntr. A/E CM
	DES	TECH	PCI	OPER	DES	TECH	OPER	
<hr/>								
Engineering								
Conceptual Design	P		R		R	R	R	E
Final Design Criteria	P		R		R	R	R	E
Title I	P		R		R	R	R	E
Title II	P			R	R			E
Title III	P			R	R			E
Procurement								
Prepare Bid Packages	P			R	I		I	E
Advertise/Receive Bids				PE	I		I	
Award Contracts	R			PE	I		I	R
Warehousing/Delivery				P				E
Construction and Installation								
Construction	I			P	I		I	E
Installation of General Equip	I			P	I		I	E
Certification of Construction and Installation	I			P	I		R	E

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5.3. PROJECT ASSESSMENT ACTIVITIES

The phases of delivery of hardware and facilities are supported by assessment activities which overlay the AVLIS Production Plant project.

5.3.1. National Environmental Policy Act

DOE selected Pacific Northwest Laboratories, operated by Battelle, as an independent organization to prepare the required National Environmental Policy Act documentation for both the AVLIS process and the advanced gas centrifuge deployment. In addition, as a part of the preconceptual documentation, the AVLIS Production Plant project is preparing an environmental assessment. This will serve as a basis for DOE to issue a letter to Congress requesting a Notice of Intent to proceed with the Environmental Impact Statement.

The current plan, assuming receipt of the authority to proceed, is to initiate Environmental Impact Statement preparation in the second half of FY85, resulting in a record of decision no later than June 1986.

5.3.2 Site Selection

DOE has not decided on the site for an AVLIS Production Plant. In parallel with preparing the Environmental Impact Statement, an assessment of alternative sites must be performed. The current plan, assuming authority to proceed, is to initiate the comparative site evaluation in March 1985. DOE would need to select a contractor to perform the evaluation by March 1985.

5.3.3. Systems Engineering

The deployment of special processes such as lasers, separators, and uranium processes in new facilities requires disciplined control of system integration at each phase of the project, from conceptual and definitive design to construction and activation. Systems engineering will prepare and control requirements, plant configuration, and interfaces using formal

change-control processes. System-integrated process design, availability, and reliability will be evaluated. Major design reviews and evaluation of the selection of alternatives will be conducted throughout the life of the project. Engineering document control and major project technical document preparation will be implemented under this activity.

Systems engineering will be performed in concert with the design throughout the project. Due to the complexity of the facilities and the number of design participants, it is necessary that the plant be evaluated from a total systems point of view. Systems goals must be determined and allocated to the responsible design organizations. The top-level systems scope will include, but will not be limited to, the following:

(1) requirements analysis of project-level functions; (2) system requirements analysis of critical subsystems to include reliability; (3) criteria verification to satisfy system functional requirements; (4) integrated test plans; (5) top-level operation and maintainability plans; (6) maintenance spare parts requirements; and (7) systems standardization.

The reliability, availability, and maintainability effort provides assessment of the plant's capability as an integrated system throughout the system's life cycles. These life cycles include design stages, procurement, construction, and operations. The main products are quantitative models representing reliability and maintainability factors of the integrated systems and supporting databases. A goal in developing the models and databases is to provide an accurate plant representation and yet maintain sufficient simplicity in operating the models to ensure their maximum use. Evaluation and assessment of such issues as system/component reliability, spare parts inventory, storage capacities, and plant operating procedures are provided.

5.3.4. Quality Assurance

The AVLIS Production Plant Project will have a Quality-Assurance policy that is established and enforced by the Contractor Project Office. The policy will meet the Quality Assurance requirements referenced in DOE Order 5700.4A and discussed in DOE Order 5700.6A. Various participants in the AVLIS Production Plant project will have institutional Quality Assurance programs.

To specifically address the AVLIS Production Plant project's explicit needs, the Contractor Project Office will prepare a project Quality Assurance Plan (issued in phases to support scheduled activities) to be included in the Project Manual. The description will be an overview of Quality Assurance procedures for handling:

- o Design control
- o Control of purchased items
- o Control of processes
- o Nonconforming items identification and resolution
- o Quality assurance records
- o Quality assurance audits

A preliminary Quality Assurance Plan and Assessment is contained in "AVLIS Production Plant Preliminary Quality Assurance Plan and Assessment" (APPO45).

5.3.5. Safety Analysis and Planning

It is the policy of AVLIS project organizations that all construction testing and operations at the project site be conducted in a safe manner in accordance with DOE prescribed Health and Safety Standards. The AVLIS project will not be licensed, however, the preliminary and final Safety-Analysis Reports will be prepared to ensure that the AVLIS Production Plant as constructed will withstand conservatively postulated accidents and natural phenomena without unacceptable impact to the health and safety of the public and operating personnel. The preliminary Safety-Analysis Report will be approved prior to production plant construction. The Final Safety-Analysis Report will be approved by DOE prior to initiation of production.

The AVLIS Project facilities will be designed in accordance with DOE Order 5480.1A, "Environmental Protection, Safety and Health Protection Program for DOE Operations" and DOE Order 6430, "General Design Criteria Manual." The AVLIS Project Design will comply with ANSI Standard Z136.1, "For the Safe Use of Laser."

An AVLIS Project Site Safety Plan will be prepared and will specify safety responsibilities and activities during the construction phases of the AVLIS project.

Employee and public exposure to such hazards as radiation and toxic and radioactive materials will be kept to the lowest level technically and economically feasible. This policy will be implemented by utilizing the best industrial practices to minimize exposures. The "as low as reasonably achievable" principal will apply to all activities, from the earliest planning stage through the final stages of operation.

During construction and installation of equipment, industrial safety will be dictated by procedures defined in the Site Safety Plan. The document will define all construction safety activities and responsibilities with specific inputs (i.e., laser system installation safety requirements) from LLNL, Martin Marietta and contractors as appropriate.

5.3.6. Safeguards and Security

The safeguards and security subproject provides for nuclear material control/accountability and physical security. The AVLIS Production Plant will be designed to comply with existing DOE Orders for safeguards and security systems.

5.3.6.1. Nuclear Material Control/Accountability. Nuclear material controls and accountability will be interfaced closely with the process systems and the plant I&C system. On-line control and accountability steps will be designed as part of the process. In addition, maximum use will be made of existing systems at Oak Ridge for control and accountability. The definitive design will be performed early in the project cycle so that hardware can be procured early in the process. This will allow sufficient time for software development and tie-in to the existing systems in Oak Ridge.

5.3.6.2. Physical Security. Physical security is defined in two elements: facility/vital equipment and site. Security monitoring and control equipment

required for facilities will be designed and procured for early installation. This is required to provide adequate controls prior to receipt of classified equipment and components. Site security will be brought in later as the existing site security system is expanded to encompass the AVLIS Production Plant. A safeguard and security plan that outlines in detail the approach and conduct of safeguards and security during operations will be developed and approved prior to start up. A preliminary plan will be prepared during definition design to ensure that all aspects of safeguards and security are properly addressed.

5.3.7. Work Assignments for Project Assessments

All project assessment activities outlined in this section will be the responsibility of the Manager of Project Assessments, who will involve staff of Martin Marietta, LLNL, and supporting contractors to accomplish the work. The Systems Engineering activities in support of the project assessments will be managed by the project's Systems Engineering Manager.

5.4. ACTIVITIES SUPPORTING PROJECT INTEGRATION AND MANAGEMENT

The work plan requires a diverse set of activities to enable project management to integrate all project designs and activities and to perform its management functions. The project will be managed through the management system discussed in Section 10 and documented through the system discussed in Section 11. Integration and management activities discussed here are derived from Sections 10 and 11.

The project integration and management functions include the following components:

1. Integrating functions
2. Schedule control
3. Cost control
4. Technical integration and configuration control
5. Project review documentation and reporting

5.4.1. Integrating Components

The integrating activities start with work definition, work allocation, and authorization. As the project proceeds, data on performance are collected, analyzed, and reported. Changes, under a controlled process, are made in the project plan as required.

5.4.2. Schedule Control

In concert with work definition and its authorization above, schedules were developed at various levels of detail and became a part of the performance criteria for the performer of the work package. The status of the work program is measured against the schedules, and changes in schedules are controlled and adjusted only through a process that carefully evaluates alternatives and the input on the project.

5.4.3. Cost Control

As with schedules, the cost baseline is set by the work planning and authorization process. Cost control is obtained through accounting to the end items required by the work package and by the project system for funds management, especially control of the use of contingency funds.

5.4.4. Technical Integration and Configuration Control

The project is technically integrated through systems integration and interface control activities. Configuration control is obtained through the use of baseline design documents and a system for appropriate evaluation prior to approval of changes to the baseline or detailed derivatives from the baseline.

Technical integration and configuration control activities must include a comparison of project assessment results against evolving designs to assure that performance criteria for the AVLIS Projection Plant are being met.

5.4.5. Project Review, Documentation, and Reporting

All documents are produced by various components of the project organization and are released through the Contractor Project Office. The Contractor Project Office will also issue periodic progress reports, conduct project reviews, and document the project in correspondence.

5.4.6. Work Assignments for Activities Supporting Project Integration and Management

Within the Contractor Project Office, the management of project engineering will be responsible for the integrating components, controlling schedules and costs, arranging project reviews, preparing periodic progress reports, and coordinating the release of all project documents.

The manager of systems engineering will be responsible for performing the tasks related to technical integration and control.

6. WORK BREAKDOWN STRUCTURE

6.1. GENERAL

This AVLIS Production Plant Project Work Breakdown Structure shall consist of a Project Summary Work Breakdown Structure and supporting Contractor Work Breakdown Structures. Both the Project Summary Work Breakdown Structure and Contractor Work Breakdown Structures shall be supported by dictionaries. The dictionaries will describe the overall scope for each Work Breakdown Structure element. Figure 6-1 shows the relationships among the Work Breakdown Structure documentation for the AVLIS Production Plant Project. The Work Breakdown Structure provides the basic framework for work definition, planning and scheduling, and cost control for the project.

6.2 PROJECT SUMMARY WORK BREAKDOWN STRUCTURES AND DICTIONARY

The top three levels of the Project Summary Work Breakdown Structure for the AVLIS Production Plant Project are shown in Fig. 6-2. The complete Project Summary Work Breakdown Structure is contained in "AVLIS Production Plant Work Breakdown Structure/Dictionary," (APP-020). Each lowest element of the Project Summary Work Breakdown Structure will be identified to a principal contractor for further breakdown within a Contractor Work Breakdown Structure.

The Project Summary Work Breakdown Structure is approved by the DOE Project Manager as part of this document. During performance of the project, any changes to levels 3 and above of the Project Summary Work Breakdown Structure elements require approval by the DOE Project Manager.

6.3. CONTRACTOR WORK BREAKDOWN STRUCTURES AND DICTIONARIES

The Contractor Work Breakdown Structure will be constructed to show products or services to be furnished. The initial elements of the Contractor Work Breakdown Structure start with the lowest level of the Project Summary

Fig. 6-1. AVLIS Production Plant Project Work Breakdown Structure Document Hierarchy.

Fig. 6-2. AVLIS Production Plant Work Breakdown Structure.

Work Breakdown Structure for which the contractor has direct responsibility and the expansion by the contractor of the lowest Project Summary Work Breakdown Structure elements results in the Contractor Work Breakdown Structure. The Contractor Work Breakdown Structure is extended to the level necessary for definition of cost accounts.

Each principal contractor associated with the AVLIS Production Plant Project will develop a Contractor Work Breakdown Structure for work that they are assigned. The principal contractors will approve the Contractor Work Breakdown Structure developed by DOE prime contractors. The Contractor Work Breakdown Structure will serve as a management tool for identifying and defining work the contractor is responsible for and it will serve to facilitate the planning and controlling of work, and to monitor and report cost, schedule, and technical performance. The Contractor Work Breakdown Structures when joined together with the Project Summary Work Breakdown Structure formulate the total Work Breakdown Structure for the AVLIS Production Plant Project.

7. PROJECT SCHEDULE AND MILESTONES

7.1. INTRODUCTION

The objective of the Atomic Vapor Laser Isotope Separation (AVLIS) Program is to establish the U.S. as the long-term world leader in uranium enrichment through rapid deployment of enrichment capacity based on the low-cost AVLIS process. An AVLIS Production Plant project plan and an engineering, procurement, and construction schedule for the initial increment of production, has been developed by the project team consisting of LLNL and Martin Marietta Energy Systems, Inc. with architect/engineer support from both Bechtel National, Inc. and Stone & Webster Engineering Corporation. The project team has integrated ongoing research and development activities, the AVLIS Program engineering demonstrations in the Full-Scale Demonstration Facility, and the production plant design/construction schedules for the initial increment of production. The initial deployment phase consists of six separators and three laser power amplifier modules consistent with the FY84 Reference Design. The initial increment of 5 million swu/yr is followed by a full activation to approximately 13 million swu/yr.

The AVLIS Production Plant project team's strategy for deployment schedule analysis focused on three schedule options:

1. Engineering Limited Schedule -- Aggressive from an engineering standpoint.
2. Authorization Limited Schedule -- Aggressive from the DOE project schedule standpoint.
3. Funding Limited Schedule -- Normal planning schedule viewpoint for a DOE project.

Figure 7-1 displays the three deployment schedule options. The three deployment schedule options developed by the AVLIS project team have been classified in ranges: optimistic, rapid/moderate, or moderate/pessimistic based on the probability of meeting the individual schedule option's major

milestones or program objectives to enrich uranium by the AVLIS process in an effective cost and schedule manner. The project team has classified each schedule option by considering the following:

- o Confidence in key assumptions/durations.
- o Optimism or conservatism.
- o Fixed-price contracts for some or all construction packages.
- o Normal or accelerated review and approval cycles.
- o Major program commitment to rapid deployment.
- o Cash flow scenarios.
- o Availability of qualified personnel.
- o Technology improvements current and planned.

