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Performance Specification

OU 7-10 Glovebox Excavator Fissile Material Monitor

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DOCUMENT MANAGEMENT CONTROL SYSTEM (DMCS)
DOCUMENT APPROVAL SHEET

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Author: Dale Cresap — Phone: 6-8968

Document Owner: Steven A. Davies — Phone:

REVIEW CONCURRENCE AND APPROVAL SIGNATURES
Denote R for review concurrence, A for approval, as appropriate.

Type or printed name	R/A	Date	Organization Discipline	
Signature				
Dale Cresap	A	3-14-2	Engineering	Performer
Dawn May	A	3-15-2	Physics	Checker
W. Rick Horne	R	3/15-02	Rad Engineering	
Steve J. Moody	R	3/15/02	Mechanical Engineering	
Paul Sentieri	R	3-15-2	Criticality Safety	
Leo R. Herbert	R	3-15-2	Quality Engineering	
Kelly A. Wooley	R	3-15-2	Industrial Safety	
Mark W. Borland	R	3/14/02	Process Engineering	
James W. Barker	R	3-14-02	Operations	

Tom Hipp T. M. Hipp	A	3/15/02	Engineering	
Steve Davies Steven A Davies	Ac	3/15/02	Project Engineer	

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USE TYPE 3

1. SCOPE

1.1 General

This specification is for a fissile material monitor (FMM) for the OU 7-10 (pit 9) excavation. The purpose of the system is to ensure that the drums are not overloaded with fissile material. The fissile material administrative operating limit is 200 grams per drum. Fissile material monitoring will be performed by passive gamma ray spectroscopy with germanium detectors in each of the three gloveboxes. It is not intended to count all material going into the drums. Some types of material are not expected to have excessive fissile content. Material identified for assay, such as intact HEPA filters, filter media and unidentified combustible material, (this material is defined as combustible (fibrous) material that cannot be readily identified as something other than filter media, such as clothing, rags, etc.) will be counted and the resulting measurement of fissile material will be tracked as a running inventory for each drum. Specific operating parameters are subject to change due to revisions in projections of OU 7-10 fissile material loadings. The FMM will be developed by BBWI R&D personnel.

1.2 Work Included

The primary deliverable will be a functioning fissile material monitoring system. Achieving this goal will require intermediate milestones and products, including drawings, procurement, assembly, installation, testing, and written manuals. Training, maintenance, and the provision of calibration standards will also be included.

1.3 Work Not Included

The FMM will consist primarily of commercially available components. No effort will be made to design and build custom components. The specimen counting area will be designed by the OU 7-10 glovebox design team.

Acronyms

FMM	Fissile Material Monitor System
HMI	Human Machine Interface
IRC	Idaho Research Center

MTTR	Mean time to repair
OU	Operable Unit
R&D	Research and Development
TRA	Test Reactor Area
V&V	Verification and Validation

2. QUALIFICATIONS

This work will be performed by BBWI R&D personnel with expertise and past experience in detecting radioisotopes by their unique gamma spectrum peaks, and in building systems to perform such analysis.

3. APPLICABLE CODES, PROCEDURES AND REFERENCES

- The FMM will conform to BBWI standard engineering practices and procedures, such as MCP-2374, *ANALYSIS AND CALCULATIONS*
- DOE-ID Architectural Engineering Standards
- National Electrical Code (applicable sections), NFPA 70
- OU 7-10 Glovebox Excavator Method System Design Criteria
- Software written to perform the executive functions of this system shall comply with MCP-550, *SOFTWARE MANAGEMENT,* with regard to implementation of IEEE-1012 for verification and validation. Routines supplied by vendors to perform system support functions will be accepted as validated software
- MCP-3630, *COMPUTER SYSTEM CHANGE CONTROL.*

4. SUBMITTALS

4.1 System Calculations

System calculations describing system components, operating parameters, and expected accuracy shall be documented in EDF per project requirements.

4.2 Peer Review of Calculations

A peer of the designer shall provide an independent check of the design to ensure it is valid and provide documentation of this effort.

4.3 Vendor Data

Catalog and data sheets shall be supplied for off-the-shelf system components, and a copy of all documentation provided for all custom built components. Electronic format is preferred for vendor data.

4.4 Spare Parts

A spare detector shall be provided and any other components whose failure would cause the loss of the FMM for more than 48 hours.

