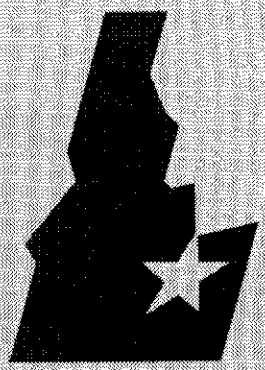

Idaho National Engineering Laboratory

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INFORMAL REPORT

FUNCTIONS AND DESIGN REQUIREMENTS FOR THE SEPARATION SYSTEM OF THE RETRIEVAL PROJECT OF THE BURIED WASTE PROGRAM

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EXECUTIVE SUMMARY

This document is the Functions and Design Requirements section of the System Design Description (SDD) for the Separation System of the Retrieval Demonstration Project (RDP) within the Buried Waste Program (BWP).

SUMMARY

The Separation System is in a contamination control cell, inside a building adjacent to Pit 9, which is located in the INEL-RWMC. The functional requirements for the Separation System are based upon the Workscope for the Retrieval Project of the Buried Waste Program, Informal Report EG&G-WM-8386.

The waste is received in batches of 1-3/8 yd^3, or smaller. To prevent the possibility of nuclear criticality, the batches will not be combined until after they have been monitored for fissile material. After monitoring, and as long as the total plutonium mass content of the pass-out container remains below the criticality operating limit, the waste can be added to fill the containers positioned at the box (and drum) pass-out ports.

The system separates the recovered waste into three sizes of material; 1) fines, 2) coarse, 3) intact drums. The volume of fines is estimated at 70 % of the total waste and dirt volume.

There are four pass-outs for remotely removing the waste from the cell; 1) fine mixed LLW, 2) fine mixed TRU, 3) coarse TRU mixed, 4) intact drums, and waste with high gamma and/or neutron readings.

The fines are surveyed by a gamma detector, fissile inventory monitor, and are weighed. These instruments transmit the data to a computer which classifies the waste as; mixed low level waste (LLW) or mixed transuranic waste (TRU). After being classified, the waste is conveyed to the proper pass-out port. Material with high gamma and/or neutron readings cannot be classified as contact handled and will be treated as "special case" waste.

Coarse waste is surveyed by a gamma detector and a fissile inventory monitor. These instruments are set to detect the "flag levels" of fissile material. After being surveyed, the waste is moved to a pass-out port.

The Intact drums are removed from the coarse size waste stream, removed from the cell through a special pass-out port and placed in a Drum Fissile Inventory Monitor (DFIM), which is located outside the cell. After characterizing, the drums are overpacked and inventoried.

Radiation monitors and alarms are located throughout the cell as required. Routine samples for contamination control are taken from the cell via pass-out ports by HP personnel.

All containers receiving the waste are labeled with a uniform bar code (UBC) to preserve identification.

ACRONYMS

AC	Alternating Current
ADM	Auxiliary Display Monitor
AISC	American Institute of Steel Construction
BWP	Buried Waste Program
CCTV	Closed Circuit Television
Ci	Curie
DAS	Data Acquisition System
DC	Direct Current
DOE	Department of Energy
DOP	Detailed Operating Procedure
EMI	Electromagnetic Interference
F&DR	Functional and Design Requirements
G or g	Gravitation force
HZ	Hertz
IEEE	Institute of Electrical&Electronic Engineers
LAN	Local area Network
LLW	Low Level Waste
mR	millirem
MTBF	Mean Time Between Failure
MTTR	Mean Time To Repair
NEC	National Electric Code
NFPA	National Fluid Power Association
OSHA	Occupational Health and Safety
PBC	Product Bar Code
PDM	Primary Display Monitor
PM	Preventative Maintenance
PRA	Probabilistic Risk Assessment
PTZ	Pan, tilt, zoom
QAP	Quality Action Plan
RFI	Radio Frequency Interference
RDP	Retrieval Demonstration Project
RWMC	Radioactive Waste Management Complex
SCIB	Separation Complex Inner Building
SDA	Subsurface Disposal Area
SDM	Secondary Display Monitor
SOP	Standard Operating Procedure
TBD	To be determined
TRU	Transuranic
UBC	Universal Building Code
V	Volt
WTS	Waste Transport System

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1.0 FUNCTION AND DESIGN REQUIREMENTS

The RDP Separation System shall receive the waste retrieved from the dig face in batches, monitor it for specific hazardous chemicals and radioactivity, and the presence of Transuranic isotopes. Based upon these analyses, it will segregate the waste into separate streams that will subsequently be passed out of the contaminated area into "drum-out"stations for packaging and preparation for storage.

1.1 FUNCTIONAL REQUIREMENTS

1.1.1 Must demonstrate the ability to retrieve 80 yds^3 per day (or be functionally scalable to this volume), and provide a technical base for establishing whether or not waste can be retrieved at this rate on a production basis. The demonstration will be limited to Pit 9 in the SDA at the RWMC.

1.1.2 Must separate the waste into three waste streams; 1) fines (less than 3-in), 2) coarse size (larger than 3-in) excluding special cases, 3) intact drums.