The classification range of the three deployment schedule options, based on the above considerations, is as follows:

- o "Engineering Limited Schedule" - Aggressive
- o "Authorization Limited Schedule" - Rapid/moderate
- o "Funding Limited Schedule" - Moderate/pessimistic

Fig. 7-1. AVLIS production plant-deployment schedule options.

During preparation of the AVLIS Plant schedules, those key factors that can impact DOE project schedules were evaluated to insure that the AVLIS Plant deployment could be achieved. Factors driving DOE project schedules which were included in the schedule analysis include the following:

- o Requisite research and development schedule constraints.
- o Dependency on operating funds.
- o Historical experience on design, procurement, and construction durations.
- o Procurement lead times on equipment.
- o Logical sequence of design, procurement, and construction.
- o Reasonable obligation and costing rates.
- o Reasonable manpower levels, build-up and ramp-down.
- o Shift work or overtime work requirements.
- o Work place space constraints.

Logic networks were prepared for the AVLIS Plant that tie all important activities and their related phases (design, procurement, construction, startup, operation) to interrelated systems for all major AVLIS equipment/systems. The logic networks also combine the key technology release information from the AVLIS Program Demonstration Facilities to the associated plant systems. The project activity durations for all project phases for key plant systems were prepared by engineers knowledgeable about plant system specifics (design and cost), were bench-marked against similar project schedules, were reviewed/supported by respective organizational management and the joint Martin Marietta/LLNL project team, and then integrated with the logic network to establish the overall project schedule. These networks and durations were then evaluated against the DOE project schedule drivers and adjusted as appropriate. The detailed schedules, supporting assumptions, and backup information establish a solid scheduling base for the AVLIS Production Plant. The realism of the schedule durations and the logic network tied to technology availability when combined with the appropriate deployment assumptions has resulted in an overall AVLIS Plant schedule that is aggressive but attainable. Further, when the overall AVLIS Plant schedule and specific

subsystem schedules are compared against other similar project schedules, appropriate confidence is established that the AVLIS Plant deployment schedule will be achieved.

DOE studies indicate that a one-month delay in the deployment of AVLIS causes a decrease in the enterprise's net present value of at least \$400 million per year. At this rate of loss, no plausible technology improvement can achieve a benefit-to-cost greater than unity, thus motivating delay. The additional funding needed to pursue the Engineering Limited scenario is less than \$100 million over FY85-86. Motivation to act on this plan is strong.

On the other hand, in spite of the benefit, it is not likely that the conditions necessary to support the Engineering Limited Schedule will be in place when needed. This program requires clear and timely direction and adequate funding. Pragmatically, the Authorization Limited Schedule is more probable. As a result this case is featured in the documents.

The three schedule cases presented in this document respond to both varying levels of schedule confidence and alternative ways of meeting deployment objectives within the constraints of cash flow and market demand. Unfortunately, we have not received updated cash flow and market demand data. Although we believe that the options presented include the full range of schedule options, the schedules presented probably do not represent our most optimum deployment scenarios from a financial point of view. Given the detailed constraints, we will adjust the details of the deployment to improve the AVLIS net present value.

The major engineering, procurement, and construction activity fiscal year and quarter start dates and durations for each option are itemized below:

Activity	Engineering Limited Schedule	Authorization Limited Schedule	Funding Limited Schedule
<u>Milestone Data</u>			
Significant Engr. start	86-1	86-1	87-1
Procurement start	87-1	88-1	88-3
Construction start	87-1	87-1*	88-1
Initial operation	90-1	91-1	92-1
Six modules operational at 95% plant capacity	92-1	93-1	95-1
<u>Activity Duration</u>			
Engr. duration	33 mo.	39 mo.	45 mo.
Procurement duration	39 mo.	42 mo.	45 mo.
Construction duration	51 mo.	63 mo.	63 mo.
Total duration from significant eng'r. start to initial operation of module #6	63 mo.	75 mo.	87 mo.

*Limited construction activities during the initial six months (mobilization, fencing, minor utility relocation, and limited site work).

The project team has selected the "Authorization Limited Schedule" for the most detailed analysis because it represents a reasonable and prudent pace for technology development, design engineering, procurement, construction and startup. This schedule requires commitment by all DOE and program participants to achieve the production deployment schedule. The project team has reviewed the "Authorization Limited Schedule" and lower tier schedules and is confident that, based on present assumptions, this mid-range schedule of major activities is attainable. This is based on a strong DOE commitment to the development efforts and facilities needed for the plant design and equipment tests.

Schedule information presented in this section is consistent with current AVLIS project plan milestones and is dependent on accomplishing ongoing research and development projects to support the key design information release requirements and meeting key engineering FY85 milestones as shown on Fig. 7-2. Figure 7-2 identifies the 1985 engineering milestones, AVLIS documentation, and process selection leading to the establishment of the Contractor Project Organization. The Contractor Project Organization would initiate major elements of the Project Management Plan. Key activities in the next five months would include: 1) preparation of the assessment package, 2) preparation of the architect/engineer bid and selection package, 3) notification of a letter-of-intent, 4) submittal of the 90% review of the conceptual design report, 5) initiation of significant engineering by the first quarter of 1986, and 6) submittal of the preliminary operations/maintenance plan for review.

The following sections contain a summary of the AVLIS Production Plant baseline schedule, schedule descriptions, major project milestone descriptions, and a schedule uncertainty.

7.2. BASIS OF AUTHORIZATION LIMITED SCHEDULE

Lower tier schedules for the AVLIS Production Plant baseline DOE Project Limit Schedule are consistent with the overall Master Schedule, Fig. 7-3. They are based on the successful completion of several key technology objectives established by the joint LLNL/Martin Marietta development team, and are shown in Fig. 7-4, Technology/Project Milestones Interrelations.

The schedules are based on major DOE decisions and/or authorizations through the project life that are critical to meeting project milestones:

- o AVLIS process selection, FY85.
- o Title I Engineering authorized, FY86.
- o Title I and II Engineering overlap.
- o Construction authorized, FY87.

Fig. 7-2. AVLIS production plant-1985 engineering milestones.

Initial increment of production

Fig. 7-3. AVLIS production plant "Authorization Limited Schedule."

- o No funding restraints after Management Plant approval.
- o High level of commitment at DOE-headquarters, DOE-Oak Ridge Operations Office, DOE-San Francisco Operations Office, LLNL, and Martin Marietta to achieve early production from the AVLIS Plant.

The schedules were prepared on the basis of the Contract Work Breakdown Structure. The Project Master Schedule and Supporting lower tier schedules incorporate work package summaries, milestones, intermediate milestones, logic diagrams, key design and procurement events, construction, fabrication and production ramp-ups.

The schedules are based on early conceptual and Title I engineering, proceeding in parallel and interacting with the development effort of a closely integrated technology/engineering team. Additionally, Title I preliminary design is planned to be performed in parallel with Title II detail design during part of FY86 for those design activities associated with construction's critical path, beginning with conventional facilities. The parallel Title I and Title II design activities will permit the preparation of an early construction activity bid package and the time necessary for bid response and analysis, and would allow the selection to be made in sufficient time for the key milestone of authorization/initiation of construction as a line item at the start of FY87. The Title I design report would be completed and submitted during the first quarter of FY87.

The AVLIS Production Plant technology objectives, closely coupled with the AVLIS Plant engineering and construction schedule, include several key performance/cost demonstrations in the FY86/87 time frame. These demonstrations are dependent on the successful completion of three essential system projects, each of which will operate fully integrated systems to demonstrate production cycle operations and obtain life-cycle data. These are:

- o Materials Handling Demonstration Module -- fully integrated materials handling at scale.
- o High-Performance Laser Facility -- fully integrated laser life cycle at scale.
- o Full-Scale Demonstration Facility -- fully integrated process performance at scale.
 - Laser Demonstration Facility
 - Separator Demonstration Facility

The baseline plan for completion of the AVLIS Production Plant project for the initial increment of production will span seven years, from project engineering authorization at the start of FY86 to the first year of full production at capacity achieved: 5 million swu/yr by FY93. This assumes that (1) the modules will be put into operation individually with initial operation of the first unit scheduled early in FY91, four years after project construction, and (2) the production ramp-up schedule thereafter is based on deployment of a module nominally every three months. There is an intermediate operational milestone providing 3 million swu/yr by the first quarter of FY92, six years after significant engineering authorization.

As discussed above, several key development milestones established by the AVLIS Program must be accomplished to support the plant schedules. These technology milestones and the plan for deployment form the basis of the AVLIS Production Plant schedules, from conceptual design in FY85 to initial increment of production achieved by the end of FY92. During this period of time many activities must be closely coordinated. These activities include design, procurement, construction, fabrication, training and preassembly, installation, and startup. The AVLIS Production Plant Master Schedule displays the planning schedule with emphasis on major activities, starting with construction authorization in FY87. Several parallel tasks are near the critical path in order to meet schedule objectives. The most important of these are given below:

- o Process-building construction completed in phased sections is to take advantage of the laser and separator refurbishment areas for equipment preassembly and training. This construction package would be followed by a cost-plus-award fee long-lead, computer-based instrumentation system including installation, software, and checkout such that the system is on-line for integrated startup of all systems.
- o Laser and separator major procurement issues for long-lead equipment that requires vendor qualification are included on the critical path to satisfy the production rates necessary to meet the deployment build-up of the six modules. Also included on the critical path are the separator process vessel and laser/separator refurbishment

(assembly) equipment. The above items are near the critical path for design, procurement, equipment/systems installation, checkout, and activation.

Task durations shown on the AVLIS Master Schedule are based on the project team's experience with similar activities or equipment in past or ongoing projects. Utilization of important system design features for special LIS equipment for the Full Scale Demonstration Facility with later transition to the AVLIS Production Plant can best assure success. The operational prototype for the primary AVLIS Production Plant hardware will be in the Full Scale Demonstration Facility. This prototype will establish the essential designs, vendor base, certain construction basis, system startup information and form a strong operational base.

One of the primary determinants in the process of planning a project schedule is the procurement cycle. As part of the conceptual engineering effort, a preliminary evaluation was made of the timing for issue of major procurement packages.

The schedules developed for the AVLIS Production Plant line-item project were based on key engineering activities in FY84-86. These engineering activities begin in FY84 with a preconceptual engineering design effort three years prior to construction project authorization. In FY86, a significant engineering-only line-item authorization will be required for Title I and II designs during FY86 and FY87.

The "Authorization Limited Schedule" project milestones and major intermediate milestones were reviewed by the architect/engineers forming part of the AVLIS project team. Bechtel National, Inc. prepared a Title I and Title II engineering design schedule where design is keyed to the master schedule with design release dates established to meet construction requirements. The construction lower tier schedule logic and activity durations have been reviewed by Stone & Webster Engineering Corp, Bechtel, and Martin Marietta.

7.3. MAJOR PROJECT MILESTONE DESCRIPTIONS

The major project milestones described below were established for the AVLIS Production Plant and are part of the rationale for the updated AVLIS Project Plan, May 1984. These milestones form the basis for the planning schedules for design, fabrication, procurement, construction, and startup activities for the "DOE Project Limit Schedule." As the design and planning effort proceeds in parallel with ongoing development activities, these fiscal year milestones have been established to meet the overall objectives and mission of the AVLIS Production Plant. The major project milestones are described as follows:

AVLIS Process Selection - June 1985

The basis for the AVLIS Production Plant schedules are based on the successful analysis, evaluation, and selection of the AVLIS process by the DOE Process Evaluation Board for full demonstration and development. Together with the selection is the premise that there will be a very high level of commitment at both DOE Headquarters and the DOE Oak Ridge Operations Office to achieve early production from the AVLIS Production Plant. This selection in mid-year 1985 would permit the Contractor Project Organization (LLNL/Martin Marietta) to proceed with preparation of the project management package. This management package will be prepared for the AVLIS Production Plant to establish the management approach/structure to accommodate DOE requirements for a major system acquisition and at the same time assure project technical success. The project management package includes the following:

- o Project Management Plan
- o Contract Work Breakdown Structure
- o Technical scope of work
- o Responsibility assignment matrix
- o Time-phased budgets
- o Project reporting plan

- o Major Systems acquisition documentation
- o Architect/engineer selection criteria

Engineering Authorized/Initiated - October 1986

A key project milestone is the initiation of Title I and II engineering design during the first of FY86 through the engineering-only, line-item authorization. This process would result in the selection of an architect/engineer to perform Title I and limited Title II design for LIS equipment and systems and full Title II design on conventional facilities and certain long-lead equipment.

Construction Authorized/Initiated - October 1987

A key project deployment milestone is the initiation of construction of the AVLIS Production Plant conventional facilities in the first of FY87 through the AVLIS Plant line-item construction authorization. This will provide approximately \$100 million in FY87 to continue Title II engineering, to initiate conventional facility construction, and to initiate long-lead procurement for certain general LIS equipment such as the separator module, vacuum vessel, and the plant control and data acquisition system central computer and software package.

Special Equipment Installation Initiated - July 1988

The special unclassified equipment installation would be initiated for certain equipment such as that contained in the laser and separator refurbishment areas, the front end of uranium processing facilities such as the toll facility, feed preparation facility (foundry), and the graphite shop.

Plant Engineering Design Complete - January 1989

The Title II detail engineering will be complete by start of the second quarter, FY89. The last phase of the engineering effort will conclude with

the final issue of special LIS equipment assembly and fabrication details. There is a planned overlap of engineering personnel assigned to assist Title III construction on interpreting drawings and specifications and provide other construction support.

