

*Advanced Recovery and Integrated
Extraction System (ARIES)*

Preconceptual Design Report

Los Alamos
NATIONAL LABORATORY

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by

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ABSTRACT

This document describes the preliminary conceptual design of the Advanced Recovery and Integrated Extraction System (ARIES). The ARIES is an overall processing system for the dismantlement of nuclear weapon primaries. The program will demonstrate dismantlement of nuclear weapons and retrieval of the plutonium into a form that is compatible with long-term storage and that is inspectable in an unclassified form appropriate for the application of traditional international safeguards. The purpose of the ARIES process is to receive weapon pits, disassemble them, and provide a product of either a plutonium metal button or plutonium oxide powder appropriately canned to meet all requirements for long-term storage. This demonstration is a 24-month program, with full operation planned during the last three–six months to gain confidence in the system’s flexibility and reliability. The ARIES system is modular in design to offer credible scaling and the ability to incorporate modifications or new concepts. This report describes the preconceptual design of each of the ARIES modules, as well as the integration of the overall system.

1. INTRODUCTION

This document describes the preliminary conceptual design of the Advanced Recovery and Integrated Extraction System (ARIES). The ARIES is an overall processing system for the dismantlement of nuclear weapon primaries. The program will demonstrate dismantlement of nuclear weapons and retrieval of the plutonium into a form that is compatible with long-term storage and that is inspectable in an unclassified form appropriate for the application of traditional international safeguards.

The purpose of the ARIES process is to receive weapon pits, disassemble them, and provide a product of either a plutonium metal button or plutonium oxide powder appropriately canned to meet all requirements for long-term storage. This demonstration is a 24-month program, with full operation planned during the last three–six months to gain confidence in the system’s flexibility and reliability. The ARIES system is modular in design to offer credible scaling and the ability to incorporate modifications or new concepts. The two-year demonstration will support pits with a straightforward design configuration. Additional information related to program scope, organization, design requirements, documentation, implementation plans, and resources are discussed in the ARIES Program Plan (Ref. 1) and the Technical Task Plans/Statements of Work document (Ref. 2). The guidance document for the development of the ARIES from the Office of Fissile Materials Disposition (OFMD) of the Department of Energy is included as an appendix.

This report describes the preconceptual design of each of the ARIES modules, as well as the integration of the overall system. The designs incorporate a base-line set of advanced processes that have evolved from research and development efforts directed at improving previously used technologies. Many of these advanced processes have already been demonstrated, and the purpose of ARIES is to combine these processes into an actual integrated operational system.

The process base lines identified in this preconceptual design report are not expected to radically change during conceptual design; however, mechanical design of process equipment will evolve as engineering and design work progresses. The design of the ARIES will become fixed at the conclusion of the conceptual design phase of the program, and changes suggested after issuance of the Conceptual Design Report will require formal change control. The balance of this document outlines the features of the preconceptual design. These features include a general system description, functional design criteria, preliminary system layout, equipment descriptions and module operations, material inputs and outputs, Los Alamos National Laboratory Plutonium Facility (TA-55) interfaces, and follow-on design activities.

2. GENERAL DESCRIPTION

This section discusses the functions and the general configuration of ARIES and includes a general outline of the associated modules.

2.1. Functions

The primary function of the ARIES process will be to receive weapon pits, disassemble them, and provide a product of either a plutonium metal button or plutonium oxide powder appropriately canned to meet all requirements for long-term storage. Several integrated subsystems (modules) will be necessary to do this, with each subsystem having a distinct functional requirement. A possible layout of the overall ARIES system is shown in Fig.1. A general functional description of each component of the ARIES follows.

- **Receiving.** Selected pits will be introduced into the ARIES demonstration line through a contamination control enclosure (introduction hood) or through the existing TA-55 overhead trolley. Once a pit is introduced into the ARIES glovebox line, the component is automatically transferred to the various modules as required for processing, using a specially designed conveyor and module access system.
- **Pit Bisection and Disassembly.** In this module, disassembly will consist of removal of any appurtenances on the pit, followed by separation of the pit into two parts. This separation is done using a bisector apparatus that works similarly to a pipe cutter. After disassembly, the various component materials may be separated. The plutonium-bearing materials will be sent to the next module for consolidation. Any uranium-bearing components will be packaged and prepared for transfer out of the ARIES for decontamination, and any non-special nuclear material (non-SNM) components will be prepared for possible declassification operations. A dry, highly pure argon atmosphere will be required in this module to avoid any damaging surface reactions on the hemishells.
- **Plutonium Consolidation.** The plutonium-bearing materials will be sent to one of two plutonium consolidation modules. (1) The hydride/dehydride/recycle module will be used to remove the plutonium from the weapon component and consolidate it as a metal ingot. (2) The hydride-oxidation (HYDOX) module will be used to remove the plutonium from the weapon component and produce plutonium oxide. Which module is used depends on the desired final form of the stored material. Both concepts will be used to process components during the ARIES demonstration. After processing, any nonplutonium components will be sent to the ARIES nondestructive assay (NDA) subsystem for assay and subsequent load-out or to a final decontamination step for residual plutonium removal followed by assay and load-out. A part- declassification module may be incorporated at this point to declassify the nonplutonium components. The plutonium products (ingot or oxide) will be sent to the canning module for packaging. A dry, highly pure argon atmosphere will be required in these modules to avoid any material reactions or contamination during the handling processes.
- **Primary Packaging.** The consolidated plutonium metal ingot or oxide powder will be sent to the canning module for packaging of the material in containers that are inspectable, hermetically sealed, tested for leaks, and marked primary (material). A dry, highly pure argon or helium atmosphere is essential to this module to avoid any material or gaseous

contamination from being trapped in the sealed can. The loaded, sealed, and leak-checked material cans will be sent to the decontamination module for removal of radioactive contaminants from the material container surface.

- **Decontamination.** The canned plutonium product and any canned, declassified, nonplutonium components will be sent to the electrolytic decontamination module to remove any radioactive material from the outside of the primary material cans. The module will include a glovebox with a partition dividing the box into two sections, a section for radioactive materials (“hot”) and a section for nonradioactive materials (“cold”). Located in the partition between each section of the glovebox will be an electrolytic decontamination fixture that will be used to decontaminate the material cans. The cans will be placed into the fixture from the “hot” section, the electrolytic system will be operated, a water wash will be done, the can will be dried, the door to the “cold” section will be opened, and a preliminary alpha check will be done. The decontaminated can then will be removed from the fixture in the “cold” section, completely checked for surface contamination, and tested for leaks.
- **Secondary Canning.** Prior to installation of the secondary can, the primary product can will be removed from the ARIES glovebox system and brought into the room. At this point, a second container will be placed around the material container and also will be hermetically sealed (welded), checked for leaks, weighed, and labeled. The double-canned product will then be carried by hand to the NDA module for material assay.
- **Nondestructive Assay.** All products and wastes leaving the integrated ARIES system through the electrolytic decontamination module will be assayed for plutonium accountability purposes. Multiple NDA techniques will be used, together with automated material handling, that will reduce radiation exposure to personnel. This combined operation will be performed in a non-glovebox environment located next to the ARIES glovebox line in a TA-55 Building PF-4 laboratory.
- **Material Handling (Conveyor System).** Movement of process materials and some maintenance items will require the use of a conveyor transport system. The conveyor system will consist of a remote-controlled cart that will traverse the length of the conveyor glovebox. The cart will be operable from local control panels on each module’s glovebox and from remote locations, such as module computers and supervisory control and data acquisition (SCADA) computers. The cart will move process components to the entrance of module gloveboxes through a series of interlocked process steps. The conveyor system glovebox may be directly connected to the existing PF-4 trolley and TA-55 Zone 1 ventilation system, or it may have an inert atmosphere and require the use of an airlock entry system to access the PF-4 trolley system. The environment of the conveyor system glovebox may be either dry air or inert argon.
- **Material Handling (Process Modules).** Movement of materials within the individual process modules may be performed using either purely manual operations, fixed automation, or programmable robotic automation, depending on expected exposure levels and other operational factors. Programmable robotic automation will be used in the NDA module due to the long measurement time intervals required, the desire to operate 24 h around the clock, the desire to reduce personnel exposure, the need for better quality control of measurements, the ease of operation, and the need to accommodate the different measurement sequences required for different products (i.e., plutonium, other SNMs, and non-SNMs).

