INSPECTION PROCEDURE 85502

DETECTION PROGRAM

PROGRAM APPLICABILITY: 2683

85502-01 INSPECTION OBJECTIVE

The objective of this inspection procedure is to verify that a detection program exists as part of the established material control and accounting (MC&A) program for a licensee's[1] Category III uranium enrichment facility, with detection capabilities as specified in the applicable regulations.

85502-02 INSPECTION REQUIREMENTS

The inspector should verify that the licensee has implemented a detection program capable of the timely detection of missing uranium or unauthorized production of enriched uranium.

The inspector should perform the following reviews:

02.01 Detection Program Structure. Review the licensee's detection program plans and procedures, and the organizational structure that supports it;

02.02 Nuclear Material Flows and Process Equipment Configuration. Review the licensee's process flow diagrams (including nuclear material and waste flows) for the subject facility;

02.03 Diversion Scenarios. Review the credible unauthorized production and unauthorized enrichment scenarios, specific to the facility;

[1]Hereinafter, the term licensee subsumes the term "certificate holder," which applies in the case of the gaseous diffusion plants (GDPs). Likewise, all certificate-related requirements, including those in GDP compliance plans and corrective action commitments, are subsumed under the term "license."

02.04 Effectiveness of the Detection Program. Review the licensee's implementation of the detection program, and evaluate its effectiveness;

02.05 Detection Data Evaluation. Review the records of observations and evaluations required in the licensee's detection program;

02.06 Evaluation of Records and Procedures. Review the indicator resolution reports, and verify that detection data processing procedures were appropriately and timely followed.

85502-03 INSPECTION GUIDANCE

General Guidance

The regulatory requirements are as follows:

(1) Detection of indications of the unauthorized production of uranium enriched to 10 weight percent, or more, in the U^{235} isotope, to the extent that special nuclear material (SNM), of at least moderate strategic significance, could be produced within any 370 calendar-day period.

(2) Detection of indications of the unauthorized production of uranium enriched to 20 weight percent or more in the U^{235} isotope.

(3) Detection of indications of the unauthorized enrichment of uranium that constitutes SNM of low strategic significance.

(4) Detection of indications of missing uranium or plutonium involving 500 grams or more of contained U^{235} or 200 grams of plutonium.

To prepare for the inspection, the inspector should:

a. Review those portions of the Fundamental Nuclear Material Control (FNMC) Plan and license conditions pertaining to the planned inspection activities.

b. Review recent MC&A inspection reports for the site.

c. Review any unresolved or followup items from the previous inspections to be addressed during the current inspection.

d. Review the content of any communications (including information notices and bulletins), to the licensee, that were issued since the last inspection.

e. Coordinate the inspection with the licensing program manager, and discuss any issues or concerns.

Specific Guidance

03.01 Detection Program Structure. The detection program structure should permit detection program personnel to effectively determine there is no unauthorized enrichment or production, and that statistically significant amounts of SNM are not missing. The detection program documentation should describe the program's structure, with the detection program manager appropriately positioned in the facility organization to be able to ensure that all aspects of the detection program are accomplished, and that there are no conflicts of interest with production operations. The detection program documentation should indicate how the separation of responsibilities for different MC&A functions ensures the independence of the detection program from those responsible for implementing other possibly conflicting MC&A functions (e.g., SNM custodianship, SNM receiving and shipping, sampling operations, on-site SNM handling operations, etc.). Detection program personnel should know the facility's production operations, MC&A activities, and monitoring techniques. The detection program should well-coordinated among the facility's managers.

The inspector should verify the following:

a. The detection program is implemented in compliance with the FNMC Plan.

b. The detection program is independent of production operations.

c. Detection program activities are integrated among managers for MC&A, production operations, and related support functions (e.g., maintenance, training, SNM shipping and receiving, etc.).

d. The person responsible for the detection program is identified by position title.

e. Organization charts show the level and interrelationship of the detection program manager with other facility managers; the program manager has the necessary authority to carry out all aspects of the program.

f. Staffing and personnel assignments are sufficient to support the detection program functions.

g. Detection program personnel have sufficient understanding of production operations, MC&A activities, and monitoring techniques.

h. There is adequate documentation of the personnel responsible for the detection program functions, their responsibilities, and their lines of authority and communication.

i. There are no personnel responsible for detection program functions with conflicting responsibilities for conducting other MC&A functions.