AVLIS Production Initiated - October 1991

Startup activation will have been completed by the end of FY89 for all equipment and systems that support the first module in the AVLIS Production Plant. The module will become operational at the first of FY90 for the initial increment of enrichment operations. All prerequisite milestones that must be accomplished from operation training/certification (the operational safety reviews, integrated systems testing, etc.) will be completed prior to this operational milestone.

Full Initial Increment of Production Capacity Achieved - September 1992

The equipment necessary to increase the AVLIS Production Plant capacity to an effective capacity of 5 million swu/yr year will have been operational to complete that phase of the AVLIS deployment strategy identified as the initial increment of production. By the end of FY92 there will be six separators and three laser power amplifier modules installed and operational that are consistent with the FY84 Reference Design.

7.4. SCHEDULE UNCERTAINTY

The AVLIS Production Plant line-item project planning schedules, from start of construction to full-plant deployment, are based on preliminary conceptual design definition within a framework of major AVLIS program milestones. As expected, such schedules carry an inherent degree of uncertainty and it should be recognized that additional scheduling efforts will be made during the conceptual and Title I engineering phase to prepare the necessary, more detailed engineering, procurement, and construction schedules. Of primary importance to minimize uncertainty is early DOE

concurrence and support of funding milestones. Other areas of uncertainty that could directly impact the AVLIS Production Plant schedule are discussed in the following paragraphs.

Commitment by LLNL, Martin Marietta, and the architect/engineer of skilled personnel to perform required design tasks in a timely fashion is critical to completing the engineering design on schedule.

Delays or problems in the performance objectives of the Materials-Handling Demonstration Module, the High-Power Laser Facility, or the Full-Scale Demonstration Facility will impact the design and subsequent procurement and construction completion dates for the plant. Since many of the Full-Scale Demonstration Facility development components are to be prototypic of components for the plant, the potential exists for AVLIS Production Plant design schedule impacts if Full-Scale Demonstration Facility components undergo major design modification.

Several key elements in the process support systems (power supplies, refurbishment equipment, and data acquisition system) require special and early attention to ensure that these long-lead components do not become the overall schedule driver.

Input from the joint LLNL/Martin Marietta technology team was used to establish the laser system schedules and, although preliminary, it is considered appropriate at this stage of the project. However, the critical path schedule, through both the laser and separator engineering procurement/installation activities, has minimum contingency for completion of the engineering phases. The schedule assumes that the laser specifications are developed, and detailed procurement planning is completed by the fourth quarter of FY87. This will permit an aggressive start of the procurement activities for the laser system and allow adequate time for the initial procurement activities of the copper-laser subassemblies/components bought from functional specifications to assure performance prior to placing major plant subcontracts in FY87. A successful laser development program focused through the Laser Demonstration Facility is a key to meeting laser acquisition schedules for the plant. A similar schedule scenario is envisioned for the design and procurement of the separator module.

The availability of the architect/engineer at the beginning of the project is necessary to permit early work on the design package for site

grading, underground utilities, and building foundations. This will help ensure that the project schedule will not be limited by the building construction schedule. This requires design criteria development and the start of the architect/engineer selection process in FY 1985 prior to authorization of the engineering-only line item.

The AVLIS Production Plant is modular, permitting early operation of the initial laser module/separator module, while the final units are still in the procurement/installation cycle. This early operation places increased pressure on the schedule for support facilities such as the refurbishment facility and the graphite shop.

There are management options that could result in a project schedule of shorter durations than presented. An example might be a change to the procurement plan for the laser that utilizes more vendors to supply system components and accelerates the total laser deliveries. To realize an overall project acceleration, multiple vendors would be required for both separator and laser components and support facilities would have to be completed early. This would increase the unit cost of lasers and separator modules, but would reduce the escalation. An important requirement to accommodate this type of multiple source procurement is the need for increased obligational authority in the early project years. Options for multiple-source procurement will be evaluated during the preliminary engineering phase.

7.5. AVLIS DEPLOYMENT PLAN, PLANT 1 AND 2

The continuation of DOE's strong commitment to the AVLIS Program and continuation of a low cost enrichment process requires the authorization/initiation of a second plant utilizing the AVLIS process. The second plant would be started later in the FY80s. Figure 7-5, AVLIS Plant Deployment Schedule, illustrates the major activities associated with the AVLIS Production Plant and the second plant. Figure 7-6 displays the AVLIS deployment strategy compared to U.S. sales production of enrichment services. The demand projections shown on this figure were provided by the DOE Office of Uranium Enrichment on June 6, 1984.

Figure 7-6 establishes the AVLIS deployment strategy which best accommodates the U.S. sales projection of uranium enrichment. The current

U.S. production of enriched uranium sales to domestic, foreign, and military customers is approximately 15 million swu in 1985 which rises to approximately 20 million swu/yr through the 1990s and from 20 million swu/yr to approximately 30 million swu in the year 2000. The U.S. sales projection is shown on this figure as the top solid line. The AVLIS Deployment Strategy utilized current technology and equipment concepts, constructed in the Full-scale Demonstration Facility, as the technical basis for the initial increment of deployment for the AVLIS Plant to permit early operation and production. The production begins in 1991 and quickly ramps-up to approximately 5 million swu/yr. An upgrade of this production equipment performance and the addition of supplementary process equipment brings the overall plant performance from 5 million swu/yr to approximately 13 million swu/yr during the mid 1990 time frame. To meet the overall U.S. sales projection, a second AVLIS Plant will be constructed of the advanced performance equipment and will become operational in the mid 1990s. The total cumulative output is shown on the dashed line of the figure which matches the overall U.S. sales projection of enrichment extremely well. During the interim period, prior to significant AVLIS production, the U.S. sales can be met through the production capacity of the existing diffusion plants.

1980's						1990's									2000's										
4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9

Fig. 7-5. AVLIS Production Plant deployment schedule.

**Demand projections provided by the Office of Uranium Enrichment
on June 6, 1984**

Fig. 7-6. AVLIS plant production to meet U.S. sales projection.

8. COST AND MANPOWER ESTIMATES

8.1. GENERAL FUNDING GUIDELINES

The cost estimates and associated budget profile contained herein were developed for the AVLIS Production Plant Project in accordance with and to meet the intent of the requirements and procedures contained in the DOE Orders and Principal Contractor Guidelines.

The Scope of the AVLIS Production Plant Project was described in Sec. 2. The guidelines for preparing a budget for each activity of the AVLIS Production Plant Project are contained in the following subsections. The terms to be used are:

- o Total estimated cost - the funding required to design, construct, and equip the AVLIS Production Plant.
- o Total project cost - all direct associated activities to design, construct, equip, and activate the AVLIS Production Plant Project, and directly supporting development.

8.1.1. Total Estimated Cost

Total estimated cost includes the following scope:

- o Applicable definitive design, procurement, construction, equipment installation, inspection, field engineering, and acceptance testing of
 - Laser systems
 - Laser support systems
 - Separator support systems
 - Uranium processing systems
 - Safeguards and security systems
 - Central plant I & C

- buildings and utilities
- o Construction management
- o Directly related participating contractor costs
- o Contingency on design, procurement, and construction
- o Martin Marietta/LLNL support activities
 - Facility and system project management in support of project activities
 - Project control in support of project activities
 - Technical direction of architect/engineer and other contractors
- o Support for procurement, construction, and installation
- o Final Safety Analysis Report
- o Project assurance in support of project activities
- o RAM studies in support of project activities
- o Records management/configuration management in support of project activities
- o Systems support in support of project activities
- o Project management activities

8.1.2. Total Project Cost

The Total project cost consists of the funding required to support activities within the total estimated cost plus the funding necessary to support the development of conceptual designs, development activities, project assessments, and training and startup. All developmental activities are funded by the AVLIS program. This effort encompasses the following.

Scope:

- o Conceptual design
 - Functional design criteria
 - Conceptual design reports
 - Advanced conceptual design reports
 - Engineering studies
- o NEPA documentation
- o Preliminary Safety Analysis Report

- o Project assurance activities in support of conceptual design
 - Health, safety, and environment
 - Quality Assurance
 - Safeguards and security
 - Material
- o Training and startup
- o Direct conceptual design phase support
 - Facility and system project management
 - Records management/configuration management
 - Design team review
- o Technology project management
- o Project control in support of operating expense activities
- o RAM and preliminary analysis during conceptual design
- o Architect/engineer technical direction during conceptual design phase
- o Project management during conceptual design phase
- o System requirements
- o Trade-off and alternative studies
- o Technical support activities

8.2. PROJECT COST ESTIMATES

Estimates were prepared for the capital and operating costs of the AVLIS Production Facility. The estimates were prepared for the initial increment of production and the fully activated plant. They were developed as bottoms-up estimates by the architect/engineer contractors. The disciplined estimating process followed an orderly development through the use of an expanded Contractor Work Breakdown Structure on the lasers and separators to level six and uranium processing facilities to level five.

The capital costs were structured around major cost drivers, i.e., lasers, separators, other special process equipment such as plant-control data acquisition systems and power conditioning systems. The Uranium Processing Facility cost drivers were also utilized.

The operating cost estimate was also developed by performing a bottoms-up estimate. The operating estimate was the product of a task force composed of LLNL and Martin Marietta operations, maintenance, engineering, and technical

support personnel. The estimate was structured around major cost drivers (i.e., operational manpower, operational material, power, utilities, and external uranium handling).

Estimating accuracy was improved by the large amount of cost-pricing data available on the AVLIS systems. The first-of-a-kind capital cost estimate accuracy was also improved by judicious use of experienced contractors.

A summary of the capital cost estimates for the AVLIS Production Plant is presented in Table 8-1. Capital costs are shown for the initial increment of production and for the fully activated plant. Detail capital cost estimates based on the FY84 Reference Design have been prepared and are presented in "AVLIS Production Plant Capital Cost Summary," (APP-050).

A summary of the operating costs for the AVLIS Production Plant is presented in Table 8-2. Operating costs are shown for the initial increment of production and for the fully activated plant. Detail operating cost estimates based on the FY84 Reference Design are contained in "AVLIS Production Plant Operating Cost Summary," (APP-110).

Table 8-1. AVLIS Production Plant capital cost estimate (\$X1000).*

Item	Initial increment of production	Transition to fully activated plant	Fully activated production plant	Comparable plant at Greenfield site
Process building conventional facilities	142,811	15,021	157,832	181,825
Process building special equipment				
Laser systems	201,224	36,171	237,395	223,523
Separator systems	120,986	50,413	171,399	158,575
Plant control data acquisition	10,652	0	10,652	14,813
Power conditioning	62,380	19,333	81,713	82,916
Process support	42,595	4,605	47,200	47,941
Uranium processing facilities	89,354	47,157	136,511	169,173
Plant support facilities	8,548	1	8,549	21,520
Total construction cost	678,550	172,701	851,251	900,336
Project integration	109,022	30,978	140,000	180,067
Contingency	171,801	61,948	233,749	264,597
Total cost	959,373	265,627	1,225,000	1,345,000

*Estimate in FY86 midyear dollars.

Table 8-2. AVLIS Production Plant operating cost estimate (\$ x 1000).*

Operating Element	Initial increment plant (5 M SWU/yr)	Fully activated plant (10-13 MSWU/y)	Greenfield site plant (10-13 MSWU/y)
Production Facility	78,288	105,559	108,749
Labor	(20,440)	(23,908)	(23,908)
Materials and services	(19,044)	(18,911)	(18,911)
Electrical power	(36,976)	(60,301)	(63,730)
Other utilities	(2,008)	(2,439)	(2,200)
Uranium processing facilities	27,954	52,272	49,445
Labor	(13,469)	(19,561)	(23,616)
Materials and services	(11,995)	(27,036)	(20,090)
Electrical power	(1,590)	(3,875)	(4,100)
Other utilities	(900)	(1,800)	(1,639)
Support facilities	6,395	8,488	8,433
Labor	(4,028)	(4,826)	(4,673)
Materials and services	(1,240)	(1,590)	(1,590)
Electrical power	(927)	(1,722)	(1,820)
Electrical power distribution equipment maintenance	(200)	(350)	(350)
Support services	14,827	18,886	22,595
Labor	(12,327)	(15,686)	(18,995)
Materials and services	(2,500)	(3,200)	(3,600)
Total operating costs	127,464	185,205	189,222

* Estimate in FY86 midyear dollars.

Numbers in parenthesis represent subtotals for the number above.

8.3. MANPOWER ESTIMATES

Estimates of the manpower required to design and build the AVLIS Production Plant were developed for the Initial Increment of Production. The estimates are based on the "Authorization Limited Schedule." A breakdown by year of the construction manpower requirements in man years is shown in Table 8-3. The Table also shows a breakdown of the total construction effort according to construction contractor. The split shows the effort for fixed price, cost plus and operating contractors. Throughout the construction phase manpower requirements will change to support the construction schedule. The number of construction workers present at the beginning of each fiscal year quarter is shown in Table 8-4. Again, the numbers are broken down by construction contractor.

As described in Section 5 engineering will be accomplished by a joint team consisting of personnel from LLNL, Martin Marietta and architect/engineers. The engineering participation for the initial increment of production is shown in Fig. 8-1. A breakdown of the engineering participation by year is presented in Table 8-5.