- Instrumentation and Control System.** Monitoring and controlling the various process systems within the ARIES will require an instrumentation and control system (ICS). The ICS will be a distributed system with three levels of hierarchy. Sensors, actuators, local controllers, and other simple instrumentation within the module gloveboxes will make up the instrumentation level. Programmable logic controllers (PLCs), which send and receive signals to and from the instrumentation level and communicate among themselves over a data highway, will form the data acquisition (DAQ) system level. Module computers and SCADA computers, which connect directly to the data highway and provide the necessary man-machine interface (MMI), will comprise the computer level. Note that, for the current demonstration system, the NDA is not considered part of the ICS, but rather is a separate module with which the ICS may communicate for NDA status messages.

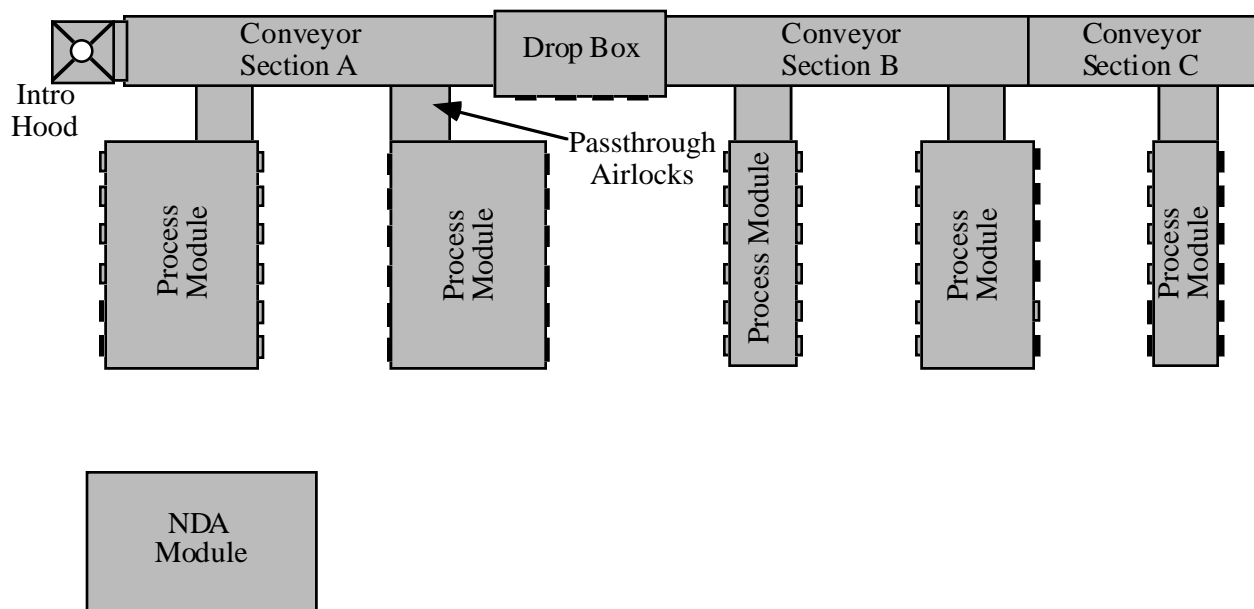


Fig. 1. Possible Advanced Recovery and Integrated Extraction System (ARIES) Glovebox Layout.

2.2. General Configuration

The individual ARIES subsystems will be configured into an arrangement of gloveboxes, air locks, and hoods connected to a central conveyor line, which will have access to all the modules as well as the existing TA-55 building trolley system. The unit processes will be operated batchwise to facilitate material control and minimize waste generation. Once plutonium material (initially contained inside a pit) is introduced into the glovebox line, it will not be removed until it is contained in a sealed decontaminated storage can, which will be available for secondary canning and final NDA. All other SNM and non-SNM components that are not intended for processing during this initial ARIES demonstration will be sent to the TA-55 trolley system to avoid bag-out procedures. A simplified material handling sequence (which does not show all the details) is illustrated in the process flow-sheet diagram in Fig. 2. Descriptions of the modules and their relationship to each other and to existing TA-55 systems are provided in subsequent sections of this report.

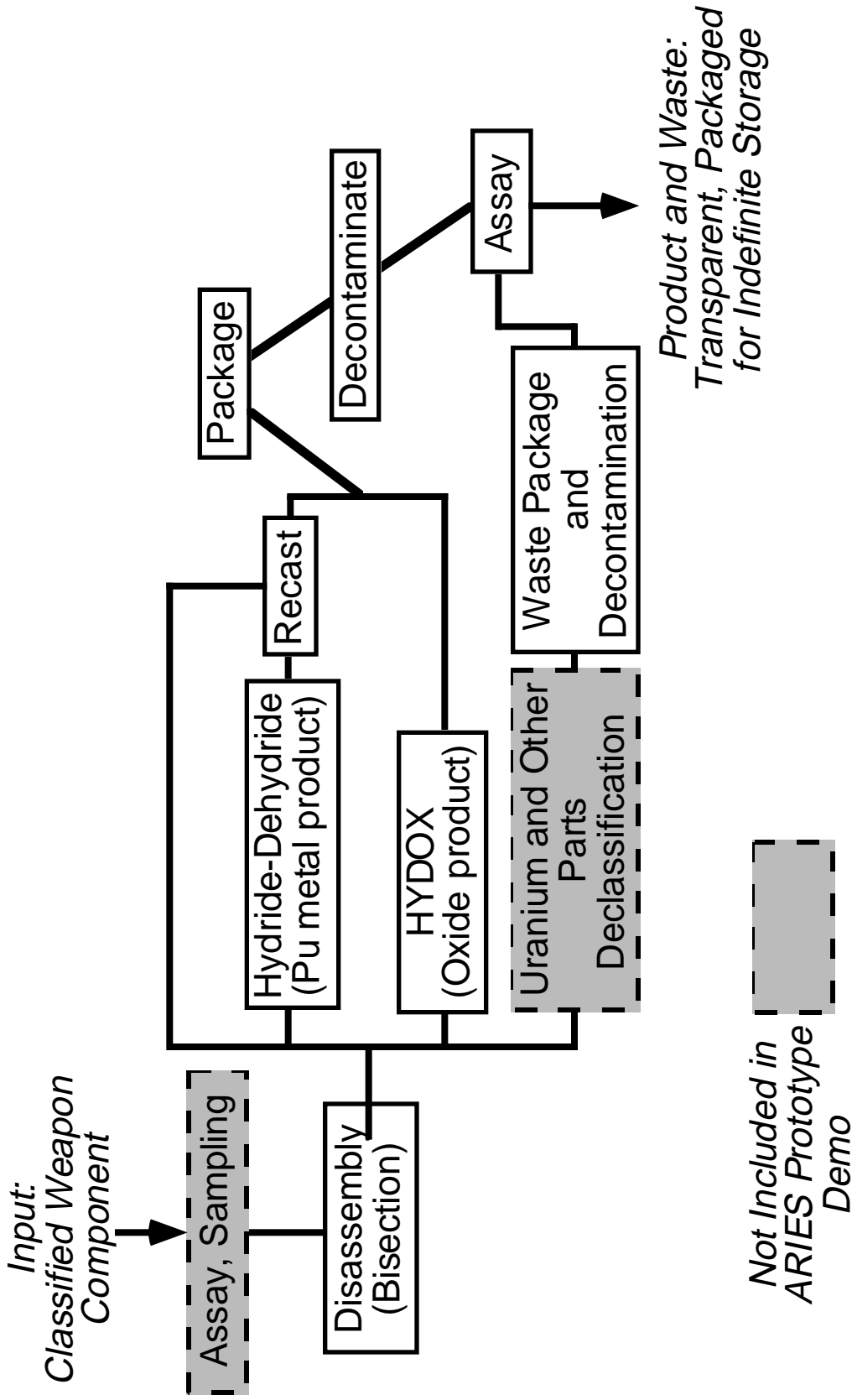


Fig. 2. Simplified ARIES TA-55 process flow sheet

3. FUNCTIONAL DESIGN CRITERIA

Criteria relating to expected performance of equipment, quality considerations, safety requirements, and durability of materials are described in this section. General functional design criteria (FDC) for the overall system and the common glovebox requirements are outlined in Section 3.1. In subsequent sections, FDC unique to each of the modules are presented.

