Safeguards Implications of Geological Disposal

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General Principles

• The **objective** of international safeguards is
  
  • “the timely detection of diversion of significant quantities of nuclear material from peaceful nuclear activities …”

• **Technical objectives** of safeguards for a geological repository include:
  
  • Detect potential undeclared structures or activities that could be associated with or facilitate diversion
  
  • Detect diversion of spent fuel
Development of International Safeguards

• Development of safeguards for geological repositories began in 1988
  • Multi-national programs
  • IAEA interactions with States
  • Safeguards does not terminate on nuclear material just because it is in a geological repository
  • Safeguards assurances for underground should be as strong as for above ground
Safeguards Considerations

• Nuclear material in spent fuel has been under safeguards verification since it was initially purified

• **Verification measures will be repository-specific** due to
  
  • Type of safeguards agreement/additional protocol in force
  
  • National or multinational ownership and workforce
  
  • Difficulty and time to remove emplaced nuclear material
    
    • Design – e.g., Shaft/ramp and tunnels, drill hole/bore hole
    
    • Geological matrix
Verification of Design

• Geological repository design is to be periodically verified during construction, operation and closure

• Repository characteristics will determine design verification techniques, such as
  • Satellite imagery
  • Geophysical monitoring - e.g., passive seismic
  • Inspector observation
  • Gyroscopic mapping
  • 3-D Laser mapping
Detection of Diversion

• Detect falsification of nuclear material quantities
• Detect removal of spent fuel from the repository
• Diversion detection techniques may include
  • Auditing of records and reports
  • Inspector surveillance
  • Tamper-indicating devices
  • Camera surveillance
  • Radiation monitoring
  • Weight and other types of monitoring
  • Geophysical monitoring- E.g., passive seismic
  • Satellite imagery
The safeguards objectives are the same whether spent fuel is disposed in a national deep geological repository, multi-national geological repository, or deep bore-hole repository.

Safeguards verification activities do not end when nuclear material is emplaced in a geological repository.

Safeguards measures will be determined by State- and facility-specific characteristics.

Frequency and intensity of verification based on assessed risks.