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Table 8-3. AVLIS Production Plant initial increment of production
authorization limited schedule construction manpower summary.
-Direct Craft-

Fiscal year	Construction manpower	Construction contractor	Construction manpower
1987	250	Fixed price cost plus oper. cont.	250 0 0
1988	680	Fixed price cost plus oper. cont.	600 70 10
1989	850	Fixed price cost plus oper. cont.	550 270 30
1990	400	Fixed price cost plus oper. cont.	25 310 65
1991	315	Fixed price cost plus oper. cont.	0 250 65
1992	61	Fixed price cost plus oper. cont.	0 37 24
Total	2556 mn yrs	Fixed price cost plus oper. cont	1425 937 194

Table 8-4. AVLIS Production Plant, initial increment of production, authorization limited schedule - breakdown of construction manpower (Direct Craft).*

Date fiscal year-quarter		Fixed price construction	Cost plus award fee construction	Martin Marietta construction support
87	1	--	--	
87	2	200	--	
87	3	300	--	
87	4	500	--	
88	1	550	--	
88	2	625	--	
88	3	625	100	20
88	4	600	180	20
89	1	600	250	20
89	2	600	250	30
89	3	550	290	30
89	4	450	290	40
90	1	100	300	60
90	2	--	320	60
90	3		320	70
90	4		300	70
91	1		300	70
91	2		300	70
91	3		250	60
91	4		150	60
92	1		148	60
92	2		--	36
92	3			
92	4			

*Manpower values represent number of workers present at the beginning of each fiscal year-quarter.

Fig. 8-1. AVLIS Production Plant "Authorization Limited Schedule" initial increment of production engineering participation.*

- * - Total manpower represents direct engineering participation.
- Engineering budget supports approximately 20 to 40 percent indirect project personnel depending on contractor.

Table 8-5. AVLIS Production Plant initial increment of production engineering manpower.

Fiscal year	Engineering manpower	Primary participant	Participant manpower
1985	55	MMES LLNL A/E	20 20 15
1986	300	MMES LLNL A/E	95 55 150
1987	340	MMES LLNL A/E	100 65 175
1988	250	MMES LLNL A/E	90 60 100
1989	135	MMES LLNL A/E	60 40 35
1990	85	MMES LLNL A/E	40 25 20
1991	85	MMES LLNL A/E	40 25 20
1992	50	MMES LLNL A/E	30 10 10
Total Requirements	1300	MMES LLNL A/E	475 300 525

9. CRITERIA FOR PROJECT PERFORMANCE

9.1. AVLIS PRODUCTION PLANT

The AVLIS Production Plant Project, a Major System Acquisition, will design, build, and operate an integrated AVLIS Production Plant. The AVLIS Production Plant will be capable of enriching uranium to commercial grade. All AVLIS Production Plant facilities and processes will comply with applicable federal, state, and local regulations pertaining to public safety and safeguards and security requirements.

The performance criteria delineated below are unclassified summaries of the primary criteria.

9.2. AVLIS PRODUCTION PLANT PERFORMANCE CRITERIA

The AVLIS Production Plant Project will provide a long-term capability to enrich uranium obtained from various sources. Initial production will commence in FY91; full production will be achieved in FY93. The performance criteria are:

- o Achieve a 25-year design life.
- o Produce enriched uranium at a steady-state annual output meeting DOE requirements in terms of isotopes, elemental, and throughput requirements.
- o Achieve a prescribed target cost of operations.
- o Process UF_6 feed and produce UF_6 .
- o Optimize plant availability meeting DOE-established requirements in the Project Charter.
- o Meet federal, state, and local regulations for protection of public safety, environment, and special nuclear material under process.
- o Operate in facilities that meet suitable natural phenomena and design-basis accident protection requirements.
- o Achieve initial production in FY91.

- o Provide an operating database for reliability, availability, and maintainability evaluation.
- o Integrate with other Oak Ridge facilities.
- o Provide an integrated security system for the AVLIS Production Plant and selected support facilities, protecting against external and internal potential diversion of special nuclear materials and protection of classified materials and processes.
- o Ensure that nuclear material accountability meets current DOE orders.
- o Process waste to meet requirements for final disposal.

9.3. TRAINING AND ACTIVATION

Training and activation consists of training, operational testing, and readiness reviews. The performance will:

- o Train and certify the initial core group of operations and maintenance personnel.
- o Demonstrate by acceptance test and operational test procedures that plant processes are ready for operation.
- o Ensure that all required technology transfer occurs prior to plant activation.
- o Verify readiness by formal review prior to operation evaluation test results, documentation, and operator qualification.
- o Provide operations and maintenance participation in all major design and construction reviews.
- o Achieve performance qualifications for operating personnel.

9.4. SYSTEMS INTEGRATION PERFORMANCE CRITERIA

The systems engineering approach will ensure that the total plant is designed and constructed in an integrated manner. The performance will:

- o Achieve project schedule objective of production start in FY91.
- o Develop a cost, schedule, and technical baseline and develop a control cost, schedule, and scope to that baseline.

- o Achieve project cost objectives within total project cost and total estimated cost.
- o Prepare the implementing documents for project management, safety, environmental, and other required assessments for a major system acquisition.
- o Produce an integrated chemical and physics design basis for enrichment performance, including integration of process measurement control.
- o Provide detailed technical criteria and use them to perform and review the design.
- o Provide configuration control, including the control of plant system functional and physical interfaces.
- o Meet the reporting and formal major decision-making process required by DOE Major System Acquisitions.
- o Prepare reliability, availability, and maintainability evaluation to support the plant design and the operating plant.
- o Allocate availability to each plant system.
- o Evaluate alternates to ensure that the most suitable features and processes are selected for the plant.

10. PROJECT MANAGEMENT SYSTEM

This section describes the methods the Contractor Project Organization will employ to plan, monitor, control and report the AVLIS Production Plant efforts. The AVLIS Production Plant Project will be a Major Systems Acquisition of DOE. Thus, the Project will be executed in accordance with the requirements of DOE Order 5700.4A, "Project Management System," and DOE Order 2250.1, "DOE Cost and Schedule Control Systems Criteria for Contractor Performance Measurement."

Organizational responsibilities and relationships of DOE and the contractors are defined in Sec. 4. Described below are the systems to be used in the management of the project. The discussion covers baseline definition, configuration control, and cost and schedule control. In addition, the objectives of the system are discussed.

10.1. OBJECTIVES OF THE PROJECT MANAGEMENT SYSTEM

The objectives of the Project Management system are to:

- o Furnish a formalized planning and controlling system that integrates the work performed by project participants.
- o Provide a formal plan for execution of the contract within the established Contract Work Breakdown Structure.
- o Monitor and measure cost and schedule performance against that plan.
- o Furnish a means of analyzing the effect of variations from that plan, forecast their impact, recommend corrective action, and modify the plan.
- o Provide a database that will hold all pertinent data and can be accessed by DOE.

10.2. PROJECT MANAGEMENT APPROACH

The AVLIS Production Plant Project Management System consists of the interrelated set of individual subsystems and disciplines shown in Fig. 10-1.

The subsystems are designed to be mutually supportive and form an integrated Project Management System. Figure 10-1 reflects the components by grouping according to principal project parameters (technical, cost, and schedule, and the integrating components).

A Project Summary Work Breakdown Structure has been developed for the AVLIS Production Plant Project and is included in Sec. 6 of this Project Management Plan. Appropriate definitions of the lowest level element of work are included in the Project Summary Work Breakdown Structure Dictionary (See AVLIS Production Plant, APP-020). MMES, LLNL, and other major contractors (i.e., architect/engineers) will develop Contractor Work Breakdown Structures as required to further define the work scope into manageable elements. Defining work segments and assigning responsibility for work at the lower levels will provide the basis for organizational Work Breakdown Structures summaries of planning and performance data.

The AVLIS Production Plant Project Management System Components will be integrated with the Work Breakdown Structures, the organizational structure, and with each other. The common basis of integration will be the Work Breakdown Structure's element coding identity, which ties together the schedules, budget, costs, and organization.

The AVLIS Production Plant Project Management System will apply the concept of feedback control in which a plan is established, performance is measured against the plan, and action is taken when plan and performance diverge significantly. Planning consists of:

- o Defining the work to be performed (work definition - Work Breakdown Structures).
- o Establishing a documented technical baseline defining the project configuration.
- o Dividing the work into manageable units and assigning it to performing organizations (work logic definition).
- o Establishing a schedule for performance of assigned work (schedule control).
- o Budgeting and allocating the resources necessary for accomplishing the work (cost control, funds management).

Fig. 10-1. AVLIS Production Plant project management system.

Performance is measured against schedules and budgets and technical adequacy is ensured. These measurements are analyzed and reported for management action (analysis and data utilization). Management actions are taken, as necessary, to bring the plan and performance into convergence, thus completing the feedback control loop.

10.3. SUPPORTING MANAGEMENT SYSTEMS

The AVLIS Production Plant Project Management System will be augmented and supported by established administrative systems in existence at Martin Marietta and LLNL. These support systems include:

- o Finance and accounting
- o Procurement services
- o Contract negotiation and administration
- o Health, safety, and environment

In addition, support such as legal services and safeguards and security are provided as needed to ensure that the AVLIS Production Plant Project is executed in an orderly manner.

The above-described support is provided to the respective project offices on a matrix basis (to the degree required) from existing functional organizations of the DOE operations offices (Oak Ridge Operations and San Francisco Operations) and Martin Marietta and LLNL.

10.4. COST AND SCHEDULE CONTROL

10.4.1. General

Since the AVLIS Production Plant Project will be a Major Systems Acquisition of DOE, the provisions of DOE Order 2250.1, "DOE Cost and Schedule Control Systems Criteria for Contractor Performance Measurement" apply.

Implementation of the Cost and Schedule Control Systems Criteria will progress as the project develops, with complete implementation accomplished after conceptual design and the development of a firm cost and schedule

baseline. The intent of the criteria with respect to baseline integrity and use of the earned-value method of measuring performance for AVLIS Production Plant project activities will be initiated at the earliest date in the project, consistent with the firmness of project cost and schedule parameters. Following is a summary description of the cost and schedule management system for the AVLIS Production Plant Project and how it will comply with the provisions of DOE Order 2250.1. A detailed description of Contractors' Cost and Schedule Management Systems will be included in their respective system description documents.

10.4.2. Organization

The project scope of work is defined by a Project Summary Work Breakdown Structure (Sec. 6). Assignment of work responsibility at the Project Summary Work Breakdown Structure level will be completed. Subsequently the Contractor Project Organization will assign Contractor Work Breakdown Structure elements of work to specific participating contractors. The combination of definition of work segments and assignment of responsibility for work at the lower levels will provide the basis for organizational and Work Breakdown Structure summaries of planning and performance data.

The AVLIS Production Plant management-system components are integrated with the Work Breakdown Structure, the organizational structure, and with each other. The common mechanism of integration is the cost account (lowest level of Work Breakdown Structure) which ties the scope, schedules, budget, costs, and organization together by its element coding identity.

10.4.3. Planning and Budgeting

The AVLIS Production Plant Project will use a flow-down scheduling system beginning with controlled milestones (established by DOE) followed by a Project Master Schedule (approved by DOE). Lower level milestone and working schedules used by the performing contractor organizations to schedule and measure the startup of work will follow. Major milestones are those milestones defined in the Project Plan as controlled by DOE Headquarters. The hierarchy is integrated with the appropriate and corresponding level of the

Work Breakdown Structure. Figure 10-2 provides a typical schedule hierarchy to be used on the AVLIS Production Plant project. A work logic diagram will provide the summary level interrelationship among Project activities. The diagram will facilitate the identification of interdependencies and interfaces necessary for effective work planning and accomplishment. The total scheduling system contains the information necessary to support lower-level work planning and to measure work progress against the plan.

The Contractor Project Organization established budgets for the performing organizations based on the work scope and milestones for which they are responsible. The budgeting system requires that managers and leaders, at the level where work will be performed, develop detailed plans and resource estimates of specific tasks to be accomplished. The summation of the resources applied to the scheduled tasks results in a time-phased budget baseline against which cost performance can be measured. Funds are then allocated by the Contractor Project Organization based on the budgeted work. Work performed is then measured in terms of earned value for comparison against plans.

10.4.4. Accounting

Direct costs incurred by all participants on the AVLIS Production Plant Project are recorded on a basis that is consistent with the way budgets are established. Costs are recorded in a formal system controlled by the general book of accounts. Costs are accumulated and segregated at a detail level of the work-breakdown and organizational structures. Consequently, costs can be summarized up through the Work Breakdown Structure and organizational structures to project totals. Indirect costs likewise can be summarized from the level of application from each applicable overhead pool.

10.4.5. Analysis

Performance of AVLIS Production Plant Project activities is measured monthly in terms of schedule and cost. The basis for such measurement is the budgeted cost of work scheduled, resulting from the budget established for each work package. Project management personnel review and analyze cost and

Fig. 10-2. Schedule hierarchy.

1 schedule variances from the plan on a monthly basis and initiate appropriate action to correct or minimize the impact of unfavorable performance.

Schedule performance of AVLIS Production Plant Project activities is measured and reported in terms of physical accomplishment of scheduled milestones (Milestone Schedule Status Report, Sec. 11) and also in terms of the value of work accomplished (budgeted cost of work performed). The combination of measurements ensures that the volume of work being performed is measured and that the sequence of work is also considered.

The AVLIS Production Plant Management System provides timely and useful performance data to project leaders and managers at appropriate levels. The generated status reports provide the bridge between performance problems and actions taken to solve the problems. A description of status reporting is given in Sec. 11.

10.4.6. Revisions and Access to Data

Procedures to accommodate significant revisions to technical, cost, and schedule baselines have been initiated and will be in full operation at the scheduled date for completion of conceptual design. The procedures will provide for the control and incorporation of revisions to any one of the baselines and for associated adjustment to the other two in a timely and well-documented manner. It is planned that significant revisions will be authorized, scheduled, budgeted, and reflected in baseline data within 60 days of approval and/or authorization of revisions.

