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An Analysis of Shared-Use Equipment for Safeguards

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Background

More nuclear facilities under IAEA safeguards

- Increased IAEA workload
- IAEA budget is not increasing proportionately

Many new facilities are large and highly automated

- Need more sophisticated & more precise monitoring equipment
  - Detect diversion of **significant quantity** w/in timeliness criteria

Facility operators often use similar equipment to monitor a facility's operations

State and regional safeguards authorities need the same measurement data to conduct their safeguards responsibilities.

Operator-owned *Equipment & Data* could be shared with IAEA for safeguards purposes.

Background (2)

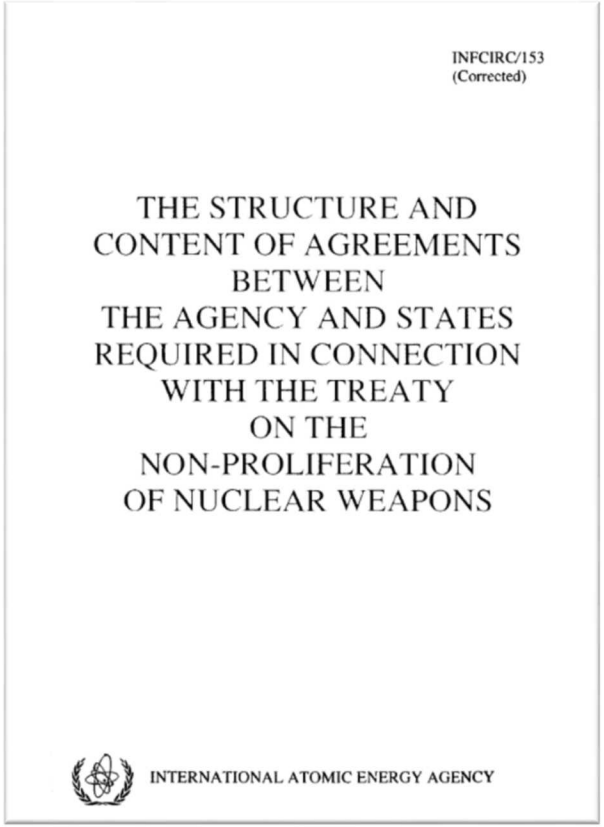
Legal commitment to jointly use equipment

- The IAEA "shall make full use of the State's system of accounting and control [and] avoid unnecessary duplication…." – *INFCIRC 153 (corrected)*

Joint Use Arrangement (JUA)

- Required among all parties sharing equipment
  - IAEA
  - Regional Safeguards Authorities (e.g., Euratom, ABACC)
  - State Regulatory Authority
  - Facility operator
- Approval by IAEA
  - Deputy Director General (DDG) for Safeguards

Independent Vulnerability Assessment



Potential Benefits of Sharing Equipment

Facilitated data acquisition

- Compared to acquiring safeguards data from independent IAEA safeguards equipment

Shared costs

- Acquiring, Maintaining, Operating safeguards equipment

Reduce safeguards burdens on facility operators

Reduced radiation exposure

- Inspectors & technicians

Sharing equipment may be the only viable solution to achieve IAEA's goals for *efficiency and effectiveness**

*K. Tolk & M. Zendel. "Considerations for Joint Use of Equipment." 2nd JAPAN-IAEA Workshop on Advanced Safeguards Technology for the Nuclear Fuel Cycle. Tokai-mura, Ibaraki, Japan: JAEA 2009. SAND2009-8331C

Potential Disadvantages of Shared Use*

Data integrity & authenticity
- Might be difficult to ensure
- IAEA security and authentication requirements
  - Could complicate equipment design, deployment and operation
- Adding IAEA authentication measures might increase costs

Safeguards measures could be easier to defeat
- Operators or State authorities …
  - Know performance characteristics of shared equipment
  - Have direct access to data

Doubts about the *independence* of IAEA's safeguards conclusions

Some operator data may be proprietary or sensitive

Mitigate these issues by considering most promising applications …
Spent fuel disposal