3.1. Overall System and Glovebox Functional Design Criteria

- In order to reduce operator dose, the overall ARIES system must emphasize remote handling as much as possible. Design considerations also must address industry, criticality, and radiation safety requirements for plutonium processing. The system must satisfy as-low-as-reasonably-achievable (ALARA) considerations.
- Electrical and mechanical passthroughs into the glovebox enclosure must maintain the differential pressure between the Zone 1 and Zone 2 atmospheres in Building PF-4.
- The various module gloveboxes must couple to each other by means of a conveyor glovebox module and transport system. The overall system must also be able to interface with the existing PF-4 overhead trolley system.
- The glovebox atmosphere in each of the modules that require an inert gas atmosphere must be monitored for both moisture and oxygen. If a high-purity argon atmosphere is required, the glovebox must be monitored for nitrogen.
- SNM identification and control must be provided by the Material Accountability and Safeguards System (MASS).
- All gloveboxes and equipment internal to the gloveboxes must satisfy LANL seismic criteria and must meet all TA-55 health and safety requirements for Building PF-4.
- The gloveboxes should be manufactured from stainless steel and in a manner that reduces decontamination procedures (e.g., they should have radiused corners and other appropriate features). Radiation dose estimates for the components selected for processing should be considered in determination of shielding design. The glovebox designs must be compatible with the LANL procurement specifications outlined in NMT-8-PS-11610-R01 (Ref. 3).
- All gloveboxes must be made in sections short enough to enable installation into the selected PF-4 laboratory. The gloveboxes need to be able to be transported around the v-shaped barrier walls at the west entrance of the PF-4 facility, through the external doors of the building, and through the double entrance doors of the selected laboratory.
- All gloveboxes, air locks, and passthroughs must be big enough to handle the largest of the expected production, secondary, and waste components. Product and waste-component storage wells may be included in the gloveboxes to facilitate overall system operation.
- All measurement and test equipment (M&TE) must be analyzed to determine whether periodic recalibration is required. Procedure No. QAD-301-R01, "NMT-6 Calibration Guide" (Ref. 4) will be used as a guide in performance of the analyses.

3.2. Receiving Module

The ARIES receiving subsystem must conform to all TA-55 requirements for glovebox workstations. These requirements are outlined in a LANL Nuclear Materials Technology Division (NMT) report on glovebox specifications (Ref. 3).

3.3. Disassembly Module

Mechanical disassembly operations must meet the following FDC:

- The component must be bisected to provide access to component nuclear materials that will be amenable to the hydride/dehydride or HYDOX operations.
- The operation must limit contaminants to the fissile material that will adversely impact the chemical purity of the end product.
- The construction materials for the mechanical disassembly module must be compatible with a dry argon environment inside the glovebox enclosure.
- The bisector must be enclosed in a customized glovebox that is large enough to permit unimpeded movement for all hands-on and remote operations, while allowing access to the machine elements required for the disassembly process.
- The disassembly module glovebox must be leak-tight and must be able to maintain an argon atmosphere with <200 parts per million (ppm) impurities.
- All electrical equipment located within the glovebox must be fully compatible with the inert argon atmosphere.
- The remote handling equipment should provide a minimum of 0.1-m separation between the operator's extremities and the unshielded pit.

3.4. Consolidation Modules

3.4.1. Hydride/Dehydride/Recycle Module

The following criteria must be met:

- The consolidation chamber and associated vacuum components must meet high vacuum standards. The system must be checked for leaks and must maintain a dynamic vacuum near 10^{-5} torr. O-ring seals must satisfy vacuum requirements at operating temperatures.
- The argon atmosphere of the glovebox must be maintained at <200 ppm impurities.
- The pressure and temperature gauges must be accurate to within 0.5% of reading.

- The load cells that are used for reaction-rate determinations must weigh in the range of 10 kg.
- The equipment items used in the consolidation process must be commercially available and must be factory-calibrated at accuracy levels exceeding operational requirements.
- Leak-checking the consolidation apparatus to meet performance standards also satisfies safety requirements for hydrogen containment. However, routine checks for proper operation of all equipment will be necessary.
- The consolidation system must be compatible with hydrogen at the operating conditions. Certain components must contain molten plutonium and should be nonwetting, if possible.
- A reusable crucible may be used to facilitate unloading of the metal product.

3.4.2. HYDOX Module

This module must meet the following criteria:

- The HYDOX glovebox must be able to maintain a leak-tight argon atmosphere with <5 ppm impurities. The HYDOX vacuum system must be capable of achieving vacuum in the range of 10^{-6} torr. The reactor must be leak-tight to 1×10^{-9} cm³/s (STP).
- The HYDOX furnace zone must be constructed from materials that are compatible with hydrogen and oxygen at temperatures up to 950°C.
- The system must use H₂ and O₂ totalizing flowmeters, as well as pressure controllers, to control gas flows into the HYDOX chamber. These instruments must be accurate to within 0.5% of reading. They must be compatible with hydrogen and oxygen at pressures less than 1 atmosphere (atm).
- Pressure-measuring transducers must be accurate to 1% of the reading. All parts that come in contact with hydrogen must be made of a material that does not hydrogen-embrittle and does not easily oxidize.
- An oxide-transferring device must be used to remove the oxide from the HYDOX crucible in a manner that does not spill any PuO₂ into the glovebox. It is desirable that this device transfer the oxide directly into either the primary can or an internal-material can, both of which must be temporarily sealed in some manner for transport to the canning module.
- The HYDOX furnace must be required to go up to 950°C, and elements of the furnace must be compatible with argon atmospheres. The useful operating time must exceed 1000 h.

3.5. Primary Canning Module

This module must meet the following criteria:

- The welding atmosphere in the primary canning process must be argon/helium with ≤100 ppm oxygen and ≤100 ppm moisture.
- The welded containers must meet DOE standard DOE-STD-3013-94, "Criteria for the Safe Storage of Plutonium Metals and Oxides" (Ref. 5).

3.6. Electrolytic Decontamination and Secondary Canning Modules

The following requirements apply to electrolytic decontamination and secondary canning:

- The decontamination module must be capable of providing the access and process to transport a primary container with a metal button or oxide from a contaminated radioactive environment to an area that is free of contamination.
- The acceptable contamination levels on the primary cans, after completion of electrolytic decontamination procedure, cannot exceed 500 disintegrations per minute (dpm)/100 cm² direct reading (fixed) and 20 dpm/100 cm² swipable reading.
- The module must contain a system for handling the fluids used in the decontamination process. The fluids will be recycled and purified, using ultrafiltration methods in order to minimize waste and maximize decontamination efficiency.
- The glovebox should be partitioned into separate chambers in order to provide a physical separation of the “hot” and “cold” operations in the module. One chamber should have access to an introductory hood (“cold”), and another should have access to the conveyor tunnel (“hot”).
- The introduction hood is needed for removing the primary material container from the decontamination unit and for providing a location for performing the necessary examination processes on the primary.
- The welding atmosphere in the secondary canning process must be argon/helium with ≤ 100 ppm oxygen and ≤ 100 ppm moisture. The welded containers are required to meet DOE Standard DOE-STD-3013-94, "Criteria for the Safe Storage of Plutonium Metal and Oxides" (Ref. 5).
- Methods for providing marking and identifying of both the primary and secondary containers should be incorporated into the process.

3.7. Nondestructive Assay Module

The NDA equipment chosen for use in the ARIES must be capable of providing required accuracy and precision for control of SNMs during system operation. These materials may take many forms, including low-assay wastes and deposits on nonplutonium components. These criteria require NDA instruments to be of proven design and capability; although their configuration in the system may be altered from traditional concepts. Table 1 lists specific operational criteria for these instruments.