03.02 Nuclear Material Flows and Process Equipment Configuration. The inspector should verify that the detection program

documentation describes all process equipment (e.g., for separation, feeding, withdrawal, and support) and processing areas, and that all nuclear material flows (including waste or tails streams with possible SNM content) are traceable throughout the process operations. The inspector should confirm that the appropriate detection program personnel understand all mechanisms for changing the amount of material in process (e.g., feeding, withdrawing, and sampling) and in waste or tails streams; the direction of material flow (valve positions and control room operations); and, in the case of the GDPs, the separative capacities of the cascades.

The inspector should verify, as applicable and needed, the following:

a. Design drawings are available, and show the process equipment configuration and the nuclear material flows.

b. Process equipment and piping containing nuclear materials are identified.

c. The design physical and chemical forms of SNM, and design uranium enrichments, are identified for all process areas.

d. The locations of control valves, block valves, isolation valves, control switches, and other equipment that can be used to control or direct process flow, are documented.

e. Authorized feed, withdrawal, and sampling locations and activities are documented.

f. Mechanisms for feeding and withdrawing nuclear materials, to and from the process equipment, are identified.

g. The mechanisms for sampling, and the locations of all sampling ports, are identified.

h. Any cylinders or canisters located in the process areas, that may contain nuclear materials, are identified.

i. At GDPs, methods for tuning the cascade, or otherwise producing changes in the cascade separative capacity, are identified.

03.03 Diversion Scenarios. The inspector should verify that detection program personnel know and understand the potential scenarios for the unauthorized production or enrichment of enriched uranium addressed in the FNMC Plan (e.g., batch recycle, cascade isolation [at GDPs]). The performance indicators relative to these scenarios should be documented, and detection program personnel should be aware of adversarial activities that could be used to conceal or illicitly modify the indicators. The licensee should periodically review the extant diversion path analyses that gave rise to the documented scenarios, for completeness and accuracy, since scenarios for unauthorized production or enrichment may change with time, with separative capacity, and with equipment configurations. The analysis should be extensive and conducted by

individuals having a thorough knowledge of the processing equipment and technology.

The inspector should verify the following:

a. The appropriate licensee personnel responsible for the MC&A system know and understand the credible diversion scenarios for unauthorized uranium production or enrichment, and the relevant performance indicators for each scenario, as documented by the licensee.

b. The appropriate licensee personnel understand the credibility of each documented scenario in terms of:

1. The minimum time to produce a goal quantity of material;
2. The number of individuals required to implement each scenario;
3. The complexity of required illicit modifications; and
4. The likely impact of the adversarial activities or modifications on production.

c. The documentation for each identified credible diversion scenario (e.g., evidence of physical modifications, use of portable equipment, changes from declared material flows and removal paths) includes the relevant performance indicators.

d. The appropriate licensee personnel know and understand the actions that could be used to conceal unauthorized activities, within the context of each documented diversion scenario.

03.04 Effectiveness of the Detection Program.

a. Goal Quantities for Successful Detection. A successfully implemented licensee detection program should be capable of detecting 1) the unauthorized production or enrichment of enriched uranium; and 2) missing uranium or plutonium. In consideration of the requirements of 10 CFR 74.33(c)(5), the following goal quantities have been identified as sufficient for practically determining that the licensee's detection program for unauthorized production is adequate (See NUREG/CR-5734):

1. 25 kilograms of U^{235} in low-enriched uranium (LEU), enriched to less than 10 weight percent;

2. 10 kilograms of U^{235} in LEU, enriched to less than 20 weight percent, but greater than or equal to 10 weight percent U^{235}; and

3. 1 kilogram of U^{235} in high enriched uranium. The detection program should be independent of production operations, and should comply with the commitments made in the FNMC Plan.

b. Detection Program Implementation Effectiveness. The inspector should verify that the licensee's program for detecting unauthorized enrichment or production of enriched uranium is effectively implemented. The detection program may consist of a

combination of (1) facility safeguards controls, (2) process data review, and (3) process monitoring (e.g., unit, stage, cell), all of which should be documented. The detection elements used will depend on the characteristics of the process system and facility preferences. The type(s) of monitoring controls utilized, and the frequency of surveillance specified in the detection program, should ensure at least a 95% power of detecting an abrupt loss of 5 formula kilograms. The inspector should review any process system modifications that may have been implemented since the last inspection, to verify that the detection program features and design parameters remain valid.