10.5. FUNDS MANAGEMENT SYSEM

The objective of the funds management system is to provide for the acquisition and use of project funds that provide optimum technical and schedule performance. The system is designed to assure that all project participants (DOE and contractors) adequately plan for the acquisition, application, and accounting of funds necessary to accomplish project work. The end product of the funds management system is an analysis of intended use

of funds versus actual performance stated in terms of authorizations, obligations, commitments, expenditures, billing, and contingency.

The DOE Project Office, the Contractor Project Office, and participating contractors review estimates of project costs periodically. The conceptual design, independent cost estimates, and other appropriate documentation contribute to the development of budget estimates and the effectiveness of the funds management process. More detailed estimates are provided by the architect/engineer during definitive design. Periodic reporting of expenditures and forecasts of future commitments by contractors will provide valuable data for project funds management activities.

The funds management process ensures that the project proceeds within scope and on schedule within the constraints of monies made available for a fixed period of time (i.e., fiscal year), allowing for uncosted obligations. Scheduled activities during the funding period shall be established according to available funds. A funding forecast will then be maintained to project the cost of these scheduled activities throughout the funding period. This forecast will be used to assess the capability to handle changes and accelerate or delay the schedule. When the forecast reflects a significant problem that cannot be handled within the capabilities of the integrating contractors, the appropriate DOE field office will be notified immediately.

The DOE controls funding to the integrating contractors via financial plans and directive authorizations. When the current forecast requires a change to either of these authorizing documents, the suitable DOE field office shall be notified via letter or request for directive change, respectively.

10.6. PROJECT CHANGE CONTROL

Change control for the AVLIS Production Plant Project is summarized here and shall be in accordance with the AVLIS Production Plant Project Control Manual procedures supported by institutional management and control systems. The change control system shall be applied to criteria, scope, interfaces, schedule, and budget. The project change control system will be interfaced with the configuration control system.

Project change control ensures the proper identification, assessment, and approval of changes to the baseline criteria, technical scope, interfaces, schedule, and budget. All configuration changes processed under configuration control must be assessed for project impact prior to approval.

10.6.1. Change Identification

A change can be identified and proposed at any level of the project organization. The originator of the change is responsible for adequately describing and justifying the proposed change.

10.6.2. Change Evaluation

Once a change to baseline data is proposed, it will be thoroughly evaluated to determine the impact on other baseline data, configuration, and availability of resources (i.e., manpower or contingency). The change evaluation process will result in an established change classification (approval level) and a listing of affected documents.

10.6.3. Change Approval

Once the change proposal has been evaluated and documented, it shall be submitted for approval based on its assigned class:

<u>Class</u>	<u>Approval Level</u>
I	DOE Project Manager
II	AVLIS Production Plant Project/Technical Project Office
III	Second tier managers for the project (managers reporting directly to Project Manager)

Table 10-1 provides the criteria for each class of change. The Project Review Board will, as a part of its charter, assess Class I and II changes.

Table 10-1. Project Change Criteria.

Class	Criteria
I**	<ul style="list-style-type: none"> o Impacts the mission need o Increases the total estimated cost or total project cost o Impacts primary or functional criteria o Impacts a controlled milestone greater than 1 month o Results in a need to revise the current financial plan or a directive authorization o Results in a need to allocate contingency greater than that amount allowed to the principal contractors (see Contingency Control) o Adds new scope to the project whose value is greater than \$500,000 o A request to rebaseline the project or a portion of the project
II	<ul style="list-style-type: none"> o A schedule change by one principal contractor which impacts the schedule of the other *o Impacts technical interface data between principal contractors o Impacts top-level design requirements contained in Primary Criteria Document o Adds new scope to the project whose value is between \$250,000 and \$500,000 o Results in a need to allocate contingency greater than that amount allowed to the individual principal contractors (see Contingency Control)
III	<ul style="list-style-type: none"> o Any program change not Class I or II to include: <ul style="list-style-type: none"> -- Change to scope, schedule, and/or budget -- Change to design requirements (non-criteria) * -- Change to technical interface data between individual contractor project elements

*A change to an interface can be handled via an interface change order as long as no other criteria are imposed (see para. 10.8.5, Interface Control).

**The AVLIS Production Plant Project Office will obtain the approval of DOE Headquarters when appropriate.

10.6.4. Change Implementation

Once approved, the change request is reissued as a change notice to affected participants for implementation. Affected documentation will be revised in accordance with their respective revision procedures.

10.7. CONTINGENCY CONTROL

Contingency is additional monies identified to the project to cover unforeseeable situations that may arise and is contained in the total estimated cost for the given project.

Use of contingency will be strictly controlled through the use of logs and requests. Contingency logs will be maintained by the Contractor Project Organization. Contingency will be monitored and controlled on a total project basis for the AVLIS Production Plant Project line item. Current available funding is monitored and controlled through financial plans and/or directive authorizations (See funds management).

No contingency is associated with non-total estimated cost elements of the Work Breakdown Structures. Each integrating contractor is responsible for establishing his own management reserve to handle unforeseeable changes within these areas. Upon establishment of a project total estimated cost based on conceptual design, contingency logs will be initiated.

The initial entries will reflect the total planned contingency. The following approvals are required for use of contingency:

- o DOE Field Office approval (Project Manager) is required for:
 - Any individual request to use contingency that is greater than \$100K.
 - Any individual request to use contingency that is greater than \$15K when the total available contingency is less than 10% of the uncommitted balance of the total estimated cost.
 - Any request to use contingency that requires a change to a DOE financial plan or directive authorization.
- o Contractor Project Office approval is required for:

- Any individual request to use contingency that is greater than \$25K.
- Any individual request to use contingency when the total available contingency is less than 15% of the uncommitted balance of the total estimated cost.
- o Individual contractors can approve use of contingency within the threshold above.

All requests to use contingency shall be documented on a request-to-use contingency form. When associated with a change request, the request-to-use contingency form should accompany the change package. When the request-to-use contingency is associated with a projected overrun, every effort should be made to obtain prior approval before a commitment is made to the overrun.

Credit entries shall also be made on the contingency logs resulting from underruns and/or scope reductions. These entries will be made directly on the contingency logs with no additional documentation required. Underruns will not be entered until either the job has been completed or a firm fixed price has been established and commitment has been made to it.

A summary of contingency status will be provided in the monthly reports. The contingency logs will be available for review as required at monthly project review meetings.

10.8. TECHNICAL CONTROL

Effective technical control shall be maintained on the project through use of criteria, requirements, design documentation, design reviews, configuration control, and interface control. Technical control will be integrated closely with the cost and schedule control system to ensure design changes are properly assessed against scope, schedule and budget. The following paragraphs provide a summary description of the technical control elements.

10.8.1. Criteria and Requirements

Criteria and requirements shall be established early in the project to support the design process. Once established, criteria and requirements shall be controlled through the project change control system (See para. 10.6). The following documentation will be used:

- o Primary Criteria -- a primary criteria document depicting top-level criteria (DOE Project Manager-Controlled) and top-level design requirements (Contractor Project Organization controlled) will be prepared and maintained throughout the life of the project.
- o Functional Design Criteria -- a series of functional design criteria will be developed, primarily at subproject levels, depicting functional criteria and design requirements (Contractor Project Organization-controlled).
- o System Requirements -- System requirement documents (Contractor Project Organization-controlled) will be prepared for selected systems which cross subproject boundaries to ensure compatibility between system elements. One such system is instrumentation and control.

10.8.2. Design Documentation and Control

The design shall be developed in two primary phases:

- o Conceptual design
- o Definitive design

The conceptual design phase shall be controlled by the functional design criteria, system requirement documents (if applicable), and any interface control documents (See para. 10.8.5). The conceptual design will result in a conceptual design report to include:

- o Conceptual system design description
- o Design and construction schedule

- o Conceptual cost estimate
- o Drawings and sketches

A conceptual design review (see para. 10.8.3) will be performed prior to issuance of the conceptual design report.

Definitive design shall commence following completion of conceptual design. The definitive design shall be controlled by the functional design criteria (upgraded if needed to incorporate additional design requirements resulting from conceptual design), system requirements documents, and interface control documents. The conceptual design is not controlling, but any deviation which results in a significant change to the conceptual design cost-estimate or schedule must be processed through project change control prior to proceeding. The definitive design shall result in detailed design drawings, procurement specifications, and construction bid packages. A definitive design cost-estimate and construction schedule will also be provided.

The definitive design documentation will be maintained under configuration control (see para. 10.8.4) after initial release, and throughout procurement, construction, and installation cycles. At the completion of construction and acceptance testing a set of as-built drawings will be prepared reflecting the actual as-built condition.

10.8.3. Design Review

A formal design review process will be maintained throughout conceptual and definitive design. As a minimum, design reviews will be conducted at approximately the following stages:

- o 90% conceptual design
- o 30% definitive design
- o 90% definitive design

For selected complex designs, another definitive design review may be conducted at approximately 60% completion. Each design review will be

1 formally documented in a design review report, issued by the design review team chairman. Resolution of design review comments by the design organization will be included.

In addition to formal design reviews, a design team approach will be implemented. The design team will monitor the design progress on a continuous basis to ensure compliance with criteria, requirements, and interfaces.

10.8.4. Configuration Control

Configuration control will be maintained on all released design media (drawings, specifications, etc.). The design managers will maintain a traceable process for changing design data and the effect of the change when appropriate. This process will be closely interfaced with the project change control system to ensure configuration changes are properly assessed for impact to criteria, requirements, interfaces, scope, schedule and/or budget.

10.8.5. Interface Control

Due to the involvement of several contractors and multiple subprojects, an interface control systems making use of interface control documents will be used. The interface control documents shall be prepared during conceptual design, and be available as controlling documents in support of definitive design. The documents shall (1) identify the physical interface points between responsible contractors, and (2) define the physical and function parameters as those interface points to which the various contractors shall design. The initial interface control documents will not include all the interface data eventually required to be defined, so a tracking system will be established to ensure release of interface data prior to its need. The released interface control data shall be under project change control control.

An interface change order will be used once an interface control document is released to add or change interface data. The interface control document would then be updated periodically to incorporate all interface change orders approved since the last revision. The interface change orders will be approved by both sides of the interface. If an interface change

proposed impacts any other project baseline elements (criteria, scope, schedule, and/or budget), a change request/notification will be initiated in accordance with the project change control system (see para. 10.6). In addition, later in the project interface tools will be used to verify the integration of specific critical components.

10.9. TEST AND EVALUATION CONTROL

Appendix B provides the preliminary test and evaluation plan for control of development, acceptance, and operation testing. In summary, control shall be exercised through use of test plans and procedures and the proper analysis and documentation of test results. No testing shall be performed without an approved test procedure. Quality assurance verification will be conducted to ensure the procedures are properly followed.

11. INFORMATION AND REPORTING

The AVLIS Production Plant Project will provide formal and uniform systems and procedures for obtaining, documenting, disseminating, and controlling technical and programmatic project data and information. To the extent applicable and required, the following DOE orders will be implemented on the AVLIS Production Plant Project:

- o DOE/CR-0001/2, Uniform Contractor Reporting System Guidelines, Vol. 1.
- o DOE/CR-0017, Cost and Schedule Control Systems Criteria for Contract Performance Measurement - Contractor Reporting/Data Analysis Guide.

The AVLIS Production Plant Project Control Manual will establish guidelines for implementation of project activities using correspondence, reporting, meetings and documentation.

11.1. PROJECT DOCUMENTATION

Project documentation is defined in terms of three categories: administrative, programmatic, and technical.

11.1.1. Administrative Documentation

Figure 11-1 displays the top-level administrative document hierarchy for the AVLIS Production Plant Project. Administrative documents are those that establish or apply the policies and procedures to be used on the project along with the approach to be taken.

The Project Management Plan defines the authority, organization, responsibilities, requirements, and management systems governing the project.

Fig. 11-1. Administrative document hierarchy.

Fig. 11-2. Programmatic document hierarchy.

11.1.2. Programmatic Documentation

Figure 11-2 displays the key programmatic documentation to be developed and maintained on the AVLIS Production Plant Project. Programmatic documentation is that which governs the baseline scope, schedule, and budget in an integrated approach. The baseline data contained in this documentation will be under project change control, along with criteria and interface data.

11.1.3. Technical Documentation

Figure 11-3 displays the key technical documents to be developed for the project, providing the criteria, requirements, design, specification, analyses, operating parameters, and as-built conditions, needed to ensure successful project completion. These documents will form the basis of quality records to be maintained on the project.

11.1.4. Document Preparation, Review, and Approval

Figures 11-1, 11-2, and 11-3 provide document hierarchies addressing administration, programmatic, and technical documents, respectively. Table 11-1 provides a combined document matrix indicating who prepares, reviews, and approves each document, and who receives them for information.

Table 11-1 is primarily a list of types of documents and is meant to convey, in condensed fashion, responsibilities of various organizations for the documents. In fact, most of the documents will be updated several times as the project progresses. It is intended that the organizations will exercise the same authority and responsibility at each stage of the project.

Figures 11-4 through 11-9 show the phasing of the documents with the evolution of the project through its stages.