1.1.3 Must remotely place the characterized waste into containers via the four pass-out ports.

1.1.4 Must monitor the waste to determine if it is within the acceptable limits of radiation.

1.1.5 Must be able to maneuver the waste and perform radiation examinations to detect plutonium content. After detection, the waste may have to be separated to reduce the plutonium levels, to below the criticality operating limit.

1.1.6 The SCIB shall be designed to handle, or absorb the following classes of waste:

* TRU
* TRU-mixed
* LLW
* LLW-mixed
* hazardous
* clean soil
* liquids

1.1.7 Must not combine the individual batches until <u>after</u> monitoring for fissile material.

1.1.8 Minimize generation of additional waste (the components removed from the system during maintenance will be classified as waste).

1.2 DESIGN REQUIREMENTS

1.2.1 System Requirements

1.2.1.1 Mechanical equipment shall have a design life of 10,400 hrs (5 years). Components that cannot meet this minimum life should have remote replacement capability, where possible.

1.2.1.2 All equipment must be able to withstand decontamination spraying without suffering damage.

1.2.1.3 Structures shall be made of closed sections (i.e. tubing) instead of rolled sections, wherever possible, for ease of decontamination.

1.2.1.4 The SCIB shall be large enough to allow the separation equipment to be positioned in an efficient manner, plus allowing for future expansion.

1.2.1.5 All lifting devices (cranes, cables, hooks, etc.) will comply to the D. O. E. Hoisting and Rigging Manual.

1.2.1.6 Interlocks will be provided, wherever required, to prevent injury to personnel or damage to the equipment.

1.2.1.7 The inside of SCIB shall have a negative pressure relative to the surrounding room.

1.2.1.8 The Separation area must have a method of contamination control to minimize the spread of contamination and keep plutonium concentrations < 10^{-8} micro Ci/ml.

1.2.1.9 The Separation System shall have provisions to prevent the accumulation of contaminated material from the conveyors that move the fine and course waste through the monitors (i.e. remove contamination that might remain on the conveyor from a preceding segment of waste already monitored).

1.2.1.10 The Separation System will have a method of separating individual batches of fine and coarse waste to reduce the plutonium content to below the criticality limit per container.

1.2.1.11 Internal combustion engines will <u>not</u> be permitted.

1.2.1.12 Hydraulic components shall comply to NFPA standards when applicable. The components shall be compatible with INEL approved hydraulic fluids ("Quintilubric #822 or equal). A safety factor of 8 (minimum) shall be applied to all hoses burst pressure and tubing tensile strength. Under no circumstances shall the maximum working pressure be exceeded. Fittings, component ports, etc. shall be either flanged type or SAE O-ring style (no pipe threads allowed). Accumulators will be charged with nitrogen gas and have the means of automatically being unloaded at the end of every (non-continuing) shift. Tubing to fitting connections shall be 37^{o} flared with a backing sleeve (i.e. "Parker Triple Lok" or equal.

1.2.1.13 Pneumatic actuated equipment shall be limited to low force applications where there are no possibilities of binding or other restrictions that will build up "spring-rate" in the system.

1.2.1.14 System components shall be designed to handle single items weighing up to 1000-lbs, at all points of travel.

1.1.1.15 Must be able to deal with waste varying in size, from fine dirt (dust) to 24-in X 7-ft long structural beams and 55-gal drums.

1.2.1.16 A gloveport pass-out system shall be installed in the SCIB walls so contamination coupons can be passed in and out of the SCIB.

1.2.1.17 Manipulators will position the contamination coupons (placed in their handling tray) to locations in the SCIB as required by health physics personnel.

1.2.1.18 The Separation System shall be able to remove non-processable waste (for example, items that are too large, or too radioactive) from the waste stream, and remove them via the large item pass-out port.

1.2.1.19 The Separation System shall have a dust suppression system to keep the process area as dust-free as practicable.

1.2.1.20 The Separation System shall have a vacuum system for removing spills and general housekeeping.

1.2.1.21 The Separation System shall be closed where ever possible.

1.2.1.22 The Separation System will contain and collect liquids with the fine material where the liquids will be absorbed by the fine material.

1.2.2 Electrical Power Requirements

1.2.2.1 The frequency of the AC voltages required by the Separation system shall be 60 HZ. The voltage levels shall be 480 V(maximum), 3 phase, or 120 V(maximum), 1 phase.

1.2.2.2 The DC voltage levels shall be not greater than 125 V, nominal.

1.2.3 Control Requirements

The control of the Separation equipment shall be implemented through the use of redundant effectors (actuators, sensors, transmitters, etc.), in order to achieve maximum reliability and availability.

1.2.3.1 All Separation equipment will be controlled by a computer system called "Separation and Pass-Out Control System." The requirements for this control system will be defined during FY-90. The interface requirements between the Separation equipment and the Separation and Pass-Out Control System are covered in the Interface Section of this document.

