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Appendix B

AVLIS Program

Statement of Work May 1, 1994 through July 31, 1994

April 1994

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Executive Summary

While the United States Enrichment Corporation (USEC) is preparing decisions regarding its future Atomic Vapor Laser Isotope Separation (AVLIS) deployment options, this interim three month plan (through July 31, 1994) is intended to maintain the USEC options for the ultimate deployment of AVLIS technology for enriching uranium, gadolinium (Gd) and possibly erbium (Er). This plan addresses the key activities leading to such commercial deployment while recognizing current, significant funding limitations.

The goal of this three month plan is to provide support to the USEC business assessment; assure that facilities, equipment and other property remain functional and retain value; and achieve maximum progress on critical tasks required for future AVLIS deployment if the USEC decides to proceed. This proposed plan continues activities (through July 31, 1994) that could lead to an overall plan for deployment of a uranium and a Gd/Er enrichment facility.

This Statement of Work (SOW) is directed toward preserving the technical capabilities and core staff of the AVLIS Program while minimizing program costs and maintaining options for the USEC pending a decision on the future course of direction for the AVLIS Program. The specific activities described in this SOW are:

- Task 1** Maintenance and surveillance of those AVLIS facilities not required for near-term operations.
- Task 2** Preparation for future photoionization.
- Task 3** Long lead preparation for future operations.
- Task 4** Provide support, as requested by the USEC, for development of strategies and market entry plans for enriched uranium, gadolinium, and possibly erbium.
- Task 5** Provide support, as requested, for the USEC Advanced Technology Business Evaluation.
- Task 6** Continue uranium processing and fuel cycle integration activities.

Consistent with minimizing program costs, a selected and limited number of laser, separators and analytical facilities will be reactivated in preparation for future Gd photoionization verification and enrichment tests. Remaining facilities will be maintained in a standby mode for possible future uranium demonstrations and Gd/Er commercial operations. Key Gd verification tests will be carried out using a uranium vaporizer utilizing a quick-turnaround-box vapor-enclosure apparatus in the Separator Demonstration Facility (SDF). Use of this apparatus is a cost effective approach to obtaining and verifying key process parameters. Vaporization tests will be initiated and key process parameters measured. Following appropriate modifications to the optical transport and delivery system for Gd, the AVLIS system will be made ready for photoionization verification tests. Computer and control system support consistent with the laser and separator operation will be provided. Future activities, not included in this three month plan, would be enrichment of 10's to 100's of grams of Gd to ~40 to 45% assays in short duration (<10 hour) tests at low

laser power and only partial vapor illumination. Results of these tests could be scaled to full design assays.

Activities that are directed toward maintaining a core staff capability while maintaining cost-effective viable options for the future course of action by the USEC will be initiated. Preparation for engineering modifications to a separator pod for future full pod enrichment (based on extensive uranium separator operational experienced and prior experience on Gd vaporizers) will be initiated as well as design of an optical fiber delivery system for the Corridor 1 and 2 copper lasers. Testing of a chlorofluorocarbon (CFC) replacement for the copper lasers will also be re-started. This work includes a thorough review of long-lead-time component procurements (>3 months) for both the laser and separator systems and initiation of pre-procurement activities for these components to maintain a uranium capability and to favorably position the program for future uranium, and Gd/Er enrichment, pending a decision by the USEC. The uranium part of the program will continue with a minimum set of uranium-feed and product-processing activities to maintain continuity of the technical program and the interactions with the commercial fuel cycle industry.

A review of the Gd point design will be completed based on the initial test results, which can potentially lead to improved enriched Gd performance. A system analysis activity including financial analysis of uranium and Gd/Er enterprises will continue, as requested by the USEC. Program operations and ES&H activities will be commensurate with the level of program activity.

A detailed description of this AVLIS SOW for the period of May 1, 1994 through July 31, 1994 is in the following sections.

Task 1 – Maintenance and Surveillance of AVLIS Facilities

This task includes the continuing maintenance and surveillance of those AVLIS facilities not specifically required for the near-term Gd operations in Task 2 but will be necessary for possible future uranium and Gd operations.