4.5 Test Plan

R&D shall provide a written test plan addressing the items in Section 7.1 for project management approval.

4.6 Test Report

R&D shall provide a written report of the test results from Section 4.5.

4.7 Operating and Maintenance Manuals

R&D will provide manuals that give clear instructions for process operators to calibrate and operate the system. Manuals shall support routine maintenance and operation. R&D shall support the FMM for non-routine operations and maintenance.

4.8 Drawings

R&D will provide drawings for assemblies, and for key commercial components where available, and for the system function and configuration as a whole. R&D shall provide all drawings necessary for installation and operation of the FMM. Drawing shall document as-built condition including modifications to commercial components. R&D shall use the dedicated I&C principal drafter.

4.9 Software

Software shall include documentation of Verification and Validation (V&V), software and system operating manuals, and code documentation.

5. SYSTEM REQUIREMENTS

5.1 General

A block diagram of the system, showing components and their connections, is attached.

5.1.1 The fissile material monitoring system shall include detectors, coolers, HMIs, and computers to form a complete operating system.

5.1.2 The FMM system shall perform according to the logic flow diagram included in this document.

5.1.3 The detector shall be sized to read a cylindrical volume 12 in. in diameter and 14 in. high.

5.1.4 The specimen shall be separated from the detector by a window in the wall of the glovebox.

5.1.5 The system shall include electronic scales that provide a specimen weight directly to the computer operating the system. Electrical connections for equipment in glovebox shall include sealed bulkhead connector for penetrating the glovebox confinement.

5.1.6 The system shall be designed to compensate for the effects of background radiation in order to permit reliable fissile material monitoring.

5.1.7 The system shall be calibrated to accommodate the range of specimen densities expected from OU 7-10 material.

5.1.8 The system shall incorporate self-contained, electrically operated coolers for the detectors.

5.1.9 A computer shall be provided at each glovebox station to perform the scan initiated by the operator on the touch screen, and all the spectral analysis and subsequent calculations necessary and provide the specimen fissile content to the operator in grams. This computer will maintain a

running total of the scanned fissile material added to a drum currently being filled and provide the operator with an alarm indication if the current specimen would exceed a pre-set limit.

5.1.10 A central computer shall be provided to archive the data from all three glove box FMM stations.

5.1.11 The detectors shall have mounts that provide electrical and vibration isolation. (The detector shall not be grounded to the glove box.)

5.1.12 The FMM must fit within the space envelope provided by the OU 7-10 glovebox design team.

5.2 Performance Requirements

5.2.1 A touch screen operator interface shall be provided at each of the three glove boxes. This touch screen shall provide for an operator to initiate a specimen count, and shall display the specimen fissile content in grams, and the cumulative drum total, and any appropriate system alarms. The system shall prompt the operator for a visual estimate of the volume of specimen material.

5.2.2 Detection Limits

The system shall be sensitive enough to detect as little as 1 gram of fissile material +/- 0.5 grams.

5.2.3 Isotopes to Detect

The system must detect either directly or by inference, and be calibrated for Pu 238, 239, 240, 241, and Am 241.

5.3 Software

5.3.1 Existing validated software shall be used to the extent possible for performing task subfunctions. New software written for this task shall perform high-level executive functions according to the included flow chart. Particular values and precise definitions of terms are still to be determined.

5.3.2 The system as a whole shall be tested and validated.

5.4 Professional Engineer Certification

Professional engineer certification is not required for the staff designing and building this system, as it is more a matter of scientific development than engineering. They shall be qualified for the work according to Section 2 of this document.

5.5 Human Factors

5.5.1 Touch screens shall be located for operator convenience and shall accommodate users wearing gloves.

5.5.2 The system shall conform to simplicity of operation principles referred to elsewhere in this document.

5.6 Reliability and Maintainability

5.6.1 The system shall be reliable enough to suffer no more than one failure during the processing campaign (approximately 100 days).

5.6.2 Spares of critical or long lead items shall be provided so that the mean time to repair (MTTR) is not more than 48 hours.

5.7 Environmental and Site Operating Requirements

5.7.1 Excessive radiation energy due to other isotopes in the specimen shall be dealt with by dividing the specimen into smaller sections as described in the logic flow sheet.