The Separation manipulator will be controlled by a computer system called "Separation Manipulator Control System." This control system shall be purchased as part of the complete manipulator system and shall meet the requirements listed below. The interface requirements between the manipulator and the RDP Supervisory Control System are given in the interface section of this document.

1.2.3.2 The manipulator shall be capable of being controlled from a operator's station in a remote control room without direct visual contact of the equipment.

1.2.3.3 The control system shall communicate information to and receive information from the RDP Supervisory Control System as described in the interface section of this document.

1.2.3.4 The manipulator control system shall support permissive logic which implements a collision avoidance function, an emergency shutdown function, and a general purpose interlock function. The permissive logic shall be able to:

a) Inhibit the movement of any degree of freedom as a result of programmable internal logic calculations. These calculations may include variables obtained by reading external interlock conditions, such as limit switches, sensors, load cells, etc.

b) Inhibit the movement of any degree of freedom as a result of external inputs. These inputs include, but are not limited to, contact closures, voltage level logic inputs, logic inputs that are communicated over an RS 232, or similar communication link.

c) Recovery from inhibited movement described above (i.e., retain the capability to move in the opposite direction).

d) Support placing any one or all interlocks momentarily in manual override.

e) Indicate at the control station which interlocks are not satisfied.

f) Indicate at the control station which interlocks are in manual override.

g) Support remote (from the control station) user programming of the permissive logic.

h) Support down loading of user programmable control logic and operating parameters from the RDP Supervisory Control System.

1.2.3.5 An emergency shutdown function shall be provided as part of the manipulator control system. The Emergency Shutdown System shall perform the following functions:

a) Remove power from the manipulator primary motor (or hydraulic motor), and lock the manipulator in the current position. Power shall not be reinstated until the shutdown condition clears and the operator manually reestablishes power.

b) Activate the emergency shut down condition upon activation of the building fire system.

c) Activate an emergency shut down condition upon activation of an Emergency switch on the operator's console.

d) After an emergency shutdown the control system shall go to and remain in the Hot Standby Mode (Section 1.3.6.2).

1.2.3.6 In normal operation the manipulator control system shall not be functionally isolated from the RDP Supervisory Control System such that the manipulator can be operated without Supervisory Control. The Supervisory Control System must be supplied with interlock and alarm status by the Separation Control System. Key lock bypass of the Supervisory Control System with bypass status indication and alarm output shall be provided for abnormal operation and maintenance.

1.2.3.7 All manipulator degrees of freedom shall use variable speed proportional controls. All degrees of freedom shall be teleoperated from the operator control station and shall be able to be programmed for robotic operations.

1.2.3.8 Hydraulic driven manipulators shall have electric/hydraulic pilot control valves. Motion and speed will be controlled by proportional servo valves with adjustable limits on acceleration and force. Force feedback shall be applied to all motions.

1.2.3.9 The manipulator control system shall provide the RDP Supervisory Control System with real time position coordinates of the manipulator.

1.2.4 Instrumentation Requirements

1.2.4.1 Instrumentation wiring shall be shielded twisted pair wherever possible.

1.2.4.2 Instrumentation shall be resistant to RFI and EMI. No signals shall be compromised by operation of induction motors, solid-state controllers, or other sources of electrical or magnetic interference.

1.2.5 Monitoring Requirements

The Separation Monitoring System shall include: Closed Circuit Television (CCTV), Audio feedback, and Lighting control.

1.2.5.1 Closed Circuit Television (CCTV)

Specified cameras in the Separation area shall have pan, tilt, zoom, focus, and iris adjustment.

Each camera's mechanical controls (pan, tilt, zoom, focus, and iris) shall be remotely controlled from the operator's console. Auto focus and iris control may be provided in addition to manual controls.

Each camera shall be enclosed within a housing which shall meet the requirements for decontamination stated in Section 1.5.8. Provisions shall also be made to keep the viewing face of the housing clean while operating with an air blast or by other means.

Each camera shall be mounted such that vibration will not interfere with visual acuity or cause the camera to prematurely fail. The limit points for this specification shall be taken at the camera's maximum zoom power.

1.2.5.2 Audio

Audio feedback to the operator shall be provided by microphones strategically placed in the Separation area in order to inform the operator of normal operation of the equipment. Provisions shall be made to control the volume and mix the different audio signals at the operator's console. The audio signals shall be output to speakers and/or headphones at the operator's console.

1.2.5.3 Lighting

Lighting shall be provided for each video camera, shall be compatible with the camera video needs, and shall be controlled remotely at the Separation system operator's console.

1.3 OPERATIONAL REQUIREMENTS

1.3.1 The Manipulator shall be remotely operated by personnel located in an explosion proof Control Room overlooking the SCIB. Normal operations are viewed by television and tracked by instrumentation. The operator will be in direct visual contact of the SCIB when working the Manipulator.

1.3.2 The waste batches shall be tracked through the separation system by television and instrumentation (i.e. load cells).

1.3.3 Waste batches having gamma/beta radiation readings at the dig face greater than established personnel exposure levels will be handled using special procedures.

1.3.4 The turnaround time to move a full waste transport dumpster from the separation systems receiving area, deposit the waste into the separation system, process and return the transport dumpsters to the receiving area, is 6-minutes, maximum.