Copper Lasers

Several copper laser operational and experimental facilities will remain in a cold standby condition. Corridors 1 and 2 copper lasers on the second floor of the Laser Demonstration Facility (LDF) will continue to remain shutdown. A low level of periodic inspection, testing, and preventive maintenance is required to prevent degradation of this equipment, and to preserve its reactivation capability. Refurbishment facilities unique to the Corridor 1 and 2 lasers, such as the pulse power electronics refurbishment facilities in Room 1037, will remain shutdown. Monitoring of hazardous material inventories, such as CFCs, and associated equipment maintenance and calibration will continue. The copper laser warehouse and assembly functions in Building 494 will be used at a minimal level only as necessary to support material receipts for the Corridor 3 operation. Other activities in Building 494 will remain idle.

Process Lasers

Two areas will remain in cold standby: the Red Laser System (RLS) in Building 490, Room 1015A, and the Diagnostic Laser Laboratory in Building 175, Rooms 101 and 104. These facilities will not conduct AVLIS activities except to the extent necessary to perform required maintenance.

Separators

Maintenance and surveillance of separator facilities include the following:

- Maintenance of equipment, particularly life-safety equipment.
- Surveillance of facilities to assure ES&H standards are met.

Building 490 – Separator Demonstration Facility (SDF)

- a. The SDF portion of Building 490 will be reactivated for Gd verification tests and, therefore, is no longer subject to cold standby.
- b. Certain AVLIS process systems will remain in cold standby. These include the product and tails withdrawal system and the pod heater system.

Building 491 – Separator Refurbishment Facility

- a. This facility will remain activated to support continuing decontamination of uranium pod and certain module system components, some of which will be required for the Task 2 activities, other components will be set aside for future use or disposal.
- b. The equipment in which these components are currently stored will also be decontaminated for possible future Gd operation.
- c. All life safety systems will remain operational.

Building 493 – Separator Storage Facility

- a. Uranium control and accountability activities will continue. Storage and surveillance of the remaining 20 MT of uranium stock will continue.
- b. Building life safety equipment will continue to operate.
- c. Decontamination and destruction of legacy separator parts and equipment will continue.
- d. Support of building modification activities as part of a Department of Energy (DOE) funded General Plant Project (GPP) is required.

Building 494 – Separator Storage Facility

- a. This facility is used for passive storage of separator equipment and materials, such as the obsolete Mars vacuum vessel and incidental contaminated vacuum equipment from Mars and SDF. Routine surveillance will continue.
- b. All life safety equipment will remain operational.

Building 175 – Separator Development Facility

- a. Areas of the facility will remain in cold standby with the requisite life safety equipment surveillance and maintenance.
- b. Negative air systems supporting the contaminated refurbishment areas will continue to operate.

Building 177 – Separator Analytical Facility

- a. This building will remain active in support of Task 2 activities.

Computers, Networks, and Controls

Computers, Networks, and Controls (CNC) will continue to provide maintenance and surveillance of those systems that will not be reactivated for the Gd tests. The VIPER system, which supports process lasers, will not be reactivated. The RLS and Mars, copper Corridors 1 and 2 systems, and some separator diagnostic capabilities will be maintained in standby. The CNC application verification and test systems will be only partially reactivated.

Hardware maintenance and software licensing contracts that were terminated will be evaluated in terms of operational impact and selected contracts will be reinstituted. This minimum cost approach may result in delays in operations while repairs are procured on an as required basis. Some Digital Equipment Corporation and Hewlett Packard contracts will be implemented on a selective basis. Most of the computer contracts canceled for the cold standby state will not be recontracted for this three month activity to be consistent with minimizing costs.

Uranium Processing

The Feed Conversion Demonstration area and the Product Conversion Demonstration System, both of which are located in Building K-1037, will be maintained in standby condition. Routine maintenance will be performed, and area lighting and heating will be provided. Routine surveillance will be performed to protect the installed equipment.

Other Facilities

Regular inspection and required standby maintenance shall be carried out, as well as facility maintenance and safety surveillance. Minimum electrical needs will be met through enhanced energy management practices. Limited property management will continue.

Task 2 – Preparation for Future Photoionization

This task includes restart of selected facilities and preparation for future enrichment of a small quantity of Gd and the minimum purchase of Gd feed.