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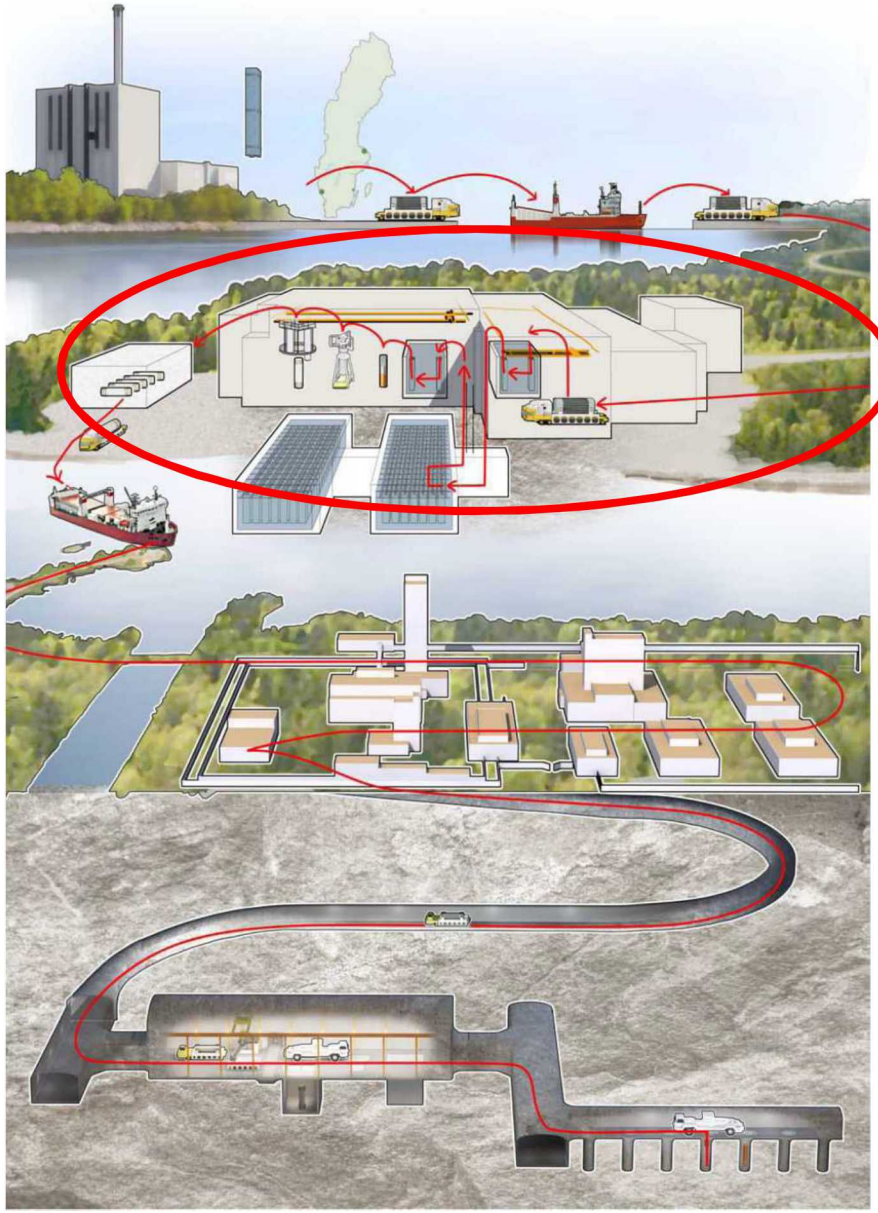
Geological Disposal of Spent Nuclear Fuel



Spent fuel assemblies
- From Nuclear Power Plant

Encapsulation Plant
- Final accountancy measurement
- Assemblies ⇨ disposal canisters
  - Assemblies no longer visible

Disposal Underground
- Permanent
- No reverification

Image credit (with permission): Jan-Olov Stål, SKB

Use Case - Encapsulation Plant for Spent Fuel

Data from equipment in Encapsulation Plant (EP) for Spent Fuel

- Tracks masses and routes of assemblies & disposal canisters in EP
- Potential safeguards use by the IAEA
  - Maintain continuity of knowledge (CoK) on fuel assemblies
  - Verify that EP facility is operated as declared
  - Detect potential diversion attempts
  - Reduced inspection times or frequencies