Table 1. Nondestructive Assay Instrument Criteria			
Instrument	Type of Material to be Measured	Range	Accuracy
Calorimeter	High-mass Pu metal	50–4500 g	0.5%
Gamma Ray Isotopic System	Plutonium (any form)	1–4500 g	0.25–5%
Neutron Counter Active	High-enriched U	>50 g	5–10%
Passive	High-Z, low- or high-Pu Depleted U	0–4500 g >1 kg	5–10% 5–10%
Segmented Gamma Scanner (SGS)	Low-SNM-, low-Z- low-U-, and low-Pu- contaminated waste	0–200 g Pu or U	2–10%

The quality assurance (QA) requirements for the assays performed by the system should be met by the requirements for MASS measurement control. The equipment must be either self-calibrating, or the calibrations must be automated easily. Safety performance must be enhanced by automatic (robotic) loading of the equipment. Robotics can be used to reduce handling and radiation exposure for operating personnel. There are no special materials needed for this system; but there will be special fixtures required for the robotics, depending on container design.

3.8. Material Handling Equipment

3.8.1. Conveyor Transport System

The following requirements apply to this system:

- The conveyor system must accommodate the design requirements of each of the modules and must use conventional LANL and Lawrence Livermore National Laboratory (LLNL) methods of glovebox design and construction (such as penetrations, lighting, windows, and glove ports) that are in conformance with PF-4 requirements (Ref. 3).
- When multiple components are used in the system, they must be of standardized design (such as air locks, sealing doors, and high-efficiency particulate air [HEPA] filters).
- The conveyor system must interface with the existing PF-4 overhead trolley system; and the drive system for the conveyor should be designed and fabricated from a simple, proven, and established technology.
- Each inert atmosphere module must be designed with a sealing door or an air-lock assembly to maintain, during unit operations, isolation between the conveyor system and the module.
- The use of any air locks must not require excessive waiting times that would hinder the operation of the overall system.
- The transport cart must be designed to handle all expected process components (pits, product cans, secondary components, waste components, and waste cans) without any major modifications required when swapping back and forth between components.

- The transport cart must be accessible to each module with minimal operator interface. The cart must be capable of remote operation and, in case of equipment failure, manual operation.
- The system must be interlocked in a manner that is similar to that of an elevator, such that the cart functions can only be activated when (1) the cart is located in front of one module station and (2) the door to that station has been opened.
- The system must be designed for easy maintenance in a glovebox environment and must use readily available components.

3.8.2. Robotic Systems

The following requirements apply to this system:

- The system must provide x, y, and z Cartesian and single-axis gripper motions to pick up process- and waste-component containers.
- The system must provide unobstructed x-translation of the robot through the entire (contiguous) length of the NDA framework. The system's y-translation must permit access, as needed, to all process material locations on the NDA fixture.
- The system must provide automated material transfer for the NDA subsystem.
- The system must be designed to accommodate a maximum 10-kg load.
- The system must provide force sensors on the robot end-effector to ensure that loads are firmly held, yet not crushed.
- The system must provide a telescoping Z arm on the robot to provide access, as needed, to process material.

3.9. Instrumentation and Control System

- The ICS must be able to monitor and control all conveyor glovebox ventilation and utility services.
- The ICS must be able to monitor and control all transport-cart and air-lock functions.
- The ICS must confirm that all preconditions are met prior to initiating conveyor operations.
- The ICS must provide DAQ functions as required for all modules, except NDA.
- The ICS must consist of commercially available hardware and software elements with proven performance in a similar nuclear facility. Any exceptions to these criteria shall require project management and QA review and approval on an element-by-element basis.
- The ICS must provide alarm and notification monitoring and handling for the entire ARIES.
- The ICS must maintain overall system security by excluding access to uncertified personnel.

- The ICS must be able to monitor module process parameters for data sufficient to inform the operator about the status and safe progress of planned events.
- The ICS must confirm that all preconditions are met before allowing operations to be initiated.
- The ICS must ensure safe shutdown of all critical control functions (such as proper positioning of valves, maintaining position of air-lock doors, and shutting down of furnaces), in case of power failures.

4. EQUIPMENT DESCRIPTIONS AND MODULE OPERATION

The modules that comprise the ARIES will incorporate technologies and equipment that fulfill the functional criteria identified previously. This section provides both a generalized description of the equipment to be designed for each module and a discussion of proposed module operation.

4.1. General Glovebox and Support Functions

Each of the major modules will be housed in a commercially procured stainless steel glovebox. Requirements for additional gamma- and neutron-shielding materials on or within the glovebox walls will be determined for the final design. The interior walls of the glovebox will be made of 304 stainless steel, and the windows will be made of safety glass. Additional external window coverings, for any required gamma shielding, will be made from transparent, lead-loaded glass or from plastic.

The support functions consist of the following components: glovebox ventilation equipment, including HEPA filter equipment and dri-trains; all utilities including electrical power, vacuum systems, gases for pneumatic systems, and glovebox lights; process gases including hydrogen, oxygen, argon, and helium; and air-lock systems.

4.2. Conveyor Transport System

Equipment. Movement of process materials and some maintenance items within the ARIES will require the use of a conveyor transport system and some type of local delivery system to each module. The material-handling system will consist of the following components: a conveyor glovebox that extends the length of the system, connects to all the module gloveboxes, and connects to the Building PF-4 trolley system through an existing drop box; a conveyor transport cart that travels the length of the conveyor glovebox and delivers components to each of the modules; and a specialized platform that mounts on the conveyor transport cart and automatically delivers/receives components to/from the entrance of each module glovebox.

Operation. The transport cart will be automatically controlled in order to transfer pits or other materials between the entrances of the various modules. An automatic system on the cart will be used, at the entrance of a selected module, to deliver a process component into the module glovebox or to retrieve a product from the module for delivery to another module. Since the existing drop box will be used, the conveyor will also be able to deliver/retrieve components to/from the existing PF-4 overhead trolley system.

4.3. Receiving Module

Equipment. The receiving module will be based on standardized introduction hood designs currently in use at TA-55. The receiving hood planned for the ARIES will accommodate one pit at a time, will be equipped with an openable front for loading, and may incorporate leaded gloves for manual handling. The outer pit casing will provide attenuation of radiation fields and contamination control during the load-in operation. Use of a transfer air lock between the hood

and the conveyor glovebox is currently being evaluated. If an air lock is used, it will also be of standardized design and will be sized to accommodate only one pit at a time.

Operation. The pits selected for this program may be transferred to the ARIES from the TA-55 storage vault by controlled cart. Pit identification and control will be provided by the TA-55 MASS. Initial NDA and any gas sampling will be performed elsewhere in TA-55 before the pits are brought to the ARIES introduction hood. Pits may be introduced into the ARIES by removing them from the transfer cart and placing them into the open-face hood under air atmosphere. Hood ventilation will be connected to the Zone 2 glovebox exhaust system. The existing standardized design at TA-55 for entry hoods will be applied to this system (Ref. 3).

After closing the receiving hood, the pits will be manually transported to the ARIES conveyor glovebox. The transfer method used depends on the type of atmosphere selected for the conveyor glovebox and whether an air lock is used.

In some cases, pits also may be introduced directly to the ARIES conveyor system through the PF-4 overhead trolley system, bypassing the receiving hood.

4.4. Disassembly Module

Equipment. The bisector will be the principal piece of equipment within this module. The bisector machine will be similar to a commercial powered pipe cutter. It will differ, however, in that the cutter platform will be horizontal and will remain stationary, while the pit will be rotated by means of an electrically powered rotary table with a vacuum chuck that will securely hold the pit on the table. Several vacuum chucks will be designed to accommodate the family of pit types anticipated for the ARIES. Use of these vacuum chucks will minimize setup time and contribute to system versatility. Incorporating a vertical axis of rotation for the bisection operation will simplify use of any required remote handling tools and production disassembly operations. To minimize the operator extremity radiation dose, the cutter wheel may be designed to be remotely advanced radially by means of a commercial stepping motor with a gear reduction drive.