Consistent with minimizing program costs, a selected and limited number of laser, separator, and analytical facilities will be reactivated in preparation for eventual Gd photoionization verification and enrichment tests. These tests will be carried out using a uranium vaporizer modified for Gd operation utilizing a quick-turnaround-box vapor-enclosure in the SDF. Use of this apparatus is a cost effective approach to obtaining and verifying key process parameters. This same apparatus could be utilized after this three month period to obtain small quantities (10's to 100's of grams) of enriched Gd at ~40 to 45% enrichment levels if directed by the USEC. These tests could also lead to a future full-scale enrichment confirmation, at the request of the USEC. Gadolinium vaporization tests will be initiated and key process parameters measured. Appropriate modifications will be made to the optical transport and delivery system for Gd testing. Computer and control system support consistent with the laser and separator operation will be provided.

Copper Laser System

The LDF Corridor 3 copper laser system (three chains) will be reactivated and operated in support of Gd testing. During May, the copper laser system will be reactivated for limited five day periods to allow for short duration tests. During this period, and extending into June, non-roster additional staff will be added and trained to support eventual round-the-clock operation. Increasingly, regular operation will be achieved in July leading to continuous, three-chain operation by the end of July. Continuous operation of the copper laser system is a cost-effective operation. Due to the long warm-up and cool down time of the laser head, startup and shutdown transitions would occupy a significant fraction of the available time, limiting the usefulness of the system. Frequent startup and shutdown cycles also severely impact the lifetime of the laser head ceramic components, thereby significantly increasing the failure rate and associated material replacement costs.

Process Lasers

The green-pumped, plant-scale dye chain (PSDC) will be reactivated and configured to operate at the Gd λ_1 and λ_2 wavelengths. Low power-light (50 W) at 4 kHz from this single chain will be available at the separator for propagation tests beginning in June and will be increased to 200 W, commensurate with the increase in available Corridor 3 power. The construction of the yellow-pumped, compact dye chain will be completed in May, and the chain will be operated at the λ_3 Gd wavelength. Both chains are configured to accept pump light from the three chains of Corridor 3 copper lasers using the existing fiber-optics delivery system. The three color light will be available to the separator optical system by the end of July in a configuration for photoionization box tests. Consistent with minimizing costs, this power and Pulse Repetition Frequency (PRF) are limited by the available copper laser power and are below that required to eventually achieve full enrichment. The

operation is adequate for photoionization verification and enrichment at a lower assay than if full power and PRF were available.

The separator optical system will be reactivated and configured for Gd operation. The laser transport system, alignment control system, wavefront control system, and module optics system will be reconfigured for operation at Gd wavelengths on one side of the separator. The goals of the separator optical system are to accept single-wavelength low-power light in early June and three color light on one side of the separator by the end of July.

Minor changes will be made to the diagnostic laser system to allow for the diagnostic measurements of ASE gain and polarization rotation resulting from propagation in Gd vapor.

The process laser activity includes operation of the optical-fiber delivery system, the spectral control system, the dye laser system, the laser transport system, the separator optical system, the laser diagnostic system, the laser safety system, and the beam control and diagnostic system. These systems will be operated with nominally a one shift staff (eight hours/day, five days/week).

Process laser systems will be maintained and refurbished as needed, including the optical, electrical, and mechanical hardware; the clean room areas; separator optical systems; dye and solvent for the dye flow system; and quality assurance requirements for the optical components.

Separators

Modifications will be made to the existing uranium vaporizer to meet the requirements for Gd testing. These activities include the following:

Restart of the Building 490 Separator Demonstration Facility (SDF). The SDF equipment will have been in cold standby for seven months. Reactivation will involve restarting selected systems, which include vacuum, e-beam power supplies, gas-scattering cell, feeder, and vapor and extractor diagnostics. In addition, operator training will be conducted. This activity will be completed upon vaporization of Gd for the first time.

Electron Beam Transport Magnetics Verification and Gd Evaporation. The electron-beam transport magnetics will be modified from the uranium design to reduce the magnetic field in the photozone. This change is required to achieve the desired isotopic selectivity. The pair of existing electromagnets outside the vessel will be replaced with a small magnet inside the vessel, which is mounted to the pod frame. The system will be operated at full electron-beam power and the magnetic field will be adjusted to optimize the electron-beam footprint on the Gd melt and to minimize the magnetic field in the photozone.