11.2. PROJECT REPORTING

Progress and performance on the AVLIS Production Plant Project will be reported periodically. The project reports defined below will communicate

Table 11-1. Responsibilities for AVLIS Production Plant Project Documents.*

	Administrative Documents	DOE Headquarters	ORO/Field Project Office	SAN	Technical Project Office	AVLIS Production Plant Contractor Project Office	Project Review Board
149	Mission need statement	Prepares	Reviews	Reviews	Implements	I	I
	Project charter	Prepares	Reviews	Reviews	Implements	I	I
	Project plan	Concurs	Approves	Concurs	Concurs	Prepares	Reviews
	Project management plan	I	Approves	Concurs	Concurs	Prepares	Reviews
	Project control manual	I	Approves	I	Concurs	Prepares	Reviews
	Project safeguard and security plan	I	Approves		Concurs	Prepares	Reviews
	Project safety plan	I	I		Concurs	Prepares	Reviews
	Quality assurance plan	I	I		Concurs	Prepares	Reviews
	Procurement/ind. access plan	I	I		Concurs	Prepares	Reviews
	Construction/installation plan	I	I		Concurs	Prepares	Reviews
	Integrated test plan	I	I		Concurs	Prepares	Reviews
	Waste management plan	I	I		Concurs	Prepares	Reviews
	Operating and maintenance plan	I	I		Concurs	Prepares	Reviews
	Project Schedules						
	Level 0 (in Project Plan)	Concurs	Approves	I	Concurs	Prepares	Reviews
	Level 1 (in Project Mgmt. Plan)	I	Approves	I	Concurs	Prepares	Reviews
	Project Budget Baseline						
	WBS Level 1	Concurs	Approves	I	Concurs	Prepares	Reviews
	WBS Level 2	I	Approves	I	Concurs	Prepares	Reviews
	Project Change Orders						
	Category I	Concurs	Approves	I	Concurs	Prepares	Reviews
	Category II	I	Approves	I	Concurs	Prepares	Reviews

Table 11-1. Responsibilities for AVLIS Production Plant Project Documents.*

Administrative Documents	DOE Headquarters	ORO/Field Project Office	SAN	Technical Project Office	AVLIS Production Plant Contractor Project Office	Project Review Board
<u>Design and Configuration Control Documents</u>						
Point Design	I	I	I	Approves	Prepares	Reviews
Engineering Design Basis	I	I	I	Approves	Prepares	Reviews
Design Criteria	Concurs	Approves	I	Concurs	Prepares	Reviews
Design Reports (Description and Cost Summary)		Approves		Concurs	Prepares	Reviews
Drawings and Specifications		I		I	Prepares	Reviews
Construction Bid Packages		I		I	Prepares	Reviews
Procurement Bid Packages		I		I	Prepares	Reviews
Interface Control Plans		I		Approves	Prepares	Reviews
<u>Assessments</u>						
QA Assessments	I	I		I	Prepares	Reviews
RAM Assessments	I	I		I	Prepares	Reviews
Environmental Impact Statement	Concurs	Approves		Concurs	Provide Input	Reviews
Safeguards and Security Assessments	I	I		I	Prepares	Reviews
Safety Analysis Report	Concurs	I		I	Prepares	Reviews
Operational Readiness Report	I	I		I	Prepares	Reviews
Plant Compliance Report	I	I		I	Prepares	Reviews

I - Reviews for Information

* Definition of Actions

Prepares - Organization has responsibility to prepare or directs preparation by a contractor.

Reviews - Organization has responsibility to comment on adequacy of the document.

Concurs - Organization has authority to review document to determine that it meets the intent of the mission of the project.

Implements - Initiates program actions to create organizations to perform the work.

Provides Input - Document is prepared under direction independent of the project; responsibility of organization providing input is to supply data, information, and comments.

Approves - Organization has final authority for approving the document as a basis for proceeding with the project.

(Note: Where no approval indication is given in the Table, the final approval authority rests with the preparing organization.)

Fig. 11-3. Technical document hierarchy.

Fig. 11-4. AVLIS production plant documentation-preconceptual design phase.

Fig. 11-5. AVLIS Production Plant documentation--conceptual design phase.

Fig. 11-6. AVLIS Production Plant documentation--Title I design phase.

Fig. 11-7. AVLIS Production Plant documentation--Title II design phase.

Fig. 11-8. AVLIS Production Plant documentation--construction/procurement/installation.

Fig. 11-9. AVLIS Production Plant documentation*--operational startup.

performance information required for the Contractor Project Organization and the DOE to effectively manage the cost, schedule, and technical aspects of the project.

The Contractor Project Organization will prepare the Project Monthly Status Report that provides a concise assessment of the status of the project. It will be prepared and submitted monthly for DOE Management to monitor project status and to provide early recognition of potential problem areas.

The report will address technical accomplishments, variations from established baselines and/or changes in technical approach, anticipated problems and proposed action(s) for their resolution, and a personal assessment of the current situation by the Project Manager. Open items requiring action by the contractors and the DOE will also be addressed. The AVLIS Production Plant Project Monthly Status Report will be supplemented with the following reports:

- o Milestone Schedule and Status Report
- o Cost Performance Report
- o Project Funds Status Report

Milestone Schedule and Status Report. The Milestone Schedule and Status Report measures progress against established milestones and scheduled activities that represent the schedule baseline plan (see Fig. 11-10). The report reflects planned and accomplished events, milestones, slippages, and changes in schedule. It is submitted by Level 2 or 3 elements of the Work Breakdown Structure and reflects deviations from schedule that are discussed in the Project Status Report.

The Milestone Schedule and Status Report will be consistent with the Master Project Schedule, contractor and, subcontractor schedules. A problem-analysis discussion will be submitted for each control milestone that is three months behind schedule or projected to be completed three or more months after the planned completion date. The problem-analysis discussion will include a description of the cause, the impact, and corrective action planned to minimize the impact of the schedule deviation.

Fig. 11-10. Milestone schedule and status report (example)--Authorized Limited Schedule.

Cost Performance Report. An integrated Cost Performance Report will be submitted to the DOE Project Office monthly as part of the monthly report. It will be consistent with DOE Reporting Guidelines and will include integrated cost and schedule performance data reflected for the current period and cumulative to date. Data elements reported include budgeted cost of work scheduled, budgeted cost of work performed, actual cost of work performed, budget at completion, and latest revised estimate. Schedule variance is derived by comparing budget cost of work performed to budget cost of work scheduled, and cost variance is determined by comparing budget cost of work performed to actual cost of work performed. Cost variance at completion is the difference between budget at completion and the latest revised estimate.

The second format of the report consists of a narrative description explaining cost and schedule variance that exceeds an established performance threshold.

Project Funds Status Report. The Project Funds Status Report will be prepared and submitted quarterly to DOE. The report will provide data for:

- o Updating and forecasting funds requirements.
- o Planning and decision-making or proposed funding changes.
- o Developing of funds requirements and estimates.
- o Redistributing funds.

Data elements to be reported will be in accordance with DOE Reporting Guidelines. The data reflected in the Project Funds Status Report will be consistent with the cost-to-date and forecast cost reflected in the Cost Performance Report.

11.3. PROJECT REVIEW MEETINGS

Formal Project Review meetings will be conducted on a regular schedule. Meeting participants may vary depending on the type and agenda of the meeting but the following meetings will be regularly held.

11.3.1. Monthly Progress Review

The monthly progress review will be conducted just prior to the issuance of the Project Monthly Report so that that document will reflect the latest project status. This meeting will be attended by members of the Project Review Board and those senior staff members having specific reports to make. Meeting minutes should be issued in addition to the reflection of major topics in the Project Monthly Report.

11.3.2. Quarterly Project Review

The quarterly project review should be more formally organized than the monthly review and should have a published agenda listing topics, speakers, and scheduled speaking times. Top project management from both principal contractors will attend the quarterly review and the proceedings of the review, including presentation material, will be published. The quarterly review will replace the monthly review in the month held.

The agenda for both the monthly progress review and the quarterly project review should be flexible, but, at a minimum, the following points will be addressed:

- o Technical status
 - Accomplishments
 - Problems
 - Recommended problem resolution
- o Schedule status
 - Problems (variance from plan)
 - Work-arounds
- o Cost status
 - Variance from plan
 - Impacts of variances
 - Recommendations
 - Contingency status

- o Open items
 - Action required by contractor(s)
 - Action required by Contractor Project Office
 - Action required by Technical Program Office
 - Action required by DOE
- o Project Manager's personal assessment

11.3.3. Other Meetings

In addition to these regularly scheduled meetings, there will be a requirement for other meetings, usually on a need basis. This will be especially true once off-site architect/engineers and other support contractors are appointed. In addition to the formal design reviews discussed in Sec. 10, periodic progress review meetings with architect/engineers and construction managers will be required, as well as meetings to address a specific problem(s). It is important that all points covered in any meeting addressing project activities be fully documented in minutes and that these minutes be placed in a formal records retention system.

11.4. PROJECT CORRESPONDENCE

Project correspondence is defined as all correspondence, internal and external, prepared or received by the Contractor Project Office dealing with AVLIS Production Plant Project matters. Procedures for the control and processing of project correspondence will be set forth in the Project Control Manual. Project correspondence falls into two categories, as defined below.

11.4.1. Formal Correspondence

Formal correspondence refers to written communication of the Contractor Project Office, with the DOE or with a participating contractor, or between contractors, that expresses AVLIS Production Plant Project policy or opinion, that reports on AVLIS Production Plant project activities, that commits contractors, or that in any way alters any previous commitment. All formal

correspondence must be controlled in accordance with the Project Control Manual procedure on correspondence control (i.e., numbered, logged, and filed in a records retention system).

11.4.2. Informal Correspondence

Correspondence dealing strictly with administrative, personnel, or other related activities is considered to be informal correspondence and need not be formally controlled except as desired by participating contractors.

APPENDIX A
AVLIS PRODUCTION PLANT PROJECT
ADVANCED ACQUISITION OR ASSISTANCE PLAN

The purpose of an Advanced Acquisition or Assistance Plan is to provide a description of the contractual means by which the project's acquisition strategy will be carried out (Ref. Doc. 5700.4A). The AVLIS Production Plant Project Advanced Acquisition or Assistance Plan, as outlined here, describes the definitive business and contractual aspects of the AVLIS Production Plant Project by establishing the organizational approach, methodology, tasks, schedules, relative financial risks, and controls to ensure the accomplishment of project objectives within time and funding constraints.

The DOE AVLIS Production Plant Project Manager and the Contractor Project Office will develop the overall business strategy for the AVLIS Production Plant Project. The overall acquisition of the AVLIS Production Plant Project shall be performed by the DOE Oak Ridge Operations Office, supported by the DOE San Francisco Office. As previously discussed in Sec. 4, a contractor project organization led by Martin Marietta Energy Systems, Inc. and staffed jointly by LLNL and Martin Marietta's will be established. This Contractor Project Office shall assist the DOE in the developing and implementing the acquisition strategy.

Development and implementation of the acquisition strategy shall be done by the various organizations according to the responsibilities and assignments set forth in Secs. 4 and 5 of the Project Management Plan.

A.1 DESCRIPTION OF PROJECT WORK

The AVLIS Production Plant Project will be a DOE Major System Acquisition project. The purpose of the project is to deploy Atomic Vapor Laser Isotopic Separation technology at the Oak Ridge Gaseous Diffusion Plant Site, in support of the U.S. Uranium Enrichment Program. The AVLIS Production Plant Project will deploy AVLIS technology by performing the design, construction, and startup of the AVLIS Production Plant to meet the production requirements of the DOE.

The AVLIS Production Plant Project encompasses the AVLIS Production Plant, supporting facilities (lasers, separators, associated processes, and all project management and support efforts necessary to ensure successful completion of the project mission. The technical support, operations, and project management land-support efforts shall be performed with the joint Martin Marietta's/LLNL organization, under the leadership of the Contractor Project Office, which will take the role of the integrating contractor. Major process/facility design and construction efforts shall be performed by the selected architect/engineer and construction manager, respectively. The Contractor Project Office shall provide for both project management and technical direction to the architect/engineers and construction managers.

A.2. FUNDING PLAN

The funding plan for the AVLIS Production Plant Project is defined in Sec. 9. Operating expense and capital equipment not related to construction funding will be authorized on a fiscal-year basis to support the AVLIS Production Plant Project management and technical support, technology development, and operations and training. Plant and capital equipment funding will be authorized by phases for the AVLIS Production Plant Project.

Associated with the above funding plan, significant schedule and cost risk will be realized if there is a shortfall of early budget year funds from the levels identified in Sec. 9. A delay in early year activities such as those for design and for assembly of key test data will place constraints on procurement and construction that will result in schedule delays. As engineering, procurement, and construction are deferred to later years, cost escalation on these items results in higher delivered costs. The project management role is to reduce schedule and cost risk by ensuring that these delays fall into noncritical path-activities wherever possible.

A.3 AWARD SCHEDULE

Upon identification of AVLIS Production Plant Project specific equipment, supplies, and/or services needed, a matrix will be developed outlining delegation of responsibility for procurement of each item, schedule of need

for installation, interfaces, approximate value, a definitive project schedule, and yearly purchase schedules for procurement.

Based on the AVLIS Production Plant Project master schedule, the procurement schedules will describe and establish procurement-activity durations that must precede the installation and/or interface date for each item, thereby establishing the initial date the request for services and/or equipment must be received by the Contractor Project Office procurement organization to allow timely delivery. Any conflicts between schedule and needs will be negotiated, and adjustments will be made.

The type of contracts to be let and awarded will be selected based on various factors and influences as given by the DOE Oak Ridge Operations Office and Martin Marietta procedures.

It is Martin Marietta's practice to purchase supplies and services from responsive/ responsible sources at fair and reasonable prices that will result in the lowest ultimate overall cost to the customer. For equipment and construction contracts, preference will be given to the firm fixed-price contracts.

A.4. DISCUSSION OF PROJECT RISKS

The project risk, by virtue of the degree of perceived uncertainty in input parameters, deals with proper placement of the AVLIS Production Plant Project into subjective risk categories and is a matter of intuition, common sense, and experience. A low-risk project has a high degree of probable success and the prescribed minimum risk. The criteria for the AVLIS Production Plant Project performance are those for a high degree of probable success. To assure these minimum-risk performance criteria, the implementation of a program plan is required to obtain the desired balance of project risks. This desired balance will be contractually implemented by negotiating anticipated trade-offs regarding project management responsibility and award-fee provisions and/or cost, technical, and schedule incentives used to alleviate or reduce potential project risks.