5.7.2 The system shall be designed to operate at ambient temperatures between '50 and 100°F and for 15 to 85% humidity conditions.

5.8 Natural Phenomena or Abnormal Conditions

5.8.1 The system shall monitor the radiation level provided by background and other isotopes in the specimen. An alarm shall be provided if this level is too high to permit an accurate fissile material reading.

5.8.2 In the event of a power failure the FMM shall retain the valid running total for the drum currently being filled, and records for previous drums, on the restoration of power.

5.8.3 The FMM shall maintain structural integrity in accordance with PC-1 classification.

6. FABRICATION

Fabrication of the FMM shall be performed by the qualified people referred to in Section 2.

7. QUALITY ASSURANCE

The FMM procurement shall be for consumer grade items.

7.1 Operational Testing

7.1.1 Bench testing will be performed at the IRC.

7.1.2 System functional testing and actual source calibration will be performed at TRA using actual fissile material with operations personnel.

7.1.3 A final system functional test will be performed after the equipment is installed at the OU 7-10 site.

8. EXECUTION

8.1 Installation

System installation will be a joint effort between R&D and BBWI technicians.

8.2 Startup and Calibration

Supplier shall calibrate the system in the final installed configuration.

8.3 Training

Supplier shall provide software and system operation manuals. Supplier shall provide equipment operations training.

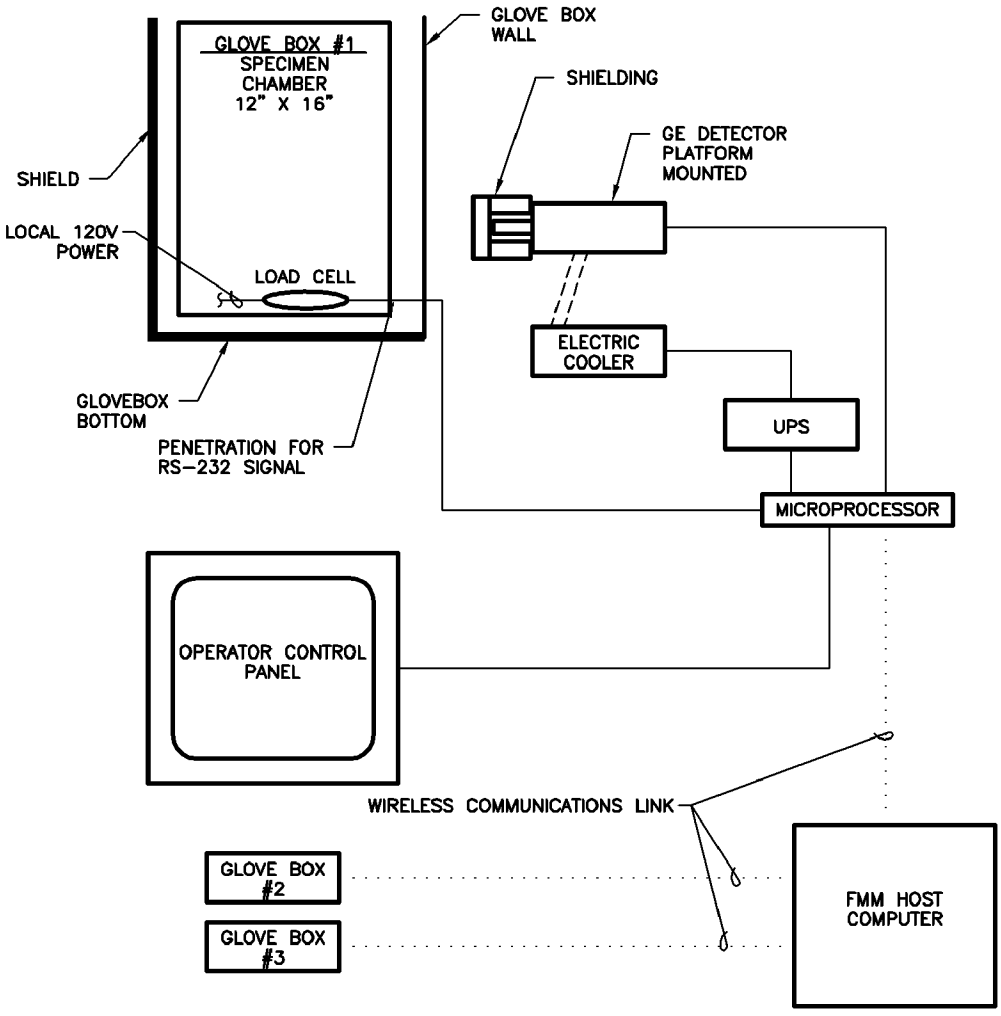
8.4 Maintenance

R&D shall provide on call support for system maintenance as needed to support the operating schedule during the operating campaign.