Like a commercial pipe cutter, advancement of the cutter wheel will result in very large radial forces during the bisection operation. These forces will be balanced by two roller-follower wheels on the opposite side of the platform. To ensure that these large radial forces will not be transferred to the rotary table and its electric motor drive, a soft structure will be used to support the very rigid cutter platform. This soft support structure will also accommodate any out-of-roundness of the pit, but the structure will be sufficiently stiff to resist the reaction torque loads produced during the bisection process.

Additional equipment within the glovebox module will include a precision, digital mass balance for inventory control; various gauging equipment including micrometers; remote handling tools for cutting, lifting, and separating subassemblies; and an overhead trolley with a minihoist for positioning and removing the pit from the bisector machine.

A dry-pumping vacuum system will be required outside of the glovebox to provide the vacuum for operation of all vacuum chucks.

Operation. After receipt of the pit into the pit bisector, remote handling devices may be used to transfer the pit from the conveyor delivery mechanism onto a scale. The pit will be inspected, will have any appurtenances removed, and will be weighed.

The pit then will be conveyed to and mounted on the bisector machine. The mounting will be accomplished by means of custom-designed fixtures for firmly holding the pit in place. The bisector machine incorporates many of the features of commercial powered pipe cutters. A rotary table with a contoured vacuum chuck will hold the pit in position. The bisection cut will be made with a chipless cutting wheel that will be radially advanced as the pit turns on the rotary table. After pit bisection, the hemishells will be transferred, one at a time, back to the scale and individually weighed. Material accountability data will be taken and entered into the MASS system. The plutonium components will then be transferred out of the bisector glovebox and delivered to one of the plutonium consolidation modules (HYDOX or hydride/dehydride). The nonplutonium components will be transferred out of the ARIES to other TA-55 facilities through the PF-4 trolley system or through the introduction hood. These parts may also be sent to a future ARIES module for possible declassification procedures.

4.5. Consolidation Modules

The consolidation operation chemically separates plutonium from bonded and nested weapon subassemblies. This operation will be carried out in one of two modules, depending on the desired final form of the plutonium. The ARIES will be designed and built to test both types of product consolidation. The hydride/dehydride/recycle module will be used to convert the plutonium in the pit hemishell directly into a metal ingot. The HYDOX module will be used to convert the plutonium in the pit hemishell directly into an oxide. Both of these systems turn out a product that will be suitable for long-term storage and will be compatible with future DOE plutonium disposition options.

4.5.1. Hydride/Dehydride/Recycle Module

Equipment. A prototype hydride/dehydride/recycle system has been designed and built in PF-4; and numerous tests on a single hemishell, as well as on two stacked hemishells, have been performed. These tests have verified the performance of the reactor assembly in such design areas as operability, maintainability, and full-scale process viability. Preliminary studies in the prototype system have proved closed-loop recycle technology to be successful. The studies have shown that further development of the uranium hydride beds is necessary.

The full-scale studies on the existing prototype system have provided valuable information that will be used in the design of a more efficient recycle vacuum system for installation in the ARIES. An O-ring-sealed vacuum chamber will be designed to allow easier loading and unloading of plutonium-containing materials. The new design will make it easier to incorporate fixed automation, if required. A two-kilowatt resistive furnace, needed for the dehydriding reaction and in situ casting, will be installed around the lower vacuum chamber of the reactor. Pressure transducers, k-type thermocouples, and furnace controllers will be installed to monitor and control the recycle reaction parameters. A load cell may be used to help determine the endpoint of plutonium processing and monitor reaction rate. A new design of the fixture that holds the plutonium component will be developed to provide easier and faster loading capability.

Studies of coating technology and of tantalum metal carburization will be used in the design of the reusable process crucibles. These types of coatings or treatments will be used to protect process crucibles from the wetting and corrosion effects of molten plutonium metal. These treated reusable crucibles will be used for in situ casting within the module vacuum furnace. Calcium difluoride-coated magnesium oxide crucibles may be substituted in the event that reusable metal crucibles do not perform as expected.

Operation. Operation of the hydride/dehydride module consists of placing the bonded hemishells into a vacuum system where, after processing, almost 100% of the plutonium will be collected as a metal ingot. The hydride/dehydride system will use pure hydrogen gas, generated from a solid storage bed (uranium powder), to form plutonium hydride on the surface of the bonded plutonium shell. This hydride will fall from the surface into a heated receiving crucible where a reverse reaction occurs, leaving behind pure plutonium metal and liberating fresh hydrogen gas for further hydriding of the plutonium on the hemishell. The spallation of the plutonium hydride will be increased by a fixture that vibrates mechanically. Reuse of the hydrogen gas in this closed-loop arrangement will permit operation with a very small hydrogen charge, will greatly improve the safety margin, and will reduce the inventory of plutonium hydride. The resulting metal ingot will be weighed, and the material accountability data will be entered on the MASS system. The product ingot will then be loaded into the primary storage can or a special internal material can and delivered to the canning module.

4.5.2. HYDOX Module

Equipment. The HYDOX reactor will consist of a stainless steel vacuum vessel with a fixture at the top for holding the pit component, a crucible chamber for containing the product, a resistance heating furnace, and gas feedthroughs for introducing controlled amounts of hydrogen and oxygen during processing. For ease of maintenance and operation, the internal components of the reactor will be designed to be taken out through the bottom of the vacuum vessel.

Other equipment that will be designed and built for use in the HYDOX module are the following: a glovebox capable of containing the HYDOX reactor and the product powder-transfer device, a two-stage “dry-pump” vacuum system and the necessary gauging, gas handling and metering systems for hydrogen and oxygen, thermocouples and pressure transducers for monitoring and controlling the process, remote devices for handling the components, and a computer/process controller to monitor all variables and potentially control some of them.

In addition, a scale will be required to keep track of incoming plutonium and outgoing PuO_2 . A transfer system and canning device will be designed for use in dustless transfer of the oxide to the primary storage can. The glovebox will need sensors to measure residual hydrogen, oxygen, and water—all in the ppm range. Remote handling tools may be designed for use in mounting the pit subassemblies into the HYDOX furnace assembly.

Operation. Remote handling devices will be used to transfer the pit hemisphere from the conveyor delivery apparatus onto a scale where the pit will be weighed. The pit will then be loaded into the HYDOX reactor, where the metal will be converted to a hydride in a similar manner as described previously; but the hydride will be oxidized into PuO_2 powder by a controlled insertion of O_2 gas into the chamber that releases the hydrogen. This process can be accomplished in either one or two steps. The two-step process completely hydrides all the plutonium in the first step, removes all the H_2 gas, and then, in a separate second step, inserts O_2 to oxidize the hydride to PuO_2 . In the one-step process, a small amount of hydrogen is used to hydride only a portion of the plutonium while, at the same time, oxygen is slowly introduced to continuously convert the small amount of hydride to oxide and to release the hydrogen that then hydrides more plutonium. This process continues until all the Pu has been converted to oxide.

The two-step process is the base-line design for ARIES, but development of the one-step process will continue to be pursued. In either case, once all the plutonium has been converted to oxide, the product will be calcined to make sure that all the hydride has been converted. A dustless transfer system will be used to transfer the oxide from the HYDOX reactor crucible into an appropriate material or temporary transport can. At this point, the can, lid, and oxide will all be weighed and the material accountability data entered into the MASS system. The product oxide will be delivered to the canning module.

4.6. Primary Canning Module

Equipment. This module will consist of the following equipment: a glovebox to contain the canning module equipment, a welding system to perform the welding of the lids onto the primary-storage cans, and a leak-detection system to check for the presence of helium and to verify the integrity of the can welds. In addition, a scale will be required to maintain accountability of the product. The glovebox will need sensors to measure residual oxygen and water—both in the ppm range.