This optimization process will be conducted first in pulsed electron-beam operation, and once the desired electron-beam footprint is achieved, full-power operation will begin. The generated Gd vapor is contained inside a box vapor enclosure. Tests using the box are cost effective, resulting in; 1) low enclosure-material cost, 2) minimal manpower for refurbishment, and 3) quick turn around time. Because of the eventual flaking of the solid collected material inside the enclosure, the test duration is limited to typically <10 hours.

This activity will be completed when the magnet system configuration is demonstrated to meet both vaporization and photozone magnetic field requirements.

System Integration and Integrated Tests

Diagnostics. Existing diagnostics will be modified to support the laser propagation and eventual photoionization tests. The major categories of diagnostics include: 1) the existing laser diagnostic packages suitably modified to measure the power and intensity of process lasers and amplified spontaneous emission (ASE) wavelengths at separator input and output; 2) polarization sensor modification for input polarization purity measurement, and development of a sensor for output purity measurement; and 3) existing seed lasers activated to measure ASE gain and polarization rotation resulting from propagation in Gd vapor.

These diagnostics are used in uranium and will be modified with different optics and filters to operate at the Gd wavelengths. Some diagnostics may need to be repositioned to satisfy the Gd requirements.

Preparation for Photoionization. Propagation of a laser beam in an atomic vapor will result in modification of the laser beam parameters. These modifications occur in uranium, but are enhanced in Gd due to the high assay of the resonant odd isotopes and the small isotope shift of the even isotopes. The most significant modification occurs on one of the three wavelengths (λ_1) utilized to photoionize the Gd.

Initial tests will focus on measuring key process parameters, including the ASE gain, polarization rotation, and intensity uniformity modification. These tests will utilize the full optical system multipass, which had been used in the Uranium Demonstration System (UDS) enrichment test series. Use of the box enclosure results in only a portion of the multipass beam being exposed to Gd vapor. By adjusting the density of the vapor, a range of vapor interaction lengths can be achieved. This will provide sufficient information to confidently project the performance impact of these effects for full single-pod operation.

The power required initially is on the order of 50 W at 4-kHz PRF, which is available from a single copper laser chain pumping a single dye laser chain. Tests later in this series will include operation of three copper chains and up to 200 W at the three Gd process wavelengths.

With the activation of the second fiber-pumped dye amplifier system by the end of July, the third wavelength required for photoionization will be available, and photoionization and isotopic selectivity tests could begin in a follow-on period. These tests would use a uranium vaporizer suitably modified for Gd with a box enclosure. Vapor will pass through a restricted orifice. Both the density and velocity of the vapor would be monitored so that a precise determination of the vapor rate (g/h) is made. The photoionization efficiency versus key process parameters including laser power, modulation, and frequency would be measured by monitoring photo current collected on a flat plate. These tests will provide confirmation of the process models developed in the point design effort. The flat plate will collect all charge and all the vapor so that no enrichment occurs. Similar

tests could be made using a mini-extractor assembly, thereby enriching material and allowing measurement of isotopic selectivity.

Point Design Optimization and Test Analysis. Data obtained from the initial tests will be analyzed and compared to model predictions. Analysis activities include vapor properties and laser propagation analysis.

The point design activities to date have resulted in the development of requirements for all major performance and cost areas. The uncertainties in performance and cost in some of these areas will be reduced as testing is completed. Models will be improved in high leverage areas to assist optimization of performance and minimization of cost.

Gd Feed Stock Preparation. Approximately 600 kg of feedstock to support the box tests will be procured from the existing Gd metal industry. Gadolinium/Cu alloying and casting tests will be performed, using existing equipment, as required to meet separator feed requirements. In addition, 120 kg of Gd will be purchased for the preparation of spare melts.

Computers, Networks, and Controls

Computer Systems Support and Operation. This activity includes the computer operations required to support the Gd tests. Computer networks related to supervisory, diagnostic, and laser and separator process control will be maintained and operated.

Operation of the business planning system in support of longer term planning and three month cost performance reporting will be maintained and supported.

Minimum CAD system support will be provided consistent with the design support associated with the laser and separator activities.

Personal computer systems will be operated and maintained consistent with the needs of the program for intercommunications, planning, and other personal computer-related capabilities.