1.3.5 The Separation equipment will have the following operator control stations, in a fixed location in the RDP control room and will be compatible with other RDP control stations.

1.3.5.1 One control station to operate all Separation equipment <u>except</u> the manipulators, which will have an independent control station.

1.3.5.2 A control station will be required to operate either manipulator. This control station will be located by an observation window overlooking the SCIB. The window will have full view of both manipulators and their full range of movement. (Note: if a probability risk assessment confirms that personnel cannot be safely located adjacent to the Separation SCIB, the control station will be situated in the RDP control room, which may be located up to 500-yds away. The operator will be seated at a manipulator control station and will view the manipulator through CCTV monitors. The CCTV monitors must give full view of the manipulator and all areas within its range of motion).

1.3.5.3 The manipulator control station shall be designed using the human engineering requirements specified in MIL-H-46855B and MIL-STD-1472C as a guide.

1.3.5.4 Any annunciated emergency, warning, or error condition shall be accompanied with an audible alarm which must be acknowledged by the operator.

1.3.5.5 Manipulator controls located at the operator station will include, but will not be limited to, the following functions:

* Emergency Shutdown Main Switch
* Manipulator arm and end effector motion controls
* Manipulator power controls
* Audio system & headset controls for volume, mixing on/off, microphone selection, and communication with other operators.
* Annunciator audible alarm
* Annunciator acknowledge
* Control for recording current end effector position

The above operator controls shall consist of appropriate push buttons, rotary switches, joysticks, master/slave teleoperation controls (geometrically similar or non-geometrically similar), etc.

1.3.5.6 The control panel area will require active indication for all control functions. The absolute position of the manipulator end effector must be displayed in a prominent place on the control station.

1.3.5.7 Status indicators, such as interlock conditions, system status, and operation mode shall be indicated on the control station.

1.3.5.8 The operator will move the manipulator to the stowed position by means of a "return to stow" position switch prior to manipulator shutdown.

1.3.6 Modes of operation

The following modes of operation of the Separation equipment control system, are described in the following sections:

Each mode of operation is controlled by a selector switch that restricts the operations to the selected mode.

1.3.6.1 Start-up mode:

The start-up mode is required to progress from the shutdown mode to the hot standby mode. This mode is to check out all instrumentation and electronic support equipment. There will be no movement of the separator equipment during the start-up mode, nor will the hydraulic system be operated.

System start-up will conform to the following procedures:

* Turn the System Mode selector switch to "Start Up Mode" position.
* Apply power to the separator control station (<u>not</u> to the Separation equipment).
* Establish control station display indications.
* Establish video display on the video monitors.
* Establish contact with RDP DAS system and other interface systems.
* Select desired video scenes on the operator station.
* Select audio system channels, volume, and mixing for monitoring the system.
* Establish current status and position of the Separation equipment.
* Verify all station controls are in the proper start-up position.
* Adjust video lighting controls and operator seat position.
* Verify all system interlock conditions.

1.3.6.2 Hot Standby Mode

The hot standby mode brings the system to a standby condition, where all the separator monitoring systems, displays, controls, and interlocks and hydraulic system are in a state of operational readiness. No movement of the operation equipment or manipulators shall be allowed in the Hot Standby Mode. The Hot Standby Mode shall also be entered after an emergency shutdown (see section 1.2.3.5)

The following functions will be performed to bring the system to the Hot Standby condition:

* Turn the System Mode selector switch to "Hot Standby Mode" position.
* Electrical power shall be applied to the motor(s) driving the hydraulic system, the presence of maximum hydraulic pressure shall be confirmed.

1.3.6.3 Operation Mode

The Operation Mode system checkout should be carried out in the following order:

* Turn the System Mode selector switch to "Operational Mode" position.

* Move the Primary Manipulator through all it's motions, after successful checkout, turn the manipulator selector switch to Secondary Manipulator.

* Move the Secondary Manipulator through all it's motions, after successful checkout, return the manipulator selector switch to Primary Manipulator.

* Cycle the Dumpster Lift through the entire sequence.

* Cycle the Dumpster Rotator through the entire sequence.

* Cycle the Receiving Hopper Gate Valve open and closed.

* Run the Vibrating Screen.

* Cycle the Fine Material Bin Gate Valve open and closed.

* Run the Fissile Inventory Conveyor.

* Run the TRU/LLW Conveyor.

* Run the Coarse Waste Conveyor.

* Normal mode operation shall be as detached in the SOP to be analyzed at a later date.

1.3.6.4 Shut Down Mode

The shut down mode operations are performed prior to shutting down the separator system. The following actions will be carried out during this mode:

* Send permanent shutdown information to the DAS.

* Inform RDP DAS system of cold shut down status (i. e. log off or meet cold shut down requirements according to RDP DAS requirements.

* Verify all station controls are in the proper shut down position.

* Shut off video lighting associated with separator.

* Satisfy all interlock conditions for entering cold shut down condition.

* Shut off all electrical power to the separator control station.