A.5. SOURCE SELECTION

The selection of an off-site architect/engineers contractor will be made according to "Architect Selection Procedures," Interim Procurement Regulations Handbook No. 2. Source selection of other major contractors is guided by DOE/PR-0027, Procurement Regulations Handbook - Source Evaluation Board. All AVLIS Production Plant Project procurements associated with obtaining equipment and services as requested by the Contractor Project Office will be initiated based on the source and selective provisions of the Martin Marietta procurement manual.

For equipment and construction contracts, preference will be given to firm fixed price contracts. Off-site architect/engineers and construction managers will be selected on the basis of contractor capabilities. These contracts are expected to be cost-reimbursement types.

It is Martin Marietta's policy (1) to purchase on a competitive basis whenever practical, and (2) to provide maximum practicable opportunity for small businesses, disadvantaged businesses, women-owned businesses, and labor-surplus area concerns to participate in AVLIS Production Plant Project procurements. However, this policy goal does not supersede the requirements for quality, timely delivery, and compliance with project specifications and contract's terms and conditions.

Occasionally, based on particular and unique requirements and circumstances, it may be impossible or impractical to obtain competitive offers. In these particular cases, a sole-source procurement(s) process is initiated. Since sole-source procurements deviate from the normal policy of obtaining competitive bids, documentation consistent with Martin Marietta's procedures is required to fully justify the sole-source procurement action.

A.6. ANTICIPATED CONTRACTORS AND PARTICIPANTS

Martin Marietta and the University of California--LLNL are currently under contract to DOE and require no additional contractual action for their participation on the project. At the outset of the design and construction phase, the Contractor Project Office will identify system interfaces where other contractors and participants will be involved.

Acquisition of off-site architect/engineers and contractor managers shall be accomplished by the Contractor Project Office, and these contractors will be under the Contractor Project Office. Other subcontracting shall be the responsibility of the applicable participating contractor, regulations, and the DOE Oak Ridge or San Francisco Operations Office. Competitive participation by industry will be maximized to foster the broadest possible industry involvement and vendor development.

The architect/engineers will be selected in FY85. When selected, the off-site architect/engineers will be responsible for conceptual and definitive design media, engineering for the facilities, and terms and conditions as established contractually.

The construction manager, when selected, will be responsible for obtaining long-lead construction materials and equipment required to efficiently and safely complete the AVLIS Production Plant facilities and for directing the activities of construction subcontractors.

A.7. SOCIOECONOMIC PROGRAMS

Whenever applicable, the AVLIS Project Plant Project will use DOE socioeconomic programs as described in the Annual Call for Goals required by Public Law 95-507 and as implemented annually by OMB guideline.

The AVLIS Project assures that the following organizations will receive the maximum practicable opportunity to participate in the performance of purchase orders awarded by the Contractor Project Office, consistent with good business judgements:

- o Small-business concerns.
- o Small socially and economically disadvantaged concerns.
- o Labor-surplus area concerns.
- o Women-owned business concerns.
- o Public and private organizations for handicapped individuals.

It is anticipated that substantial procurements can be made to meet DOE's socioeconomic program goals in such areas as the AVLIS Production Plant,

supporting facilities, safeguard and security, substation, and balance-of-plant processes. Efforts will continue to maximize socioeconomic program involvement in procurements of high-technology items.

A.8. ACQUISITION OF EQUIPMENT, SUPPLIES, AND CONTRACTUAL SERVICES

Authority and responsibility for acquisition of AVLIS Production Plant Project equipment, spare parts, supplies, and contracted services, in support of the AVLIS Production Plant Project, shall rest with the Contractor Project Office, and acquisition shall be performed in accordance with Martin Marietta procurement policies.

While all procurements will be administered by Martin Marietta, the Contractor Project Office will delegate to LLNL and supporting contractors various technical responsibilities, such as vendor technical qualification and inspection.

During the conceptual engineering phase, a listing of long-lead procurement items will be developed. The long-lead procurement activity is defined as the tools, equipment, or services whose procurement must be initiated and completed significantly in advance of construction, installation, or upgrading to eliminate any risk associated with schedule or availability. Long-lead procurement activity shall be independent of construction activities. The integrating and interfacing of long-lead procurement activities shall be the responsibility of the Contractor Project Office. Procurement plans will be developed by the Contractor Project Office detailing long-lead procurement activities.

The acquisition of equipment, supplies, and services will be based on the comprehensive industrial access program that has been part of the AVLIS base program. This effort for development of an industrial basis for AVLIS and the approach and feasibility of acquiring equipment and services for the AVLIS Production Plant are discussed in the Industrial Access Program Document (PP040).

Certain items to be procured will be sole-sourced because of technology advancements and component standardization requirements. These items will be identified as design and technology requirements are developed and handled in

accordance with appropriate procurement regulations for sole-source procurements.

A.9. ANTICIPATED ORGANIZATION CONFLICT-OF-INTEREST CONCERNS

Explanation of any such concerns including a statement regarding legal counsel-consultation and results of such consultations will be dealt with at such time as the conflict-of-interest concern becomes apparent.

A.10. PATENTS AND DATA

Any licensed processes or patents that may be used by the AVLIS Production Plant Project will be addressed when they become known. The licenses will supply a basic process design package that will reveal the process in sufficient detail for design and engineering of the unit where the process is used. Where it appears to be in the best interest of the project, the licensor may perform detailed engineering and actually participate in procurement and construction. The Oak Ridge Operations Office/Field Project Office, the Technical Program Office, and the Contractor Project Office will collaborate in all licensing activities.

A.11. REPORT REQUIREMENTS

The required administrative reporting of each contract under the Uniform contractor reporting system by Martin Marietta and LLNL will follow established guidelines. Project performance will be regularly assessed. A report system will portray budgets allocated to specific contract or project tasks, indicate work progress and measure performance against the plan, properly relate cost, schedule, and technical accomplishment, and supply administrative management with a practical level of summarization.

A.12. RECEIPTS

All anticipated receipts, if generated from royalties, sales of products, fees for services or benefits including scrap, with respect to the AVLIS Production Plant Project, will be described and estimated by fiscal year throughout the life of the project.

A.13. NONGOVERNMENTAL PARTICIPATION

In addition to technical contacts with potential contractors and vendors, as established by the technical functions involved in the program, Commerce Business Daily publication procedures also provide involvement and information to potential contractors and vendors.

The Department of Energy Acquisition Regulations contain a requirement for publication of proposed procurement actions estimated to cost \$100,000 or more in the Commerce Business Daily in accordance with Federal Acquisition Regulations, 1-1.1003.7.

The requirement that DOE operating and on-site service contractors synopsise proposed procurement actions of \$100,000 and above in the Commerce Business Daily will expand participation of small disadvantaged business concerns in DOE-funded contracts. When circumstances make the publication inappropriate, the contracting officer is allowed to waive publication requirements.

A.14. SITE-SELECTION AND ACQUISITION OF REAL PROPERTY

To meet the AVLIS Production Plant schedule, DOE must select the site of the plant by September 1985. A comparative study of sites should be undertaken during FY85. Since it is anticipated that a present enrichment site will be chosen, no acquisition of land is required.

A.15. USE OF OTHER PROCEDURES

Consulting engineers that specialize in certain technical disciplines and procedures such as life-cycle costing, and the use of surveys or questionnaires, will be retained under subcontractors or consulting agreements to provide technical services for the AVLIS Production Plant Project, as required.

A.16. OTHER INFORMATION

Information that may have serious impact on contractual actions such as special review and approval by DOE Headquarters, requirements for sole-source procurement, consulting service, periodicals, etc., will be addressed as the need arises.

APPENDIX B

TEST AND EVALUATION PLAN

Tests and subsequent evaluations for the AVLIS Production Plant Project can be categorized by the following:

- o Process demonstration
- o Vendor inspection/testing
- o Acceptance testing
- o Operability testing

The appropriate time-phasing of these test activities is shown in Fig. B-1.

In all areas, appropriate test plans and procedures will be developed, along with test results. No tests will be conducted without properly approved test procedures. The following paragraphs further define the requirements and plans for the above areas.

B.1. PROCESS DEMONSTRATION

Process demonstration involves the operation of the Full Scale Demonstration Facility to confirm the definitive design of the AVLIS Production Plant. In addition, confirmatory demonstrations of uranium processing technology will be conducted. This work is described in the AVLIS Program Plan Executive Summary, (EB030), and the AVLIS Program Plan (PP010).

B.2. VENDOR TESTING

Component/material testing requirements will be defined as part of the purchase request provided to suppliers and will be negotiated as part of the purchase order. This will include the type of testing required and test documentation to be submitted as part of the vendor data. Selected vendor testing will be physically monitored by the procuring organization.

Fig. B-1. AVLIS production plant-technology/milestone interrelations.

B.3. ACCEPTANCE TESTING

Acceptance testing will be performed by the architect/engineer in accordance with the DOE construction requirements contained in DOE Order 6410 prior to closeout of the Project or a portion of the project. Acceptance test procedures will be prepared by the Contractor Project Office as part of definitive design. The architect/engineer will also prepare an acceptance test plan outlining the approach for conducting the acceptance tests.

B.4. OPERABILITY TESTING

Operability testing will be conducted to ensure that integrated systems perform as intended. Prior to testing, an integrated systems test plan and supporting operability test procedures will be prepared and approved for use. The test results will be analyzed and documented for record.

A readiness review team will be established to monitor and review all startup activities to ensure that tests have been conducted and documented in accordance with procedures. A Readiness Review Report will be prepared to request startup approval from DOE.

APPENDIX C

ENVIRONMENTAL, SAFETY AND HEALTH

C.1. POLICY

The AVLIS Production Plant Project will be designed, constructed, and operated in a manner that will assure the protection of the public, operating personnel, and the environment.

It is the policy of the AVLIS Production Plant Project to take all reasonable precautions in the performance of its work to protect the health and safety of employees and members of the public and to minimize potential risk to life and property. The AVLIS Production Plant Project will comply with health, safety, and fire protection regulations and requirements of the DOE, as officially directed. These shall be at least as effective as those promulgated by the Occupational Safety and Health Act of 1970.

To meet these objectives, the AVLIS Production Plant Project will provide a staff of health and safety professionals, together with the necessary training and resources, to ensure compliance with all applicable policies, codes, standards, and regulations. Line management shall be responsible for the establishing, implementing, and maintaining an effective health, safety, and environment program for all facilities and activities under their control. All AVLIS Production Plant Project personnel are responsible for maintaining the risk of their activities at the lowest levels technically and economically achievable, and for observing health, safety, and environmental requirements when conducting all AVLIS Production Plant operations.

C.2. SAFETY RESPONSIBILITIES

Line Organization. Safety is a line responsibility extending throughout the line organizations to all AVLIS Production Plant project employees. The primary responsibility for safety rests with those people responsible for carrying out the various phases of the AVLIS Production Plant project.

1 That supervisory responsibilities for safety and health rank equally in importance with other duties is a fundamental project approach to accident prevention. These responsibilities are fulfilled by recognizing or anticipating potential hazards, informing employees of associated risks, specifying protective measures, and assuring that employees are properly trained and that appropriate protective measures are effectively employed. Careful, prudent behavior in work places, and strict observance of prescribed procedures and regulations shall be a condition of employment by the AVLIS Production Plant Project and shall be enforced by line management.

All Employees. Each individual is responsible for performing his assignments in a manner that will not endanger himself or his fellow employees and for complying with established safety rules and requirements. Employees are encouraged to contribute to the safety program and to bring potentially unsafe conditions to the attention of their supervisors or safety representatives.

C.3. SAFETY ASSESSMENTS

All proposed construction, operation, maintenance, or significant modifications of experiments and/or facilities must be properly analyzed and evaluated to assure adequate provisions for safety prior to commencement of such activity.

In addition, for major projects or projects involving large potential hazards, a preliminary evaluation must be completed prior to application for funding to assure that adequate funds for safety-related items or systems are included in the project proposal. This will be in the form of safety analysis reports required by DOE Order 5481.1.

These reports are prepared by the principal contractors and approved by them prior to facility construction (Preliminary Safety Analysis Reports) and AVLIS Production Plant plant operation (Final Safety Analysis Report). In addition, the Final Safety Analysis Report will be formally approved by the DOE ORO prior to the initiation of operations. The approved Final Safety Analysis Report is updated to reflect changes in plant design and operating limits. Operating limits will be defined in the operating safety requirements

established in the Final Safety Analysis Report. They will be implemented by the plant's operating procedures.

The two major safety documents (Preliminary Safety Analysis Report and Final Safety Analysis Report) are preceded by Hazards Assessment, which considers specific hazards associated with each operation.

During construction and installation of equipment, industrial safety will be controlled by procedures developed under the Site Safety Plan. The document will define all construction safety activities and responsibilities by Martin Marrietta, with specific inputs (e.g., laser system installation safety requirements) from LLNL and the construction manager.

Any proposed usage of fissionable material will be properly analyzed, evaluated, and documented as required to prevent critical accidents prior to commencement of such activity.

The storage, use, and shipment of fissionable material shall be conducted in such a manner that the general public, employees, and public and private property are protected against the results of, or possibility of critical accidents arising from these activities.

The Martin Marrietta AVLIS Program Director and Project Manager will appoint a Criticality Officer to advise on the review of the use of fissionable materials.

The Criticality Officer will be responsible for criticality safety training seeing to it that a sufficient number of AVLIS personnel are familiar with criticality safety and, from time-to-time, conducting refresher courses in conformity with applicable DOE orders on criticality safety.

