Licensing Considerations for Future Nuclear Fuel Cycles: Material Control and Accounting

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Material Control and Accounting

• Objectives of a Material Control and Accounting (MC&A) Program
• Elements of an MC&A Program
• U.S. Nuclear Regulatory Commission (NRC) Requirements for MC&A
• MC&A for Future Nuclear Fuel Cycles
• Potential Solutions and Next Steps
Objectives of an MC&A Program

• Maintain control of special nuclear material (SNM) to ensure continuity of knowledge and the ability to deter and detect unauthorized removal

• Maintain and report accurate, timely, complete, and reliable information on locations, quantities, and characteristics of SNM in the facility’s possession

• Ensure that if loss, theft, diversion, or misuse does occur, the facility’s MC&A program triggers timely detection, response, investigation, resolution, and recovery operations

• Meet international reporting obligations
Elements of an MC&A Program

- Management structure
- Measurements and measurement control
- Physical inventory
- Item monitoring
- Process monitoring
- Detection and resolution of indicators
- Independent assessment
- Recordkeeping
NRC Requirements for MC&A

- Most requirements are in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 74, “Material Control and Accounting of Special Nuclear Material”
- Reporting and recordkeeping requirements in place for all transfers of 1 gram or more of SNM
- Additional performance-based requirements follow a graded approach tied to the type and quantity of SNM
- MC&A programs are subject to NRC inspection
MC&A for Fuel Cycle Facilities

• Fuel cycle facilities (fuel fabrication and uranium enrichment) are subject to 10 CFR Part 74, Subpart C, D, or E, depending on type and quantity of SNM
• These facilities are required to have an NRC-approved MC&A plan
• The MC&A plan describes the capabilities and implementation of the MC&A program for the facility
MC&A for Future Nuclear Fuel Cycles

- Existing MC&A requirements were developed for the present light-water reactor fuel cycle
- Some future designs may include closer integration of the fuel cycle with the reactors
- Different fuel types and advanced reactor designs may require new approaches to meet the MC&A objectives
Some Potentially Challenging Aspects

• Higher enrichments -- high-assay low-enriched uranium (HALEU)
• Large numbers of discrete fuel elements not in assemblies (e.g., pebble fuel designs)
• Nondiscrete fuel admixed with coolant/moderator (e.g., some molten salt designs)
Potentially Challenging MC&A Topics

• Process monitoring
• Item control and item monitoring
• Measurements
• Detection and resolution of indicators
• Physical inventory
Potential Solutions and Next Steps

• Performance-based regulations retain flexibility
• Early recognition of challenges may help to inform designs and operations
• Some guidance is available from previous analyses and international experience
• Engage NRC staff early and often