



# 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

# Conclusion

- 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