Could help IAEA to draw safeguards conclusions

- Ensure validity & authenticity of op equipment

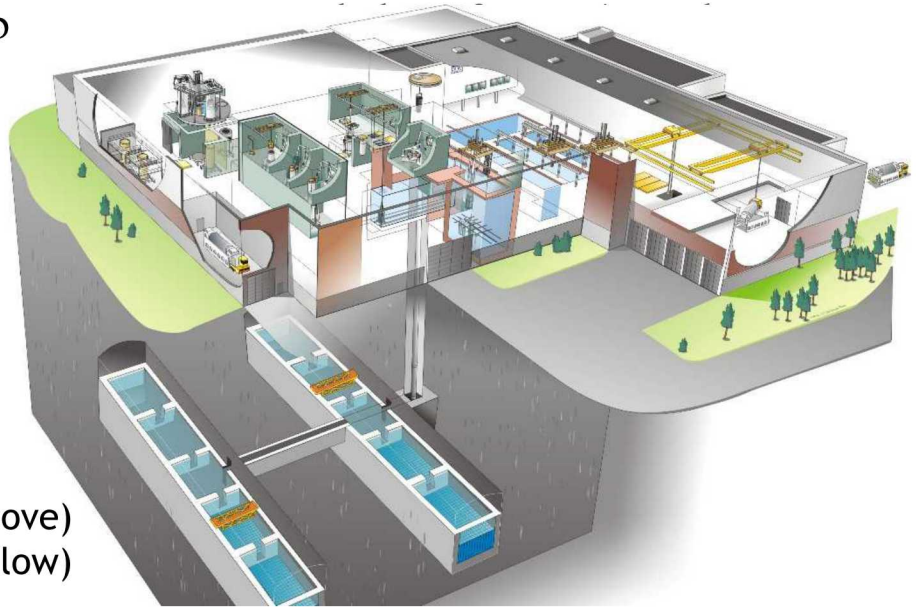


Illustration of Sweden's combined EP (above) and central interim storage facility (below)

Image credit (with permission): Jan-Olov Stål, SKB

Operator Equipment for Possible Joint Use at an Encapsulation Plant

Hoists and Cranes

- Lift and move spent fuel assemblies and disposal canisters

Transporters for Disposal Canisters

- Carry and move disposal canisters

Equipment data could be shared with IAEA

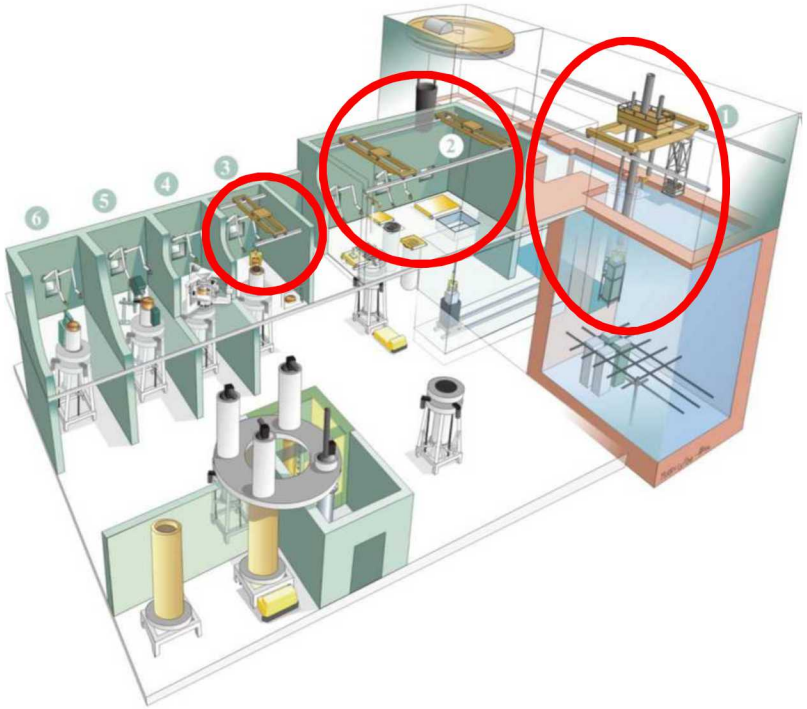
- Mass measurements correlate with item movements

EP operator data is unlikely to be sensitive: Mass & item movements

EP equipment: Hoists & Cranes

Move assemblies & canisters

- Correlate mass and movement direction



EP fuel-handling cell (Sweden)