1.3.7 Local Operation

Local (hands on) operation of the individual separator systems must be provided for each unit. No status indication, interlock indications, or position displays are required for local operation. Local operation is required for initially positioning the equipment and for maintenance operations only, and will not be used for separation operations.

1.3.8 Operator Training

Training is required for operating the Separation Systems. A minimum of four trained operators are required. Preliminary SOP and DOP shall be provided at the time of training. A simulator may be used in place of actual equipment as approved by the RDP.

1.4 Interface Requirements

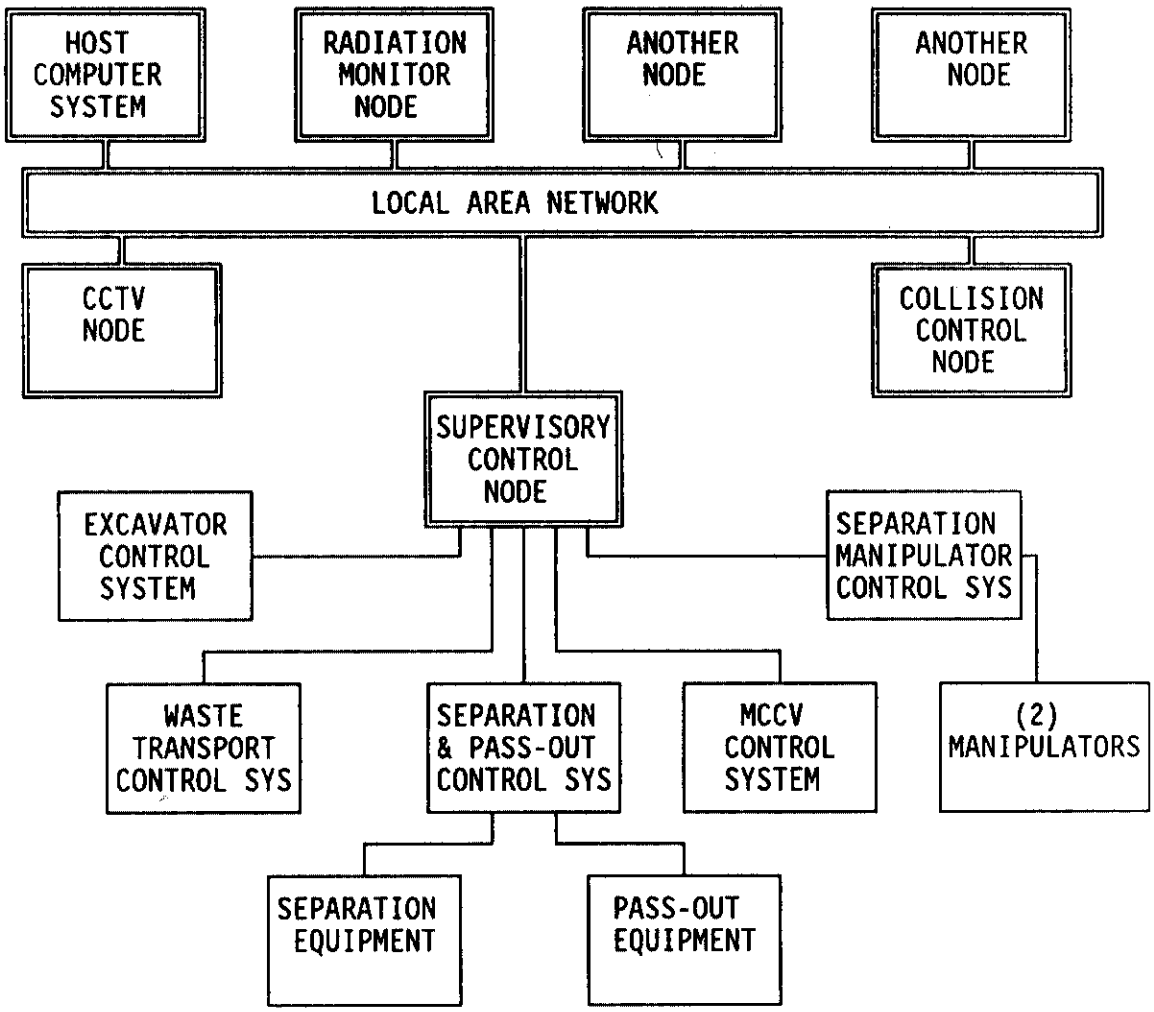
At the input end, the separator system interfaces with the transport system, bringing waste into the process from the dig face sufficient to support the system process capacity of 80 yds/day. The separation system shall be able to receive the waste container and relay the container identification to the RDP DAS. The waste container shall be received reliably, emptied and returned to the WTS, with as little contamination spread as is practical. At the output end, the interface is with the pass-out system, which will convey the separated waste into drum or box storage for further handling. The separation system shall deliver the separated waste into double-lid pass-out drums, boxes or into other transportation and storage containers. All pass-out operations shall be performed at a rate sufficient to support the 80 yd^3/day system process rate guideline. All pass-out operations shall ensure that no (or minimal) contaminated spillage occurs. The waste information received for each waste container received from the WTS shall be reliably passed on to the RDP DAS.

