Molten Salt Reactor Safeguards

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Joint IAEA-NEA-EC/JRC Workshop on the Taxonomy and Related Terminology of Fuel Cycles for Molten Salt Reactors

IAEA Safeguards

- Safeguards are a set of **technical measures** applied by the IAEA on nuclear material and activities to **independently verify** that all nuclear material is **not diverted** from peaceful activities
- States **accept these measures** through the conclusion of safeguards agreements

191 States have SG agreements in force

Safeguards Objectives

- How do we verify that **all nuclear material** is not diverted in States with comprehensive safeguards agreements?

No **diversion** of declared nuclear material

No **misuse** of nuclear facilities for production of undeclared material

No **undeclared** nuclear material processing anywhere in the State

Safeguards Technical Measures

In-field safeguards measures

- ✓ Nuclear material accountancy
- ✓ Containment and surveillance
- ✓ Design information verification
- ✓ Non-destructive measurement
- ✓ Sample collection
- ✓ …more

Applied in accordance with SG agreements

Typical Reactor Safeguards Activities

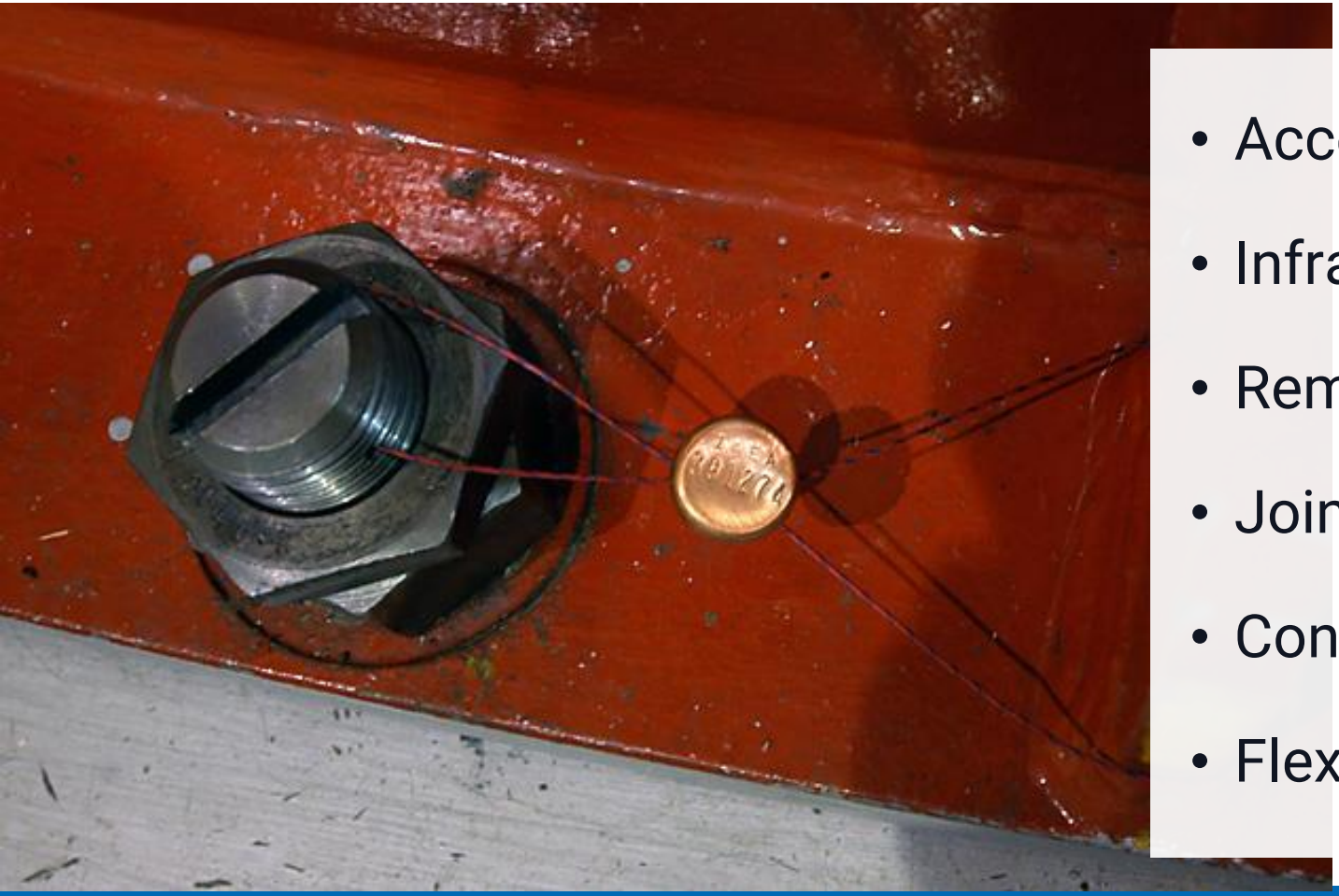
- Fresh fuel assemblies are **counted, identified,** and **verified**
- The reactor core or surrounding infrastructure is placed under **surveillance** and a **containment** boundary is established
- Core fuel assemblies are **counted** and **identified** when the core is open
- Spent fuel is **verified** after discharge and placed under **surveillance** with **periodic reverification**