Systems Integration

Overall direction, planning, and management of the AVLIS Program with regard to Gd operation, facilities, and external interactions will be undertaken. Project resources will be managed and monthly technical and financial reporting will be supplied to the USEC.

Evaluations of the planned Gd tests in Building 490 will be conducted by the Hazards Control and Environmental Protection Departments to determine the adequacy of the existing Safety Analysis Documents (Safety Analysis Document for the Laser Demonstration Facilities Complex, March 1992, L-14492; Safety Analysis Document for the Separator Demonstration Facilities Complex, January 1992, UCRL-AR-106366 Rev. 1) or the DOE Categorical Exclusion for "Building 490 Enrichment of Gadolinium and Erbium (May 12, 1993)", which enables Gd enrichment.

Existing facility and operational safety procedures will be reviewed and appropriately modified to include Gd operation. If requested by the USEC, the Program will review NEPA requirements in anticipation of an EA/EIS submittal for large quantity Gd enrichment.

Computational support will be required on Gd design definition and performance analysis. Moreover, conversion of computer control systems utilized in uranium enrichment experiments will be required to prepare for Gd enrichment experiments.

Facilities

General facility maintenance, including custodial support, trailer leasing, stores, property accountability, and facility management will continue. Most of the activities for Gd will occur in Building 490 and adjacent office Building 482. In addition, Buildings 491, 492, and 493, will be reactivated, as required. Routine and regular maintenance will continue on such systems as fire detection sprinklers, security, and emergency power. Electricity will be provided to operate the copper lasers, dye lasers, separator, and HVAC system.

Task 3 – Long Lead Preparation for Future Operations

This task includes activities that are directed toward engineering of selected components and subsystems beyond those described in Task 2. This activity maintains an enrichment core staff capability, as requested by the USEC, while maintaining cost-effective viable options for future courses of action by the USEC. This task also includes pre-procurement activities (through the bid process but not actual contract signing) for long-lead components to keep future options viable.

The activities in Task 3 are directed toward continued engineering of the copper lasers for non-CFC coolant operation, design of an optical fiber delivery system for the Corridor 1 and 2 copper lasers, design of a third dye chain and beam propagation to both sides of the separator, and design modifications to the existing uranium pod to adapt it to Gd operation.

Continued operation of the LDF copper laser system, whether that will be Corridor 3 or eventually Corridors 1 and 2, depends on the timely conversion of the remaining copper-laser CFC-cooled electronic assemblies to a different cooling concept. Operation of the copper laser system with CFC coolants as is presently done may not be allowed after implementation of the CFC production ban which is expected to go into effect December 31, 1995, based on the Montreal Protocol Agreement. Expeditious completion of this engineering work now is critical to a timely coolant refit in FY 1995. To date, prototypes of a completely non-CFC-cooled oscillator have been built. However, this effort must continue with the completion of designs for refitting the existing amplifiers, as well as the original oscillators, with non-CFC cooling. Efforts on this task will consist of limited testing and design iterations in order to establish the scope of work necessary for an eventual coolant refit. Actual procurements and fabrication efforts associated with a refit will be deferred pending a decision by the USEC on the future course of action.

As a cost saving measure, this SOW does not include operation of the Corridors 1 and 2 copper lasers. Future operation, however, requires fiber delivery of higher laser output to the dye chains in order to increase the tunable light delivered to the separator beyond the 200-W goal of our initial work. Since our present dye laser chains utilize the advanced fiber optic delivery system, it is necessary to design an equivalent delivery system for the Corridors 1 and 2 lasers. The design of the optical fiber delivery system for the copper S-lasers in the Corridors 1 and 2 copper lasers will be completed.

The engineering design effort will also include design of the third dye chain and beam propagation to both sides of the separator. The third dye chain is required to generate the λ_1/λ_2 power required for eventual multipod operation. Initial design work will focus on facility requirements for the dye flow system. Propagation to both sides of the separator will be necessary to photoionize and enrich the full pod throughput. By the end of the design effort, all opto-mechanical hardware procurements will be fully defined, and we will be prepared to initiate any facility work that is required.