1.4.1 Specific Equipment Interfaces

* vehicles moving the dumpsters to and from this system.
* waste containers.
* pass-out ports.
* vehicles removing the containers from the pass-out ports.
* tunnel connecting the separation SCIB to the dig-face.
* Retrieval control room.
* Separation system containment structure.
* Dumpster coupon transfer tray
* Internal interfaces between each module.

1.4.2 Separation & Pass-Out Control System Interface.

A conceptual diagram showing the relationship of the Separation equipment and the Separation/pass-out control system to other components of the RDP retrieval project is given below:



The scope of this document is confined to the design and interface requirements of the Separation equipment. The direct interface to the Separation equipment is with the Separation & Pass-out Control System as shown. The control system includes one or more operator control stations.

1.4.3 Separation and Pass-out Control System.

The Separation and Pass-out control system will provide the computational power and appropriate Input/Output (I/O) functions to completely control each piece of Separation and pass-out equipment. The Separation and pass-out control system includes at least one operator control station for the Separation equipment and one operator control station for the pass-out equipment (the manipulator will use a separate, vendor supplied, control system and operator station). The control system will be required to interface with limit switches, interlock sensors and switches, motor controls, etc., located on or near the Separation equipment. Since the control system may be physically separated from the Separation equipment by up to 500 yards, the control system will require a buffered data transmission link to the Separation area. This link is included as part of the control system. The control voltages at the output of the control system will be limited to 5 VDC to 48 VDC, and 120 VAC Any other voltage levels required to be switched by the control system must be approved by BWP electrical engineering. Motors and other systems which require operating voltages greater than those listed above shall utilize switch gear which can be controlled with the listed voltage levels.

1.4.4 Supervisory Control Node

The supervisory control node manages the individual control systems of the waste handling equipment, from dig face excavation to final waste container pass-out. These control systems are shown in the above diagram connected to the supervisory control node by a single line. The supervisory node will calculate system level interlocks which will be used to prevent retrieval operations which are out of sequence or which must wait for other waste processes to be completed. The supervisory control node will be capable of disabling any motion or degree of freedom controlled by the Separation and pass-out control system.

1.4.5 The Local Area Network (LAN).

The local area network provides the communication protocol for all nodes connected to the network. Each node on the network provides a computer control or data acquisition function dedicated to a specific process. The diagram does not attempt to define all nodes on the network, only those which interface with the Separation system. The double lined blocks shown in the diagram are connected to the Local Area Network, the single lined blocks are control systems which interface with the supervisory control node. The LAN is defined as an IEEE 802.3/Ethernet system using communication software conforming to Open System Interconnection (OSI) or more specifically, Government Open System Interconnection Profile (GOSIP) standard (FIP's pub. # 146)

1.4.6 Host Computer

The host computer system provides the base computing resources for the network system, such as system management software, large RDP database, large data storage area, etc. All alarms shall be logged by the host computer in long term data storage; all alarms shall be output on an alarm printer in the control room.

1.4.7 Collision Control Node

The collision control node will receive the position information of all movable equipment in the excavation and Separation area. This data will be provided over the network by the supervisory control node, which receives the data from the various equipment control systems. The collision control node will determine when collisions are imminent and will provide lockout data to the supervisory control station. The supervisory station will then lockout the appropriate motion or operator commands to prevent a collision.

1.4.8 Manipulators System Interface.

Both manipulators shall be operated from the Manipulator Control System shown in the above diagram and will be purchased together as a complete package. The manipulator control system must interface to the supervisory control node as defined by the following requirements. Switching shall be provided to operate either manipulator from the single control station.

a) The manipulator control system shall receive absolute position information from both of the manipulators. The manipulator control system shall use the position information to maintain closed loop control and to prevent manipulator collisions with fixed equipment in the Separation area. The manipulator control system shall send the position information to the supervisory control node at a minimum update rate of once per second. The transmitted position data may be raw unconfirmed data or it may be converted to engineering units. The Supervisory Control Node shall be required to handle converted data and convert raw data to engineering units.

b) The manipulator control system must be designed to allow the supervisory control node to individually disable any degree of freedom on both manipulator arms and end effectors for collision avoidance.

c) The physical communication media and protocol between the supervisory control node and the separator control system can be any of the following:

1. RS232
2. RS422
3. Local Area Network
4. Data highway

Any other communication media and protocol must be approved by RDP Electrical Engineering.

1.4.9 RDP Control Room Interface.

The Separation system interface requirements with the RDP control room are listed below:

* The control room could be located up to 500 yards from the excavation area.

* There will be no direct visual contact between the control room and the excavation area. There may be direct visual contact with the manipulator.

* The Separation system control station will be permanently mounted in the control room, requiring remote operation of all operator controls over the Separation distance. If the manipulator control station is not allowed in an observation gallery, it will also be placed in the control room.

* The Separation system control station will be fabricated as part of a multistation control station which includes the control stations listed below. Each station will be similar in design.