For a vertical slice approach, the inspector should select a safeguards risk-significant, unauthorized enrichment or production scenario(containing specific removal mechanisms or paths). For the diversion scenario selected, estimate the indicators that would result, and verify that the detection program would detect implementation of the strategy before a goal quantity of SNM was illicitly produced or diverted.

In the context of the three-tiered detection inspection strategy discussed in 05.04 of Inspection Manual Chapter 2683, the inspector should verify the following:

a. The detection program is documented and faithfully implemented.

b. The implemented detection program adequately addresses all credible unauthorized production or enrichment scenarios.

c. Detection program personnel know about operational activities and standard operating procedures.

d. All areas associated with nuclear material processing (e.g., processing areas, control rooms, feed and withdrawal areas, etc.) are routinely available for surveillance and monitoring.

e. The selected types of process monitoring (e.g. unit, stage, cell), controls, and surveillance are effective in detecting the unauthorized production or enrichment activities postulated in the identified credible scenarios.

f. The frequencies of surveillance and data evaluation for process (e.g., unit, stage, cell) monitoring controls ensure timely detection of postulated adversarial activities.

g. The licensee’s procedures support the timely investigation, notification, and reporting of anomalies.

The FNMC Plan may address the contribution of facility controls (e.g., access controls or procedural controls) towards detection of activities associated with the unauthorized production or enrichment of uranium. These controls would limit direct access for personnel with job responsibilities in the controlled areas, to (1) the process system, (2) the process system controls, or (3) the

safeguarded nuclear materials. The following verifications should be done in the context of the as-built process configuration.

The inspector should verify the following:

a. FNMC Plan-specified personnel access controls are effective in limiting the number of individuals who could gain access to the enrichment processing equipment or its control mechanisms.

b. FNMC Plan-specified barriers and surveillance systems (e.g., locked and alarmed doors and closed-circuit television) are effective in limiting or detecting unauthorized access to process controls, process equipment, or nuclear material in process.

c. FNMC Plan-specified process control systems are effective in indicating unauthorized use of production equipment.

d. Employee training and provisions for informant protection (e.g., whistle blower protection rules) encourage detection and reporting of potential unauthorized activities by facility personnel.

03.05 Detection Data Evaluation. The evaluation of MC&A data, process data, and production information (e.g., log books, batch sheets) may contribute to detecting missing SNM or unauthorized enrichment or production of enriched uranium. Timely analysis of this information can indicate potential losses of safeguarded nuclear material or unauthorized (or unannounced) changes in process operations. The effective evaluation of such data, as specified in the FNMC Plan, will need to be verified.

The inspector should verify the following:

a. Personnel with FNMC Plan-specified data evaluation responsibilities know about MC&A and process control activities.

b. Personnel with FNMC Plan-specified data evaluation responsibilities are aware of the current operational status.

c. Currently updated process flow sheets, to support data evaluation are maintained, and readily available to personnel with FNMC Plan-specified data evaluation responsibilities, to reflect current processing operations.

d. MC&A data on feed, product, and tails cylinders, and in-process inventory estimates, are readily available to personnel with FNMC Plan-specified data evaluation responsibilities.

e. Balances for total uranium, U^{235}, and minor uranium isotopes (if measured) are periodically evaluated, in accordance with the FNMC Plan.

f. Calculations are performed to verify that the actual separative work at uranium enrichment facilities, accomplished during a given time period, is consistent with the documented (or authorized) on-line separative capacity.

g. FNMC Plan-specified laboratory test results from sampling in-process material and cylinders or containers are readily available to personnel responsible for FNMC Plan-specified data evaluation.

h. Sampling data confirm that isotope concentrations are consistent with design parameters in the FNMC Plan, and with other regulatory requirements.

i. Personnel with FNMC Plan-specified data evaluation responsibilities are able to independently validate process control measurements (e.g., weighing and sampling operations) and laboratory enrichment measurements (e.g., isotopic assay).

j. Personnel with FNMC Plan-specified data evaluation responsibilities are authorized to request independent samples to be withdrawn from the process.

k. Personnel with FNMC Plan-specified data evaluation responsibilities are able to verify process enrichments [e.g., through random nondestructive assay (NDA) measurements].

A surveillance and/or enrichment monitoring system may exist for the detection of unauthorized enrichment of uranium (e.g., unit, stage, cell monitoring). Monitoring can consist of different types of portable and installed instruments (e.g., optical surveillance, seals, radiation monitors, or flow meters). The monitoring and surveillance system should be effectively implemented.