In the Separator area, because of the low magnetic field requirement in the photozone for Gd operation, modifications will be made to the vaporizer (lower

pod) as described in Task 2. While these modifications allow operation with the box enclosure, they will inhibit eventual mating with the upper pod to the vaporizer for future full pod enrichment. This interface between upper and lower pod is a critical area of the pod because the high temperature sections of the upper pod must meet the water-cooled sections of the lower pod. This task will address these engineering issues and will be completed when the pod engineering design is revised, and when prototype upper pod components mate with the lower pod.

Some of the components for the full-scale demonstrations are long-lead (>3 months) procured parts. The long-lead components will be identified, and purchase requisitions for these items will be prepared.

Engineering designs for possible future upgrades to the computer-based supervisory systems will be completed. Such upgrades, if implemented, have the potential for significant reduction in maintenance and operation costs of the supervisory system. Significant cost savings can also be realized by automation of the separator operations and conceptual designs will be evaluated.

Task 4 – Market Entry Plan Support

This task provides support to the USEC, as requested, in the development of market entry plans for deployment of Gd and uranium enrichment facilities, and includes the Gd feed and product assessment activities necessary for market entry. The following key tasks could be undertaken, if requested.

Examine, by fuel fabricator and country, the current and future market for Gd as a burnable absorber. Generate a forecast and investigate current Gd market entry impediments.

Further investigate the potential market for enriched Gd with a comparison of enriched Gd to natural Gd (or the most appropriate burnable absorber). This market evaluation would include the market size by region, a market penetration analysis, and an analysis of the probable value/price.

Provide a recommendation on possible strategies for marketing enriched Gd, including the interface with fuel fabricators and utilities, possible competition with other isotopic separation ventures, and priority targets.

Long-lead time preparations for Gd enrichment could include minimum activities directed toward developing low-cost suppliers of feedstock and product conversion. A primary objective would be to obtain preliminary assessments from industry on: 1) the availability, price, and quality of Gd/Cu alloy and Gd metal supplies from industry; and 2) the availability, price, and quality of services to purify the Gd/Cu alloy and convert it into nuclear-grade Gd_2O_3 . These activities should be initiated during this three month period to ensure that adequate quantities of feedstock can be purchased, and that product conversion services can be obtained in a timely manner if requested by the USEC.

Provide support to the USEC to develop plans for the deployment of AVLIS for uranium enrichment. Examine the optimum plant deployments to meet the USEC's market and production requirements and strategic business objectives. Develop plans for predeployment activities for preliminary design, NRC preapplication activities, fuel cycle interface studies, confirmation testing, validation of economic projections, site selection and feasibility risk studies that could lead to future plant construction and operations. Plans would include key decision points, estimates for capital and operating costs, and schedules, based existing data bases and documentation. A full accounting would be made as to the benefits of Gd deployment on cost, schedule, and overall risk reduction.

Task 5 – Business Assessment Support

This task provides support to the USEC, as requested, for the Advanced Technology Business Assessment and any follow-on support during the assessment review by the USEC. This assessment includes uranium enrichment, Gd enrichment, and other AVLIS technology alternatives that may be of interest to the USEC.

The following key subtasks could continue to be undertaken, if requested.

- Assistance in the evaluation of business planning options:
 - ENTERprise financial analysis model to be used to assess the economic performance of business planning options.
 - Evaluate alternative business and financial configurations.
 - Evaluate range of deployment options.
 - Evaluate business plans for a range of market environments and competitor actions.
 - Update ENTERprise data basis for AVLIS, GDP, and HEU divisions as required.
 - Develop financial models for competitors if requested.
 - Assist with report integration, refinement, publication services, and development of presentation materials.
- Support evaluation of enrichment market conditions using internal and external data bases:
 - Overall demand and price structure.
 - Impact of U.S. and Russian HEU.
 - Impact of U.S. and Russian Pu/MOX fuel.
 - Ureneo, LES, Cogema, Russian, and Japanese competitor capability and pricing.
 - Impact of international centrifuge and AVLIS technology deployment.
 - Impact of uranium feed price on SWU demand.
- Assist in developing specific production and alternative technology deployment options:
 - HEU and Pu impacts on production requirements.
 - GDP production.
 - Deployment of centrifuge or AVLIS alternative technologies.
 - Options without deployment of alternative technologies including AVLIS termination.
- Provide cost and production schedules for alternative centrifuge and AVLIS technologies consistent with deployment options:
 - RD&D.
 - Capital.
 - Operating.