Image credit (with permission): Jan-Olov Stål, SKB

EP equipment: Transporters

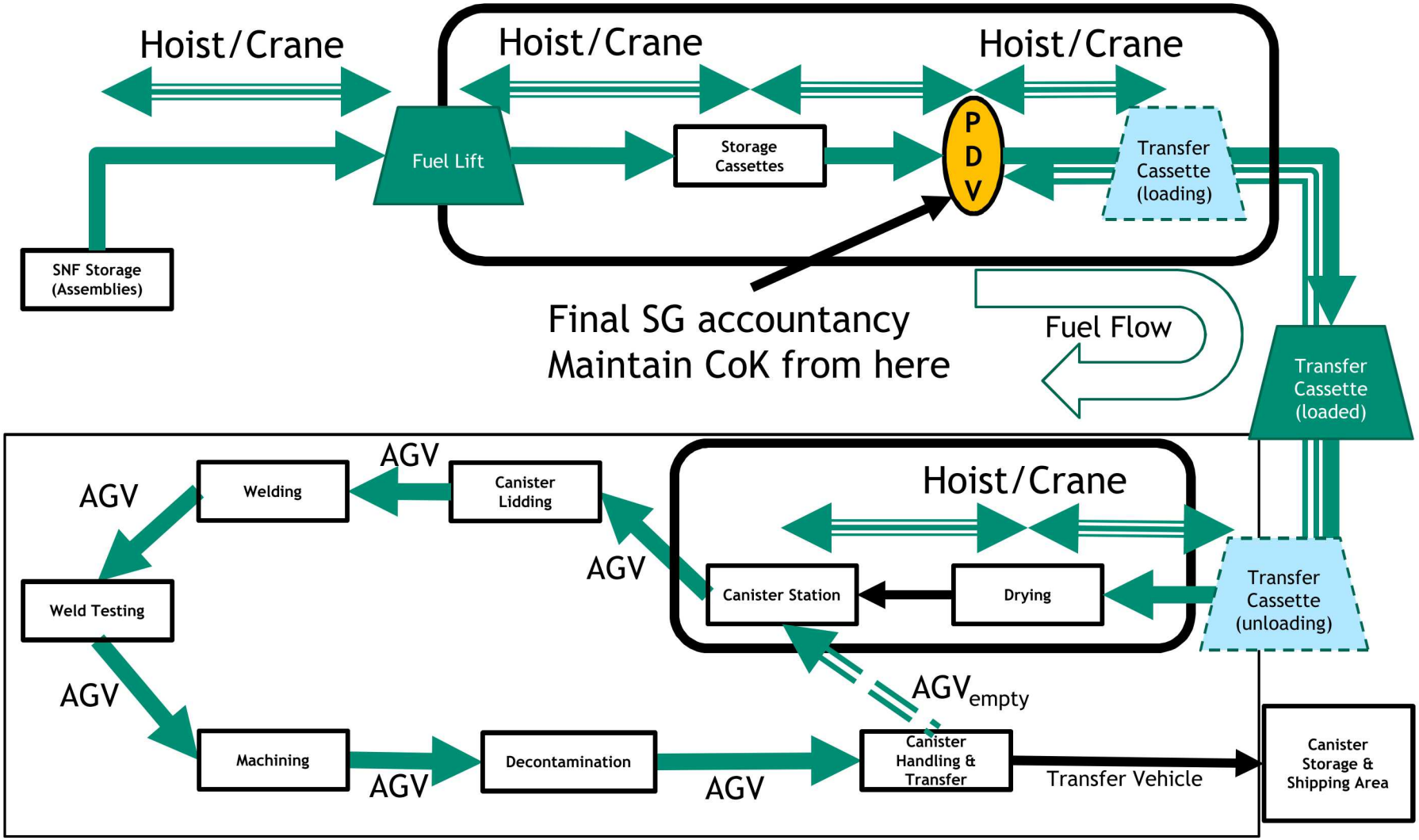
Move disposal canisters

- Correlate mass and direction of movement

AGV - automatic guided vehicle (Sweden)

Image credit (with permission): Jan-Olov Stål, SKB

Material Flow at an Encapsulation Plant for Spent Fuel*



AGV= automated guided vehicle

Based on Sweden's EP design

Existing platforms

IAEA Load-Cell Based Weighing System (LCBS)

- IAEA-owned equipment to measure masses of UF6 canisters
- Apply to mass-measurements with operator equipment?

IAEA Real-time And Integrated STream-Oriented Remote Monitoring (RAINSTORM)

- Real-time data collection from safeguards instruments in the field
  - Hypertext Transfer Protocol (HTTP)
  - Public-key cryptography
- RAINSTORM compliant equipment includes:
  - Remote Monitoring Sealing Array (RMSA)
  - Laser Mapping for Containment Verification (LMCV)
  - On-Line Enrichment Monitor (OLEM)
  - Next Generation Surveillance System (NGSS)

Euratom Remote Acquisition of Data and Review (RADAR)

- Automatic data acquisition
  - Network-based
  - Remote operation
  - Modular Data Analysis
    - Central RADAR Inspection Support Package (CRISP)

SNL Enhanced Data Authentication System (EDAS)

- Data authentication and encryption
- Unattended monitoring and data collection

Load-Cell Based Weighing System (LCBS)

Load cell being used to weigh a UF_6 cylinder

Image credit: IAEA

Enhanced Data Authentication System (EDAS)

Branches data from operator instrumentation

Secure & authentic byte-by-byte replica of a data stream to a safeguards inspectorate

Operates unattended without interfering with facility operations

Installed in the instrumentation signal path of operator instrumentation

- as close to the sensor as possible

Field tested at Springfields, UK

Operator Computer

Inspector Computer Euratom RADAR

Summary

Safeguards by Design

- Identify potentially sensitive data
- Identify & integrate SG measurements into facility design

Shared Equipment

- Integrate data-authentication measures
- Tamper-resistant and tamper-indicating enclosures
- Joint-use Agreement

IAEA experience with Rokkasho Reprocessing Plant (Japan)

Encapsulation Plant Use Case

- Non-sensitive operator data
- Near real-time tracking of mass & material/item movements

Facility monitoring

- Quickly identify potential misuse

Continuity of Knowledge

- Item tracking through mass movements

Assure *independent* IAEA Safeguards conclusions

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Thank You