Operation. After consolidation, the product (metal ingot or oxide powder) will enter the canning module in a primary-storage can or in a special-material can compatible with the primary-storage can. If the special-material can is used, then it will be loaded into the primary-storage can prior to performing the welding operations. The primary-storage container then will be loaded onto the lid-welding apparatus and purged with helium gas (to facilitate later leak-checking), and the lid will be welded closed. After welding, the can will be moved to a leak-check station to determine the integrity of the weld by detecting for helium leakage from the container. If a leak is detected, a second weld pass will be made to reseal the container. Material accountability data will be entered into the MASS system. The hermetically sealed primary-storage can then will be transferred out of the canning module and delivered to the electrolytic decontamination module.

4.7. Electrolytic Decontamination and Secondary Canning Module

Equipment. The electrolytic decontamination module will consist of the following equipment: a glovebox designed with a “hot” chamber and a “cold” chamber, a decontamination fixture mounted in the partition between the two chambers of the glovebox, an electrolyte manifold and treatment system, a direct-current power supply to power the electrolytic decontamination system, and an alpha measurement system to determine the contaminant level on the primary-storage cans immediately after they are removed from the decontamination fixture. In addition, a scale may be required to maintain accountability of the product. The glovebox will need sensors to measure residual oxygen and water—both in the ppm range. Also, the “cold” chamber of the glovebox will contain a hood to allow removal of the canned product from the ARIES glovebox line into the laboratory room.

A second welding system will be located outside to the glovebox in the ARIES laboratory room to perform the welding of the lids onto the secondary cans. In addition, a system to check for helium leaks will be used for determining the integrity of the secondary can lid welds.

Operation. After canning, the product will be transferred to the “hot” side of the electrolytic decontamination module. The electrolytic decontamination fixture will be located in a partition between the “hot” and “cold” chambers of this glovebox. The contaminated can will be placed into the fixture from the “hot” chamber. The fixture body will be electrically connected to the negative terminal, and the can itself will be connected to the positive terminal of a low-voltage direct-current power supply. The electrolyte fluid will be pumped from its reservoir to the fixture and recirculated while a low-DC voltage is applied. After the decontamination process, the can will be rinsed with contamination-free water and then be dried. The decontaminated can will be removed from the fixture to the “cold” chamber of the glovebox, where the can will be alpha checked to ensure that the remaining contaminant level is below specified limits. The aqueous electrolyte used for decontamination will be recycled; and, after numerous cycles, the contaminants will be removed from the solution as solid waste.

Once the primary can has been removed from the decontamination fixture on the “cold” chamber of the glovebox and it has been alpha checked to verify decontamination, the can will be removed from the glovebox into the room. Then, it will be loaded into a secondary container made from stainless steel and will be laser marked for identification purposes. Following a procedure similar to that performed for the primary can, the secondary container will be loaded onto the lid-welding apparatus and purged with helium gas (to facilitate later leak-checking), and the lid will be welded closed. After welding, the can will be moved to a leak-check station to determine the integrity of the weld by detecting for helium leakage from the container. If a leak is detected, a second weld pass will be made to reseal the container.

Material accountability data will then be entered into the MASS system. The double-canned, sealed, laser-marked product then will be transferred out of the “cold” chamber of the electrolytic decontamination module through an open-face hood that is under air atmosphere. The product can then will be transferred manually to the NDA module for material assay.

4.8. Nondestructive Assay Module/Robotics Support

Equipment. The NDA module will consist of the following assay instrumentation: a segmented gamma scanner (SGS) for the assay of low-density, low-SNM material; a calorimeter/in-line gamma-ray isotopic system (GRIS) for the assay of high-plutonium-content (>50 g) items (two instruments); and a passive and active neutron-counting device (NCC) for the assay of high-z, low-SNM materials, both uranium and plutonium, or high-Pu (product) materials. An automated system will conduct the assays by robotic manipulation of the product cans between the various instruments. The assay equipment will be located in an open platform (no glovebox required) with the gantry-type robot mounted overhead.

A programmable three-axis robot with specialized grippers will be used within the NDA module to transfer the SNM and non-SNM product cans between the various assay instruments. The robot will be capable of moving and manipulating any anticipated ARIES load of up to 10 kg. Tooling necessary for gripping and manipulating the product and other material cans will be purchased or fabricated.

Operation. NDA of material produced by the ARIES process will be necessary for final control and accountability of SNM. The instruments needed to analyze all of the possible material produced by the ARIES processes have been chosen for the NDA subsystem. The NDA system will be used to analyze the plutonium product (oxide or metal) within the double-canned plutonium product containers, as well as any canned uranium or non-SNM material generated in the ARIES process.

At the conclusion of the NDA processes, the product plutonium will meet all requirements for long-term storage; and the cans will be sent to the TA-55 vault for interim storage. The cans will be in an inspectable and unclassified form that is appropriate for the application of traditional international safeguards. Other SNM and non-SNM items will be sent to appropriate locations within the TA-55 facility for further processing or storage.

4.9. Instrumentation and Control System

Equipment. The ICS will consist of the following components: sensors, actuators, local controllers, other simple instrumentation, instrumentation racks, wiring, cables, programmable logic controllers (PLCs) for DAQ, module computers, SCADA computers, and associated software. Figure 3 shows these components in the three-layered architecture of the ICS. Note that the NDA is shown in Fig. 3 only for interface/communication purposes and is not considered part of the ICS.

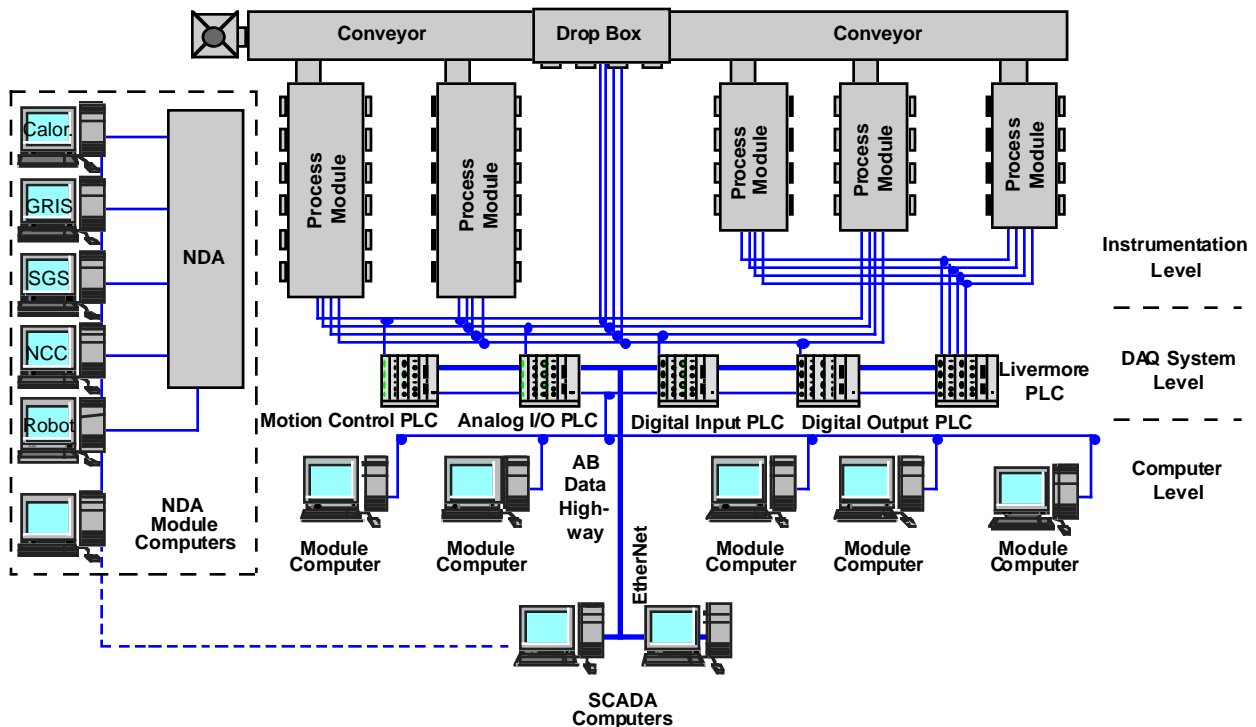


Fig. 3. Three-layered architecture of the Instrumentation and Control System (ICS), showing module and supervisory control and data acquisition (SCADA) computers.