The inspector should verify the following, for surveillance systems:

a. Personnel with FNMC Plan-specified detection responsibilities are able to verify the designed process system configuration, and identify any unauthorized modifications.

b. Personnel with FNMC Plan-specified detection responsibilities can detect unauthorized use of production equipment or the presence and/or use of unauthorized equipment, through direct observation.

c. Personnel with FNMC Plan-specified detection responsibilities are able to verify the status of tamper-indicating seals, that may be applied to process valves and flanges.

d. Personnel with FNMC Plan-specified detection responsibilities are able to identify the presence of unauthorized cylinders and canisters in processing areas.

The inspector should verify the following, for monitoring equipment:

a. Monitoring equipment and instrumentation relied upon in the FNMC Plan are sufficiently sensitive to detect unauthorized production through indicators specified in the FNMC Plan.

b. Personnel with the applicable FNMC Plan-specified detection responsibilities have sufficient technical expertise to operate, inspect, or maintain process monitoring equipment, and to analyze the data generated by them.

c. Installed process monitoring equipment is protected against tampering.

d. Procedures for operating process monitoring equipment, confirming equipment calibration, and analyzing and reporting data are documented and implemented.

e. Data from installed process monitoring equipment are evaluated at intervals necessary to support the detection strategy.

f. Preventive maintenance is scheduled and performed at a frequency sufficient to ensure high availability and reliability of the measurement equipment.

03.06 Evaluation of Procedures and Records. The inspector should verify that detection program data are maintained and analyzed, and that potential indicators of missing uranium or unauthorized production can be recognized, if they were to occur.

The inspector should review the procedures the licensee maintains for detecting missing uranium and unauthorized enrichment or production of enriched uranium within the facility. Records of the evaluations, monitoring of data, and surveillance performed should be audited to verify that the detection time goals have been met and that tests have been conducted using the methods described in the FNMC Plan.

After reviewing the procedures and auditing the records, the inspector should observe the performance of a random sample of the established procedures, to verify that the procedures are adequately implemented, and are appropriate for conditions in the process area. The procedures should demonstrate that the system is capable of detecting a goal quantity of production with at least 90 percent power of detection [Ref: 10 CFR part 74.33(c)(4)(ii)].

During review of the process monitoring records, the inspector should note whether any indicators were investigated, and determine whether any other indicators should have been investigated. The inspector should calculate a sampling of the indicators to verify the licensee’s calculations, and compare the indicators with the alarm limits. The inspector should verify the licensee’s methods for identifying, reporting, investigating, and resolving indicators that exceed alarm limits. The inspector should make a judgment or

conclusion as to whether the licensee's procedures for alarm recognition and follow-up actions are adequate.

The inspector also should verify the following, as applicable:

a. Detection program data and observations are recorded and appropriately stored.

b. The results of process facility inspections are documented and maintained.

c. A record of monitoring system equipment failures is maintained.

d. Procedures indicate what to do if a potential indicator is observed.

Process system operations should be validated by NRC to verify that the detection program is functioning sufficiently to recognize indicators of missing uranium or unauthorized enrichment, should they occur. The inspector should perform tests for this purpose, such as making independent NDA measurements on process pipes, for comparison with similar FNMC Plan-specified tests, to confirm that enrichments higher than authorized are not being produced.

85502-04 REFERENCES

Regulations

10 CFR 74.33(a)(2), (3), (5), (6), (8), and (9); 10 CFR 74.33(c)(5), and 10 CFR 74.82.

Regulatory Guides and Reports

Regulatory Guide 5.67, "Material Control and Accounting for Uranium Enrichment Facilities Authorized to Produce Special Nuclear Material of Low Strategic Significance," Sections C.11 and C.12, 1992.

NUREG/CR-5734, "Recommendations to the U.S. Nuclear Regulatory Commission on Acceptable Standard Format and Content for the Fundamental Nuclear Material Control (FNMC) Plan Required for Low-Enriched Uranium Enrichment Facilities," Chapters 9 and 10, November 1991.

NUREG/CR-1686, "Feasibility and Cost/Benefit of Advanced Safeguards for Control of Nuclear Material in Process," October 1980.

NUREG/CR-0532, "Safeguards Against Insider Collusion," December 1978.

SAND79-0484, "Operations Monitoring," February 1980.

END