- Provide the design and technology basis for AVLIS deployment options as required:
 - One-line plant.
 - Two-line plant.
 - Four-line plant increment.
 - Six-line plant.
- Assess issues for AVLIS deployment options:
 - Fuel cycle interface strategy, technology, and cost.
 - Environmental impacts.
 - AVLIS patent and related claims.
 - Royalty asset value.
 - Regulatory licensing.
 - Nonproliferation leverage.
- Assess commercialization of non-uranium applications of AVLIS technology including Gd enrichment and laser and electron-beam processing:
 - Business plan development.
 - Market assessments.
 - Competitor positions.
 - Production facility options and costs for RD&D, capital, and operations.
 - Technology and concept basis.
 - Financial analysis.
- Provide the basis for evaluation of possible AVLIS plant deployment options or variations outside baseline cases:
 - Maintain the capability of the AVLIS-K Enrichment Model (AKEM) to make systems performance, cost projections, and uncertainty analysis.
 - Exercise AKEM as required.
 - Extend or modify cost models where appropriate to reflect non-DOE operation of AVLIS facilities.
 - Extend AKEM to non-uranium plant designs if requested.
 - Updating of AKEM code documentation.
 - Modeling of process physics for projections of integrated enrichment performance.
 - Comparisons of various small plant configurations of interest to USEC.
 - Evaluation of financial return on any future development expenditures.
 - Evaluation of enrichment performance impacts of any component performance shortfall.

Task 6 – Uranium Processing and Fuel Cycle Integration

The uranium chemical processing functions required before and after the U-AVLIS enrichment process are an important cost element for utility customers and are a key element of net costs for AVLIS SWUs. Successful integration of these functions into the existing fuel cycle will be a critical element of U-AVLIS commercialization. Therefore, pending a decision on U-AVLIS commercialization plans, this task represents a minimum cost effort: to 1) maintain technical and management continuity of our program to define, test, and implement the lowest cost methods of performing feed and product conversions; and 2) continue our broad-based technical interactions with the potential providers of these services within the fuel cycle industry.

In the feed conversion area, the primary objectives for the three month period will be to prepare statements of work for follow-on feed conversion assessment contracts and to begin preparations for industrial demonstrations of low-cost feed-stock production methods. Evaluations will be performed in the areas of alloy casting and diluent salt selection for the continuous UF_4 reduction process. In the product conversion area, the primary objectives will be to complete preparations for a second contract to evaluate impure AVLIS product-to- UO_2 conversion at a fuel fabricator facility and to evaluate process and design data that will be useful to industry in its assessments of investments in AVLIS product conversion services. Finally, economic and technical evaluations for both feed and product conversion will be updated and integrated based on recently obtained data.

Work Scope Schedule

Schedule of proposed AVLIS activities for the period of May 1, 1994 through July 31, 1994

Activities	May	June	July
Task 1. Maintenance and surveillance of AVLIS facilities			
	ongoing for facilities on cold standby		
Task 2. Preparation for photoionization			
— Copper laser systems and controls	Reactivate Corridor 3 CVLs		Begin sustained operation of Corridor 3 Lasers
— Dye laser and optical systems	Reactivate dye lasers	50 watts at 4 KHz to separator	200 watts at 13 KHz to separator
— Separator systems and controls	Restart separator operations	Complete e-beam magnet tests	
	Begin Gd evaporation tests	Procure Gd feed rods	Ready for Gd photolon measurements
	Begin laser propagation tests	Complete laser propagation tests	
— System integration and integrated tests	Modify optical diagnostic packages for Gd tests		Ready for Gd photoionization verification
Task 3. Long lead preparation for future operations	Restart non-CFC design	Begin pre-procurement of long lead components	
— Copper laser systems and controls		Complete design of fiber delivery system for S-lasers	
— Dye laser and optical systems		Begin product plate procurement	
— Separator systems and controls	Begin upper pod modification for C operation		Ready for long lead material and component procurement
Task 4. Market entry plan support		As requested	
Task 5. Provide support, as requested, for USEC advanced technology business evaluation		As requested	
Task 6. Perform U processing and fuel cycle integration activities			Evaluate alloy casting and diluent salt alternatives

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