Operation. Each module glovebox will contain various sensors, actuators, and other simple instrumentation that comprise the instrumentation level. As shown in Fig. 3, signals from this level will be sent to and from a DAQ system layer that consists of several PLCs that communicate over an Allen-Bradley data highway. Each PLC will receive and send signals of a different type in order to make optimal use of PLC input/output (I/O) modules. The exception to this arrangement will be the PLC for the modules designed and constructed at LLNL. The LLNL modules will have a resident dedicated PLC within the DAQ system to allow distinct control systems to be developed at Livermore. Module computers and SCADA computers in the computer layer will connect directly to the DAQ system.

A module's control functions may reside in either a module computer or a SCADA computer. Module computers will only monitor and control their respective modules. SCADA computers will monitor and control modules with control functions that reside in SCADA computers, monitor and control the material transport system (i.e., all shuttles, doors, air locks, and the conveyor cart), monitor the atmospheric systems (e.g., oxygen and moisture ppm), and monitor module computers for notifications. Using a module computer will provide the benefit of independent system development. Using a SCADA computer will reduce the number of computers in the ICS, as one SCADA computer may monitor and control several modules. As such, a module's control functions may begin in a module computer during development of the ARIES and be transferred to a SCADA computer during integration and operation of the ARIES.

5. SYSTEM LAYOUT

The ARIES process line will be installed in a selected laboratory in Building PF-4 at TA-55. Specific requirements for the location of the system within the room must be developed prior to assembly. These requirements must include the most logical layout of the process gloveboxes, utility needs, structural needs, interface needs, and needs for access to existing trolleys and service rooms at PF-4. Many of these needs are defined in the following descriptions of layouts and arrangements for equipment and associated gloveboxes.

5.1. Glovebox Arrangement

The ARIES includes six glovebox systems and one nonglovebox system. The conveyor glovebox system will consist of two, approximately 20-ft-long, tunnel sections connected to each end of an existing drop box in PF-4. The drop box will provide the interface connection to the current PF-4 overhead trolley system. This conveyor glovebox will be located next to the back wall of the laboratory and will have no windows or glove ports on the side next to the wall.

Attached in-line to one end of the conveyor glovebox will be the receiving hood. Attached, at various locations along the conveyor glovebox and mounted perpendicular to the glovebox, will be the five major modules that make up the ARIES line (HYDOX, canning, pit bisector, hydride/dehydride, and electrolytic decontamination). All these gloveboxes will be attached to the conveyor glovebox and will use a sealing door or a pump-down air lock to isolate the module atmospheres. The gloveboxes will be designed with flanged connections to facilitate glovebox replacements or future additions to the line. The NDA system will be located in the same laboratory room, but it will be mounted in a nonglovebox framework that will not be connected to the main line.

The flow of product materials in the ARIES will be from the receiving hood to the disassembly and plutonium-processing modules, to the canning and decontamination modules, and finally, out of the glovebox line and to subsequent manual transfer to the NDA system. The material flow-through concept for SNM accountability will require the output from one module process to directly provide the input to the subsequent process. The final layout and process flow will accommodate this requirement while minimizing the floor-space usage within TA-55.

5.2. Equipment Layouts

The layouts described in this section are for the ARIES modules only. Support systems, such as the atmosphere ventilation equipment and utilities, must be arranged to optimize interaction with the process systems and yet to minimize laboratory space needs.

The modular process equipment planned for the ARIES will be arranged in a fashion to facilitate material movement and to minimize radiation exposure. The layouts within each of the process modules are described below.

- **Disassembly.** The pit bisector will be enclosed in an individual glovebox in a position that will permit unimpeded movement of all expected process components, while allowing access to the machine elements required for the disassembly process. An overhead hoist system may be incorporated for remote handling of the product and waste components. Vacuum

equipment, needed to operate the pit bisector and any other equipment, will be placed either under the glovebox or as close to it as possible. External equipment will include moisture and oxygen sensors and a process power supply.

- **Consolidation.** Both the HYDOX and hydride/dehydride modules will be located in individual gloveboxes. For the hydride/dehydride system, the hydrogen storage beds will be located next to the apparatus. For the HYDOX system, the hydrogen and oxygen supply cylinders will be located outside the glovebox system with metered lines into the glovebox. In both modules, the vacuum pumping stations will be placed either under the glovebox or as close to it as possible. Both systems will have hydrogen detectors, as well as oxygen and moisture sensors, located in the glovebox. External equipment will include power supplies, control units for the sensors, and system process power.
- **Primary Canning.** The primary canning process will be located in one glovebox that contains two workstations. The principal piece of equipment in one workstation will be the can-welding station. The second workstation will contain the leak-checking apparatus. Adequate workspace within the box will also be an important feature. External equipment will include moisture and oxygen sensors and a process power supply.
- **Decontamination.** The decontamination glovebox will consist of a double-wide, standard-depth glovebox that will have two isolated chambers. The "hot" chamber will be accessed from the conveyor glovebox through a sealing door or air lock. The "cold" chamber is accessed through the decontamination fixture located in the wall between the two chambers. The "hot" chamber will contain the electrolytic decontamination apparatus supporting equipment. The decontamination fixture is located in the wall between the "hot" and "cold" chambers. External equipment will include moisture and oxygen sensors and a process power supply.
- **Nondestructive Assay.** The layout for NDA equipment in the ARIES will use a four-well arrangement, with each well supporting a separate instrument. The actual measurement instruments will be located below the floor level of the open NDA support structure. A gantry-type robot will be used to automatically move the canned product or waste components around the structure to the various NDA instruments.
- **Instrumentation and Control System.** The ICS will consist of approximately three instrumentation racks and up to seven module and SCADA computer stations. The instrumentation racks will house the DAQ system of PLCs, other rack-mounted instrumentation (such as the glovebox atmospheric monitoring systems), and associated power supplies. The instrumentation racks, module computers, and SCADA computers must reside in the same room as the ARIES. The layout of the ICS will conform to standards and recommendations contained in DOE-STD-1062-94 (Ref. 6). These requirements will ensure that sufficient space exists around ICS equipment to allow operators and other ARIES personnel to perform their duties.

6. MATERIAL INPUTS/OUTPUTS

Dismantlement of pits in the ARIES will require the use of various materials and will produce radioactive products and wastes. The amounts of these materials will depend on the number of pits introduced into the system. Currently, a minimum throughput rate is envisioned, representing various designs in the nuclear stockpile. The material inputs and outputs related to operation with these pits are described in Table 2, as an aid to future safety evaluations of the ARIES design.

Table 2. ARIES Chemical Inputs/Outputs				
System	Reagents	Waste		Products
		Primary	Secondary	
Receiving	None	None	Kimwipes®	Pits
Disassembly	None	Non-Pu metal	None	Pu hemishells
HYDOX	H ₂ gas O ₂ gas	Non-Pu metal H ₂ gas O ₂ gas	Fixtures, Furnace elements	PuO ₂ powder
Hydride /Dehydride	H ₂ gas from depleted U bed	Non-Pu metal	Depleted U powder Crucible Fixtures	Pu metal
Primary Canning	He gas Material cans	He gas	None	Canned Pu metal Canned PuO ₂ powder
Decontaminatio n and Secondary container	NaNO ₃ Electro- lyte Water Secondary cans	After the campaign Uncontaminated Electrolyte, Water, possibly filters	Kimwipes® Off-gas Fantastic™	Canned Pu metal Canned PuO ₂ powder Canned wastes
NDA	None	None	Kimwipes® Fantastic™	Canned Pu metal Canned PuO ₂ powder Canned wastes (Ready for storage)

7. INTERFACES

The ARIES, once installed, will interface with a number of existing systems and services at TA-55. These systems and services range from vital safety systems, such as fire alarm monitoring in the operations center, to supporting services, such as the chilled-water system. These systems can be viewed as primary interfaces, from which the ARIES receives an input, or as secondary interfaces, to which the ARIES produces an output. In Table 3, requirements for each type of interface are described for every process subsystem in the ARIES, except internal material flows and process control signals.