9. PACKAGING AND SHIPPING

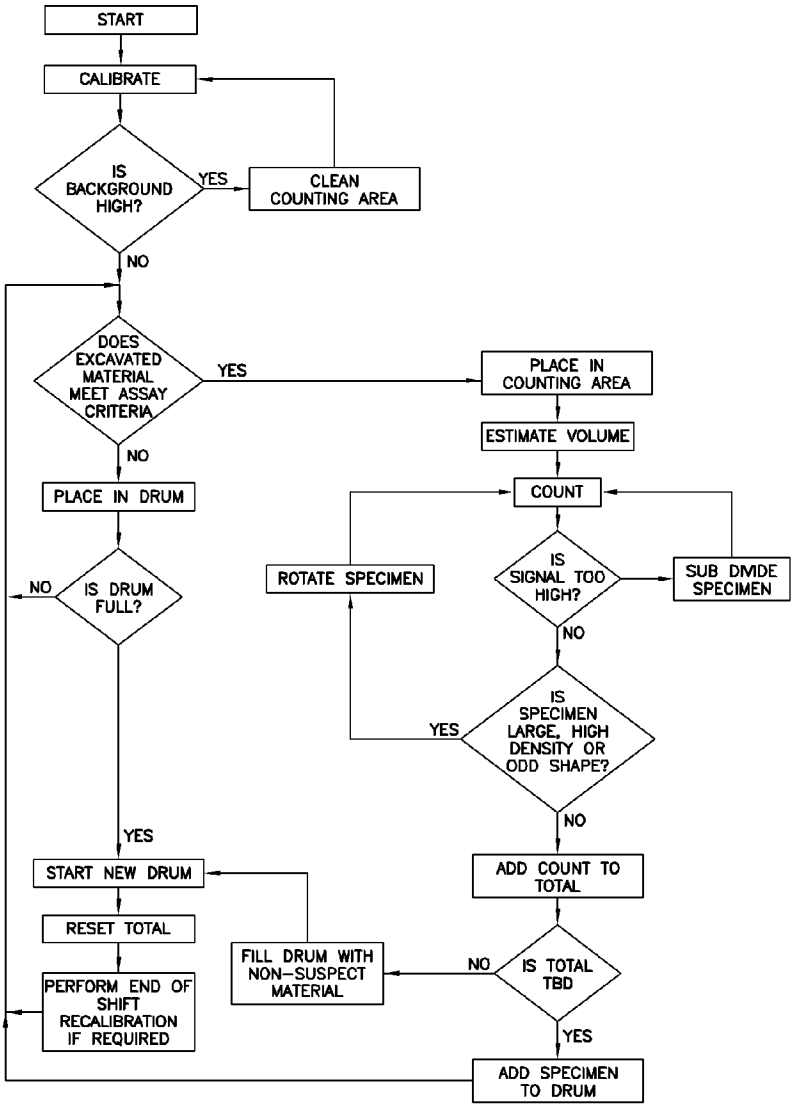
All packaging and shipping shall be performed by INEEL personnel.

OU 7–10 FISSILE MATERIAL MONITOR BLOCK DIAGRAM



NOTES:
1. DETAILS FOR GLOVEBOX 2 AND 3 ARE IDENTICAL TO GLOVEBOX 1.

FMM LOGIC FLOW



NOTES:
1. THIS DIAGRAM IDENTIFIES SYSTEM FUNCTIONS. PARTICULAR VALVES AND PRECISE DEFINITIONS OF TERMS ARE STILL TO BE DETERMINED.

2. IF TOTAL IS TBD IN THE BOTTOM DECISION BLOCK, THAT SPECIMEN IS SUBDIVIDED AS NECESSARY TO PRODUCE A COUNT TBD AND ADDED TO A NEW DRUM.