IAEA Safeguards by Design (SBD)

- SBD is the **early consideration** of safeguards technical measures in the **design process** of nuclear facilities
- **Collaborative risk management** between the State, the IAEA, and the reactor vendor
- Reduces risk to scope, schedule, budget, licensing; reduces operator burden; reduces need for retrofitting

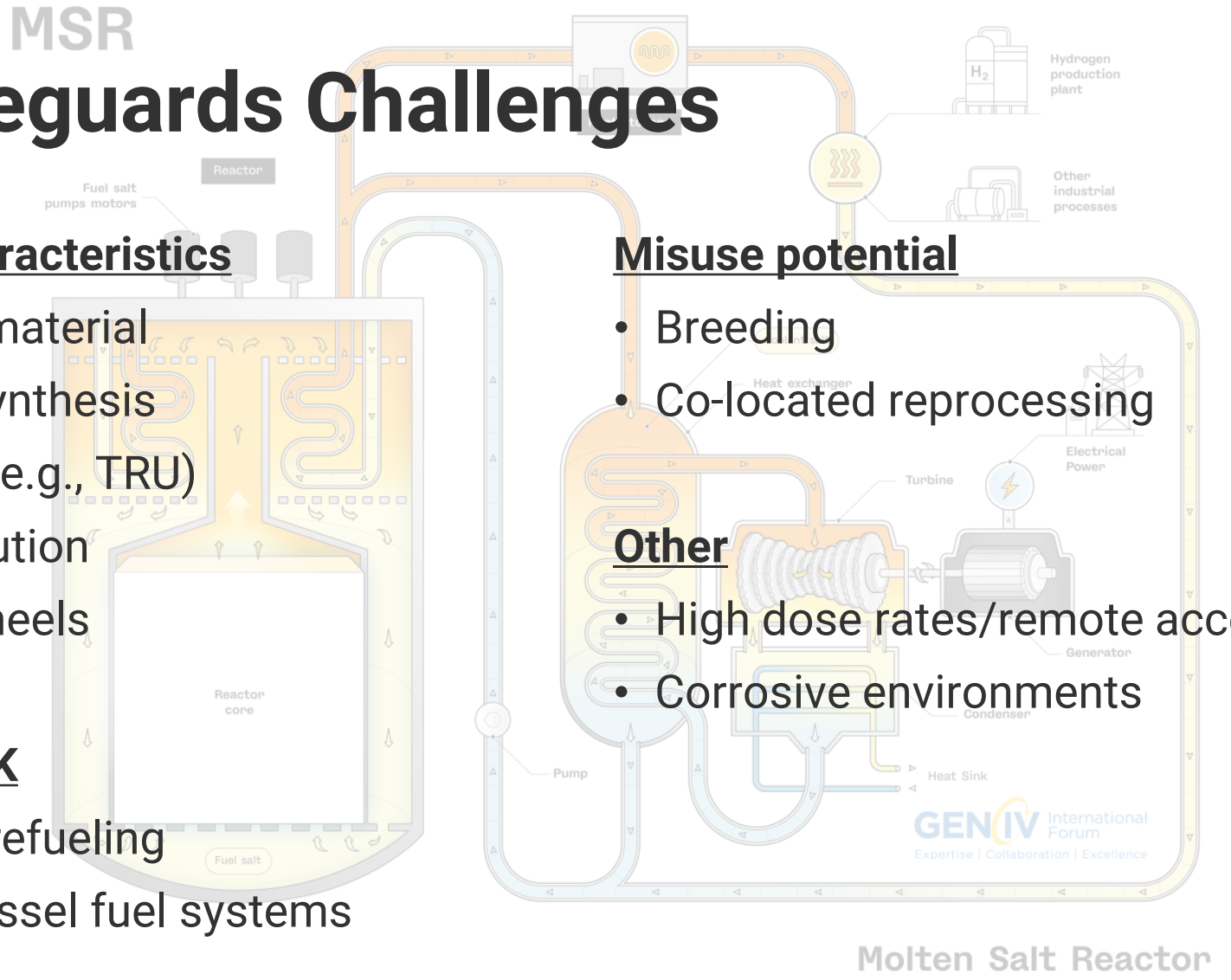
Improves the effectiveness and efficiency of SG implementation

Key SBD Concepts/Topics



- Access requirements
- Infrastructure requirements
- Remote/unattended systems
- Joint-use equipment
- Continuity of knowledge (CoK)
- Flexibility

MSR Safeguards Challenges



Unique fuel characteristics

- Bulk nuclear material
- On-site fuel synthesis
- Novel inputs (e.g., TRU)
- Fuel salt evolution
- Fuel-bearing heels

Maintaining CoK

- Online/inline refueling
- Ex-core/ex-vessel fuel systems

Misuse potential

- Breeding
- Co-located reprocessing

Other

- High dose rates/remote access
- Corrosive environments

MSR design variation will require a versatile approach

Summary

- MSRs pose a number of safeguards challenges that will require consideration during the design process
- SBD vendor engagements are underway for various advanced reactor designs (including MSRs), often through Member State Support Programmes
- The IAEA seeks to standardize SBD guidance through the development of model safeguards approaches
- The IAEA remains ready to collaborate on SBD for advanced reactors

Thank you!