Table 3. Essential Interfaces		
Module	Primary Interfaces	Secondary Interfaces
Receiving	Zone 2 air to receiving hood Dry air to transfer air lock Light-duty electric power Selected pits for processing	Exhaust air to Zone 1
Disassembly	Dry argon recycle (dri-train) Electric power House vacuum	Exhaust argon to Zone 1 Non-Pu parts to trolley
HYDOX	Hydrogen gas Oxygen gas Dry argon gas Electric power Vacuum system	Exhaust argon to Zone 1 Furnace exhaust to dry vacuum system Non-Pu parts to trolley
Hydride/Dehydride	Hydrogen gas Dry argon gas Electric power Chilled water (CW) Vacuum system	Exhaust argon to Zone 1 Furnace exhaust to dry vacuum system Closed-loop limited volume Cooling water to CW system Non-Pu parts to trolley
Primary Canning	Dry argon gas He gas for canning operation Electric power Vacuum system	Exhaust argon and Helium to Zone 1
Decontamination	Zone 2 dry air Electric power Cleaning water He gas for canning operation Vacuum for leak-check operation	Exhaust air to Zone 1
NDA	Electrical power	Assayed Pu, U, wastes to storage
ICS	Status messages from NDA Electric power	Alarms and notifications to TA-55 facility control room

In addition to the interfaces described in Table 3, a number of other primary and secondary interfaces are required to support all subsystems. These interfaces are identified as follows:

- Primary Interfaces—nonglovebox electric power, Zone 2 air supply, MASS access, telephone, and intercom access.
- Secondary Interfaces—glovebox overpressure signals to local glovebox ventilation alarms, fire detector signals to operations center, air samples to monitors/alarms, low-level waste (LLW) handling.

Other generic support services, such as cleaning and maintenance, are not discussed due to their very general application to all systems in Building PF-4.

8. FOLLOW-ON DESIGN ACTIVITIES

In order to complete this ARIES design, many support activities leading to release of the definitive design packages are necessary. The key steps, after the completion of the preconceptual design described here, are refinement of designs through the conceptual design process. Then the definitive designs can be completed and procurement can be started. These and other activities, including the development studies supporting the ARIES design, are described in the ARIES Program Plan document (Ref. 1).

REFERENCES

1. "Advanced Recovery and Integrated Extraction System (ARIES) Program Plan," Revision 1, Los Alamos National Laboratory document LAUR-96-866 (February 2, 1996).
2. "Advanced Recovery and Integrated Extraction System (ARIES) Technical Task Plans/Statements of Work for FY96," Los Alamos National Laboratory document (February 1996).
3. "Procurement Specifications for Process Enclosures," Los Alamos National Laboratory document NMT-8-PS-11610-RO1 (December 20, 1991).
4. "NMT-6 Calibration Guide," Los Alamos National Laboratory document QAD-301-R01; Effective August 31, 1994; Expires August 31, 1997.
5. "Criteria for Safe Storage of Plutonium Metal and Oxides," Department of Energy document DOE-STD-3013-94 (1994).
6. "Human Factors Engineering Design Criteria: Volume 1, General Criteria," Department of Energy document DOE-STD-1062-94, (February, 1994).

APPENDIX

DOE Guidance Document for ARIES Demonstration Project



Department of Energy
Washington, DC 20585

February 14, 1996

Dr. James Toevs
Laboratory Manager
Los Alamos National Laboratory
P.O. Box 1663
Mail Stop: F628
Los Alamos, NM 87545-0656

Dear Dr. Toevs:

Attachment 1 details the actions and agreements of the February 6-7, 1996 ARIES meeting at LANL. Attachment 2 details the objectives of the ARIES prototype demonstration.

If you have any questions, please get back to me at (202) 586-7524.

Sincerely,

A handwritten signature in cursive script, appearing to read "Damian Peko".

Damian Peko
Engineer
Office of Fissile Materials
Disposition

Attachments

cc: G. Rudy, MD-1
H. Canter, MD-3
A. Cygelman, MD-3
T. Nelson, LANL
M. Bronson, LLNL
J. Buksa, LANL
R. Erickson, LANL
D. Dennison, LLNL
W. Brown, LANL
W. Brough, LLNL

**February 7, 1996 Fissile Materials Disposition Program
ARIES Meeting Actions & Agreements**

1. MD to set up meeting between MD, EM and LANL (Erickson) on two canning issues, the canning system and the can configuration.
2. LANL to consider, in advance of the above meeting, teaming with a commercial vendor or vendors to propose the LANL electrolytic decontamination & canning system for consideration by the DOE as their “standard can”.
3. Gallium may have to be removed.
4. LLNL and LANL will examine approaches for development of a backup method for gallium removal should pre-heating before sintering fail by March 8, 1996.
5. LLNL and LANL will develop test plan for a shakedown and a test run of the prototype and submit to DOE by 3/22/96. The test plan will detail and justify the pit sampling regime.
6. MD will finalize the goals and objectives whitepaper by February 9, 1996.
7. LANL and LLNL will develop a follow-on plan for follow-on ARIES activities.
8. LANL will provide a copy of the Rocky Flats Pit Design Book and a copy of Brown’s and Brough’s presentations to MD by February 16, 1996.
9. MD will provide guidance on the expected scope and direction of the OFMD’s Nuclear Fuels Technology efforts by March 8, 1996.
10. LLNL and LANL will provide MD copies of material provided to the DNFSB and report on these activities in the monthly reports.

Objectives of the ARIES Prototype Demonstration

One of the stated strategies in the Office of Fissile Materials Disposition (OFMD) Strategic Plan is in the context of the US plutonium stockpile, to “demonstrate the early feasibility of a process for the disassembly, extraction and conversion of plutonium from weapons components into forms suitable for feed for disposition and/or storage”. An additional stated strategy is to “Demonstrate the feasibility of a process that could be used by the US and Russia for the disassembly and verifiable extraction and conversion of plutonium from weapons components to forms suitable for disposition.” A further stated strategy is to “Demonstrate the technologies and systems that can be deployed to disposition the surplus weapons-usable plutonium so as to give the US the basis and flexibility to initiate verifiable disposition efforts either multilaterally or bilaterally, through negotiations”. The integrated test of ARIES is intended to support these strategies.

In keeping with the strategy of demonstration of the “early” feasibility of the process, the ARIES must be successfully demonstrated as a production-type process by the end of FY 1997.

In keeping with the strategy of demonstration of the “feasibility of a process” applicable to the US stockpile, the ARIES must demonstrate the functional configuration and operation of the production facility expected to be used for the disassembly and conversion of US weapons components. The reference ARIES for the OFMD program is a prototype system installed in a facility with external support systems. As such, the ARIES must demonstrate the functional design and operation of a building-based production facility. It also must be operated for sufficient duration to demonstrate throughput and reliability.

In keeping with the strategy of demonstrating a system that could be used by “both the US and Russia, for the verifiable extraction and conversion”, the ARIES prototype must demonstrate conversion of materials to a transparent form using processes that are acceptable to both the US and Russia. Transparency requires that the final form be able to be assayed and reveal no sensitive information. As such, the ARIES prototype must demonstrate packaging and assay technologies acceptable to both the ISS and Russia.

In keeping with the strategy of demonstrating technology and systems to give the US the basis and “flexibility to initiate verifiable bilateral or multilateral disposition efforts”, the ARIES needs to demonstrate the flexibility to readily adapt to different constraints and incorporate different processes that may be required for the disposition of foreign weapons components. As such, the ARIES prototype design must emphasize simplicity and modularity. A simple, modular system can be more rapidly installed in a reference design facility or more readily modified to conform to different disposition needs or installation in different facilities, as might be required in support of bilateral or multilateral disposition negotiations.

The actual demonstration equipment may have constraints imposed by the tight schedule, budget and emplacement in TA-55. Wherever possible, functional design and operational differences imposed by these constraints should be minimized. Where these constraints do result in differences between the ARIES prototype and the expected production facility, these differences, their justifications and their potential impacts should be documented and this documentation included as a deliverable for the ARIES prototype test program.

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