1. The supervisory control station.
2. Excavator control station.
3. Multifunction contamination control vehicle control station.
4. Waste transport system control station.
5. Separation manipulator control station.
6. Separation process control station.
7. Pass-out process control station.

Fabrication of the manipulator control station shall be a combined effort between the control system vendor and RDP Engineering. All vendor supplied control systems and operator controls must be fabricated to support the RDP multistation control station design.

1.4.10 Instrumentation and Control Interface

The separator system shall Include control of the CCTV system PTZ and focus, camera selection, and audio control.

The interface shall allow complete operation of the Separation system from the remote control room.

1.5 Maintenance Requirements

1.5.1 Preventive Maintenance

Equipment requiring preventive maintenance (PM) shall be located outside the separation SCIB, if possible. Equipment that cannot be removed from the SCIB, shall be equipped with automatic (remote) lubrication systems. Self lubricating or sealed ball bearings shall be incorporated wherever possible.

1.5.2 SCIB Entry

Personnel entry into the SCIB will require direction from Health Physics.

1.5.3 Painting Requirements

All carbon steel components shall be painted with Du Pont 62ZF urathane primer (5 mils thick), Corlar 82 HB High Build Epoxy Enamel (5 mils thick) and Corlar 823 Epoxy Enamel (2 mils thick). Color to be determined.

1.5.4 Pass-out Port Requirements

An equipment pass-out port must be provided in the SCIB wall to permit the largest single piece of equipment to be bagged-out and replaced.

1.5.5 Human Engineering

The Separation system shall be designed to enhance the maintenance, servicing and the decontamination of the equipment by utilizing maximum accessibility, modularization, quick disconnects, and decontaminable surface finishes.

1.5.6 Operational Life

All components shall be designed for a minimum life of 20,000 hours. Components expecting replacement prior to this time must be able to be remotely replaced by the manipulator(s), or by personnel working through gloveports.

1.5.7 Decontamination

The separator subsystems shall be designed utilizing the modularity concept where feasible, to aid in disassembly and reassembly of the equipment when decontamination is required. Surface finished that can be scrubbed with impunity shall be utilized.

1.5.8 Spray Compatibility

All equipment located in the contaminated areas of the Separation SCIB shall be designed to be decontaminated with a high pressure spray system delivering a mild soap and water solution without damage to the equipment.

1.5.9 Equipment Access

All equipment located in the contaminated areas of the separation SCIB shall be designed to be maintained by personnel working in Zone III anti-contamination equipment.

1.5.10 Calibration

Components installed to sense the separator parameters or actuate control points shall be designed to be either:

replaced with a pre-calibrated replacement;
remotely calibrated;
calibrated in place or, removed, decontaminated, and calibrated in a lab.

1.5.11 Documentation

Drawings, schematics, operation manuals, calibration procedures, and maintenance instructions shall be provided for use in identification and repair of any equipment, components, or modules in the system, as applicable. Manuals prepared using a supplier's format shall be generally considered as acceptable for procured off-the-shelf equipment.

1.5.12 Planned Maintenance

A planned maintenance program for this system shall be developed and documented in accordance with RDP requirement. Items to undergo PM shall be identified, and a recommended interval shall be provided.

1.5.13 Spare Parts

The initial compliment of recommended spare parts is to be included with the procurement of the separator subsystems.

1.6 Environmental Requirements

This section describes the operational and storage environmental requirements for the Separation system.

1.6.1 Environmental Regulations

The system shall comply to all environmental regulations applicable.

1.6.2 Operation Temperature Range

Temperature range, 40^{0} to 90^{0} F

1.6.3 Operating Elevation

System shall operate at 4800-ft above sea level.

1.6.4 Separator Operating Environment

The separator subsystems shall operate reliably and safely in the following environmental restraints:

1.6.4.1 Humidity

The operating environmental humidity is: 10% to 90% relative humidity, non-condensing.

1.6.4.2 Radiation Level

The maximum equipment radiation exposure shall be equivalent to 200 RAD for a one year operating period.

1.6.4.3 Shock and vibration

Normal system induced shock and vibration shall not reduce mean time between failure of the Separation Control System.

1.6.4.4 Operating Atmosphere

The equipment shall be capable of operating in an environment which contains organic vapors, such as:

Carbon tetrachloride
trichloroethane

1.6.4.5 Dust Levels

Dust Levels, i.e., particle size, distribution and total quantity suspended in air.

1.6.4.6 Seismic Requirements

System and equipment support structures shall comply to BUCK, seismic zone 3.

1.6.5 Control Room Operating Environment

Temperature: +60 to +90 F.

Humidity: 30% to 70% relative humidity, non-condensing.

Seismic: The operator's console is not required to operate during seismic event but shall be able to meet the requirements of the Uniform Building Code. Separator and Control Room Storage Environment

1.6.6 Storage Life

The separator subsystems shall function normally after being stored for periods up to one year in the following environment:

Temperature: -40 F to +130 F.

Humidity: 5% to 100% relative humidity, condensing.

Altitude: ~5000 feet.

Protection during storage shall be provided by the user.