C.4. MAINTAINING RADIATION AND TOXIC EXPOSURES AS LOW AS PRACTICABLE

Employee and public exposure to such hazards as radiation and toxic and radioactive materials will be kept to the lowest level technically and economically feasible. This policy will be implemented by utilizing the best industrial practices to minimize exposures. The "as low as reasonable achievable" principle should be adhered to in all laboratory activities from the earliest planning stage through the final stages of operation.

C.5. LASERS

The Martin Marietta AVLIS Program Director and Project Manager will appoint a Laser Safety Officer to advise him and the project staff on laser safety issues. The Laser Safety Officer is responsible for auditing laser safety training and laser use for compliance with recognized traditional standards.

C.6. WASTE MANAGEMENT

Disposal or discharge of radioactive and potentially hazardous materials will be kept to the lowest level technically and economically feasible. In pursuit of this policy, all activities will be conducted in such a way as to minimize the generation of hazardous waste, including solid waste, liquid waste, and gaseous emissions. Treatment, processing, and disposal of such wastes will be carried out under prescribed conditions.

C.7. ENVIRONMENTAL PROTECTION

The AVLIS Production Plant Project will minimize the effects of its activities on the environment. For purposes of this policy, the environment includes all ecological factors, as well as historic and archaeological sites and artifacts. To implement this policy, the AVLIS Production Plant Project will continuously determine the environmental effects of its activities and will establish practices and procedures to ensure the minimum adverse impact on the environment.

C.8. NATIONAL ENVIRONMENTAL POLICY ACT

The National Environment Policy Act requires that an environmental evaluation be performed to assure that the construction and operation of the AVLIS Production Plant does not result in unacceptable risks to the environment.

Pacific Northwest Laboratories was selected by DOE as the independent contractor to prepare an environmental assessment of AVLIS and gaseous centrifugal processes. These assessments will be a part of the basis for process selection in May 1985. An environmental impact statement will be prepared, using the Pacific Northwest Laboratories assessment as a basis during the second half of FY85, resulting in a definitive decision on the AVLIS Production Plant project by January 1986.

C.9. HEALTH AND SAFETY TRAINING

The AVLIS Production Plant Project will provide health and safety training to enable its employees to perform their assigned tasks in a safe manner. The function of such training is to impart the necessary knowledge that will enable employees to recognize the risks associated with their job activities and to make an informed judgment before assuming such risks. Instruction in health and safety procedures, operating procedures, and the recognition of potential hazards are important elements of this program. Required health and safety training is separate and distinct from training programs provided primarily for career advancement.

C.10. EMERGENCY PLANNING

Emergency planning becomes an important element should an accident occur due to a program failure. Emergency plans establish lines of authority, responsibility, and general procedures to be implemented in response to an emergency. Formal emergency plans will be required for AVLIS Production Plant facilities/operations.

Training programs will be conducted to educate personnel regarding emergency plans and procedures. Drills to test the plans, training, and equipment will be conducted, as appropriate, based on the degree of risk, changes in personnel, or changes in facilities or operations. Plans involving special hazards should be tested at least annually.

A program to maintain all emergency equipment is essential. Records of the maintenance should be regularly reviewed. An inspection program will exist to verify maintenance of critical emergency equipment.

C.11. AVLIS Production Plant Appraisals and Inspections

Formal appraisals of health, safety, and equipment programs throughout the AVLIS Production Plant Project will be made on a regular basis. Inspection of facilities will be conducted periodically by operating management and supervision, as well as by the Health Safety and Environment staff, to determine that all procedures, equipment, and facilities are in compliance with applicable health, safety, and environment requirements.

APPENDIX D
COST AND SCHEDULE PERFORMANCE MEASUREMENT SYSTEM

D.1. BASELINE BUDGET

The estimated cost of performing the project work will be maintained by the project team. Each individual assigned responsibility for a task will prepare an estimate of the resources to accomplish the work assigned. This estimate will be divided into identifiable work packages defining the work to be performed, the milestones measuring technical accomplishment, and the product to be produced. The sum of all the tasks, plus general and administrative expenses and management reserve, will yield the total estimated cost. This will become the contract baseline budget. The baseline budget cannot be exceeded without prior written approval of the DOE Project Contracting Officer.

Time-Phased Budgets. Since both the critical path method schedule and estimate are prepared for each major Contract Work Breakdown Structure element (usually Level 4) and are identifiable by the master code, the estimated resources can be time-phased in accordance with the schedule. This will produce the budgeted cost of work schedule, a manpower plan, and contract funding requirements.

Work Authorization. The project plan will be used as a basis for authorizing project work. The Project Manager will authorize each project team manager to proceed with a specified amount of Contract Work Breakdown Structure element work to be accomplished within a given budget and schedule.

D.2. DATA COLLECTION

Accumulation of Actual Cost and Expended Manhours. Actual cost of work performed (in manhours) are planned to be accounted for and reported. These reports will be summarized by organizational elements, by task, and by

Contract Work Breakdown Structure. This is the basis for actual cost of work performed for a given accounting period. Finally, reports will be summarized into monthly reporting periods, using the Contractor Project Organization's accounting months.

Other Direct Costs. Other direct costs normally include costs for office material and supplies, reproduction, communications, travel, computer service, consultants, material, office equipment, and service subcontracts. These costs will be identified by the master code, accumulated by the Contract Project Organization accounting department, and reported on a monthly basis. In addition, monthly reports will be required from each major subcontractor giving major control elements and the actual cost of work performed, budgeted cost of work scheduled, budgeted cost of work performed, budgeted at completion and estimate at completion.

Technical Accomplishment. As work is accomplished, the responsible engineering group supervisor will report the milestone points reached for each task. This information will be entered into a computerized program. It will be used to develop the status of drawings, specifications, material requisitions, studies, other tasks, and earned value (budgeted cost of work performed) and used to update schedules.

D.3. PERFORMANCE MEASUREMENT/VARIANCE ANALYSIS

Actual progress will be correlated with actual cost by means of variance analysis in terms of budgeted cost of work scheduled, budgeted cost of work performed, actual cost of work performed, budget at completion, and estimate at completion. In most situations, earned value (Budgeted Cost of Work Performed) will be computed by summing the predetermined values of each completed milestone. Technical progress will be measured by determining schedule progress through an earned value system. Performance measurement uses discrete measurement techniques and level of effort which are described below.

Milestone/Interim Milestone. This method is used when there is at least one meaningful milestone in each accounting month. For 0-100 the start and complete milestones should be in the same accounting month (Table D-1).

Table D-1
MEASUREMENT OF PERCENT COMPLETION OF A MILESTONE

CHARACTERISTIC

- o Used when subtask exceeds two accounting periods and there are months without interim milestones and/or milestone occurs early in month.
- o Budget for each accounting period should reflect the resources needed
- o Earned value similar to interim milestone.
- o Use percent complete technique between milestones (up to 90 percent of next milestone).

<u>Month</u>	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>Budget at Completion</u>
<u>Budget</u>	<u>50</u>	<u>150</u>	<u>150</u>	<u>50</u>	400

Milestone/Interim Percent Complete. This method is usually applied when task/subtask exceeds two accounting months and will not have a meaningful milestone each accounting month. For accounting months without a milestone the task/subtask manager will provide a percent complete on the budgeted cost of work performed calculation form. Since most task/subtasks usually have several interim milestones these will be used to earn the cumulative budgeted cost of work performed. While utilizing the interim percent complete, the

budgeted cost of work performed will not exceed 90 percent of the cumulative budgeted cost of work scheduled for the next schedule milestone. This method provides adequate performance measurement for tasks that are similar to the concept analysis and trade studies tasks.

Percent Complete. This method is used when task/subtask exceeds one accounting month with only start and complete milestones. Since the earned value is subjective, the cumulative budgeted cost of work performed will not exceed 90 percent of the task/subtask value until the completion milestone is met.

Fifty-Fifty. This method is used when task/subtask effort is approximately the same for two accounting months and no meaningful milestone is available at the end of the first accounting month. Fifty percent of the task/subtask value will be earned (budgeted cost of work performed) when the effort starts and the remaining 50 percent when the effort is complete.

Level of Effort. Level of effort is the least desirable performance technique and its use will be kept to a minimum. The level of effort method will be used when no measurable discrete effort can be planned. Task/subtask managers will plan and budget to reflect the required resources. At the end of each accounting month budgeted cost of work performed will be calculated equal to budgeted cost of work scheduled; therefore, there can be no schedule variance.

Milestones. Milestones are the basis for all discrete performance measurement and must meet the following criteria:

- o Be a product or event.
- o Be within the authority of the performer.
- o Provide clear objective criteria for measuring accomplishment and quantified whenever possible.
- o Be directly related to the statement of work.
- o Be weighted in relationship to the time-phased budget.

- o Be expressed in calendar dates with identified cost-item code number and summary schedules.

Types of Variances. Three types of variances will be monitored: schedule variance, cost variance, and at-completion variance.

Schedule Variance (budgeted cost of work performed minus budgeted cost of work scheduled). A schedule variance occurs when the budgeted cost of work performed varies from the budgeted cost of work scheduled. If the budgeted cost of work performed is less than the Budgeted Cost of Work Scheduled, less work has been done than was planned and a behind-schedule variance exists. The schedule variance will be analyzed to determine actual schedule status with regard to cost account milestones, possible impact on higher level milestones, and the appropriate corrective action.

Cost Variance (budgeted cost of work performed minus actual cost of work performed). Cost variance is defined as the difference between the value of work performed during a given period and the actual cost incurred for the performance of the work. A negative cost variance indicates an unfavorable cost status. The cause of the variance will be identified, its impact determined, and appropriate corrective action proposed.

At-Completion Variance (budget at completion minus estimate at completion). The variance at completion is defined as the difference between the budget at completion and the estimate at completion, and at any point represents a forecast of budget overrun or underrun. Every change to the variance at completion at the Contract Work Breakdown Structure level will be reported in the monthly report.

Variance Analysis. For performance measurement reporting, the Contractor Project Organization will identify both cost and schedule variances which are reported in hours/dollars. Within the project management system, cost/schedule variances can be calculated and printed at the subtask level. These are summed to the task level for formal internal variance analysis

reporting. When internal variances are exceeded at the task/subtask level a written Variance Analysis Report will be prepared by the subtask manager and routed to the project manager. See Table D-2 for an explanation of how these variances are derived. A simplified summary of the budgeted cost of work scheduled/budgeted cost of work performed/actual cost of work performed relationship can be seen in Table D-3.

The Contractor Project Organization's Project Control System generates the data required for the Cost/Schedule Status Report. Subcontractor (if used) data will be incorporated into the Cost/Schedule Status Report by the requirement that each critical major subcontractor provide a Cost/Schedule Status Report in the same format required of the prime contractor.

Variance Analysis Procedure. At the end of each month, summaries of Budgeted Cost of Work Scheduled, budgeted cost of work performed, actual cost of work performed, budget at completion, and estimate at completion will be prepared for each Contract Work Breakdown Structure element. Variances in cost and schedule for each element will be shown. If the variance for the project plan exceeds the thresholds established with DOE a variance analysis report will be prepared citing the cause and impact of the variance and specifying appropriate correction action. After the analysis is developed and reports are assembled, reviews will be held at each level of management. Performance data will then be summarized to the reporting Contract Work Breakdown Structure level and reviewed by project management. All variances will be reviewed, along with the recommendations for specific action to be taken. Finally, after approval by the Project Manager, monthly performance measurement system reports to DOE will be prepared.

Table D-2. Variance Calculation for Schedule and Cost.

<u>Schedule Variance (SV)</u>	<u>Cost Variance (CV)</u>
BCWP-BCWS	BCWP-ACWP
Column 5 = column 3 - column 2	Column 6 = column 3 - column 4
\$5,000 = \$75,000 - \$70,000	\$5,000 = \$75,000 - \$80,000
<u>% of Variance</u>	<u>% of Variance</u>
$\frac{SV}{BCWS} (100) = SV\%$	$\frac{CV}{BCWP} (100) = CV\%$

Note: BCWS = Budgeted Cost of Work Scheduled
 BCWP = Budgeted Cost of Work Performed
 ACWP = Actual Cost of Work Performed

Table D-3. BCWS/BCWP/ACWP Relationships.

<u>Schedule and Cost Variances</u>			<u>Interpretation</u>	
BCWS	BCWP	ACWP	Schedule	Cost
\$10	\$10	\$10	On	On
\$20	\$20	\$10	On	Under
\$10	\$10	\$20	On	Over
\$10	\$20	\$20	Ahead	On
\$10	\$20	\$30	Ahead	Over
\$10	\$20	\$10	Ahead	Under
\$30	\$20	\$10	Behind	Under
\$20	\$10	\$30	Behind	Over
\$20	\$10	\$10	Behind	On

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ABSTRACT

The AVLIS Production Plant is designated as a Major System Acquisition (in accordance with DOE Order 4240.IC) to deploy Atomic Vapor Laser Isotope Separation (AVLIS) technology at the Oak Ridge, Tennessee site, in support of the U.S. Uranium Enrichment Program. The AVLIS Production Plant Project will deploy AVLIS technology by performing the design, construction, and startup of a production plant that will meet capacity production requirements of the Uranium Enrichment Program.

The AVLIS Production Plant Project Management Plan has been developed to outline plans, baselines, and control systems to be employed in managing the AVLIS Production Plant Project and to define the roles and responsibilities of project participants. Participants will develop and maintain detailed procedures for implementing the management and control systems in agreement with this plan. This baseline document defines the system that measures work performed and costs incurred. This plan was developed by the AVLIS Production Plant Project staff of Martin Marietta Energy Systems, Inc. and Lawrence Livermore National Laboratory in accordance with applicable DOE directives, orders and notices.