1.6.7 Safety

The Separation System shall be designed, manufactured, installed, and tested in accordance with the applicable sections of IEEE, SAE, and ID Appendix 0550.

System safety program requirements shall be in accordance with the following sections of MIL-STD-882A: Section 4, Task 100, Task 202, Task 204 as a minimum.

The system shall be capable of meeting the applicable "operating requirements" of the EG&G Radiological Controls, and Safety manuals

1.7 Fabrication, Shipping, and Installation Requirements

1.7.1 Fabrication Requirements

The separator subsystems shall be fabricated using materials consistent with the environmental and operating requirements specified herein. Workmanship shall be of the quality prevailing among manufacturers producing equipment of the type specified herein. Defective components, parts and assemblies which have been repaired to overcome deficiencies shall not be furnished. Welded, bolted and riveted construction shall be in accordance with the highest standards of industry.

The Separation system shall be delivered in a clean operating state after installation and checkout. All loose wire clippings, hardware, lubricants and fluids shall be removed.

1.7.2 Installation Requirements

Installation of the separator subsystems shall be performed in accordance with installation manuals provided by the supplier. The supplier shall checkout the equipment after installation to ensure proper operation.

1.7.3 Identification Requirements

The Separation system shall have identification marking in the form of a securely attached corrosion resistant metal nameplate permanently and legibly marked with the following information for each major component and the control console:

Nomenclature.
- Manufacturer's model no.
- Manufacturers's serial no.
- Special characteristics (HP, voltage, etc.).
- Manufacturer's name.
- Contract no.
- Date of manufacture.
- Weight.

1.7.4 Lubrication Requirements

The major separator components requiring lubrication shall have a securely attached lubrication plate showing the following information :

Type and grade of hydraulic oil
Type and grade of lubricants.
Filter types and part numbers.

1.7.5 Packaging

The separator system components shall be inspected for preservation, packaging, packing and marking for shipment and storage to verify conformance with the terms of the contract. Accelerometers shall be attached to packaged electronic equipment and shall exhibit no greater that 10 g's acceleration.

1.7.6 Installation

The separator subsystems shall be installed in accordance with supplier installation manuals and shall meet all INEL and national code requirements.

1.7.7 Vendor Checkout

The separator subsystems shall be checked out by the supplier and all operating deficiencies and anomalies corrected prior to customer buyoff of the subsystem.

1.8 Quality Assurance Requirements

Quality assurance during system design, procurement, documentation, installation, and testing shall be in accordance with QPP-149, "BWP Quality Program Plan". All data gathered and used for making BWP programmatic decisions shall be in accordance with EG&G-WM-820, "BWP Data Collection QAP".

1.8.1 Quality Level

Quality level for the system and system components is level B with Quality involvement as required. Quality will constantly monitor the installation of all hydraulic hoses and tubing to ensure the proper assembly of fittings to the tubing and that internal cleanliness is maintained per ANC-STD-7022, Level A.

1.8.2 Inspection

The vendor's inspection/verification of hardware conformance shall be performed in accordance with specification MIL-I-45208A and/or ANSI/ASME NQA-1.

Received items shall be inspected to ensure compliance with ordering documentation. Installation shall be inspected to EG&G Idaho workmanship standards and applicable engineering drawings or wiring schedules.

1.8.3 Acceptance Testing

Acceptance criteria shall be identified and incorporated into acceptance test procedures that are to be successfully performed at the vendor's facility prior to shipment authorization.

1.8.4 System Operational (SO) Test criteria shall be identified and incorporated into SO test procedures. These procedures are to be successfully performed by RDP operations at INEL prior to separation system acceptance by BWP operations.

1.9 Codes, Standards and References

The following documents of the issue shown shall form a part of this requirements section to the extent specified herein. When an exact issue is not specified, the applicable issue shall be the current issue in force at the date of this document. Additional specific codes and standards may be chosen that apply to the design, construction and installation of components at the discretion of the system designer, subject to the limitation that management-approved standards shall be used for all components for which applicable standards are available.

QPP-149	BWP Quality Program Plan
EG&G-WM-820	BWP Data Collection QAP
EG&G Safety Manual	
EG&G Radiological Controls Manual	
DOE-ID Architectural Standards	
MIL-I-45208A	
ANC-STD-7022	
ID Appendix 0550	
MIL-STD-882A	

1.10 Documentation and Reports

The following documents shall be provided as part of the Separation system:

Acceptance test for each modular component;

System Operational test for each modular component;

operator's manuals;

maintenance manuals;

spare parts lists;

vendor procurement progress reports;

engineering design file;

preliminary design review;

procurement specification;

final design review;

design review minutes;

design review letter dispositioning the actions;

a completed SDD.

The supplier shall provide to the customer for approval:

Copies of Quality Assurance Program Plan and Inspection procedures.

Status reports as directed by the contract, test procedures, test reports, installation, operation, maintenance and service manuals and packing and shipping procedures.

A complete set of drawings, including mechanical, structural, electrical, hydraulic system and electronic control system schematics, logic and block diagrams.