Fast Reactor Safeguards

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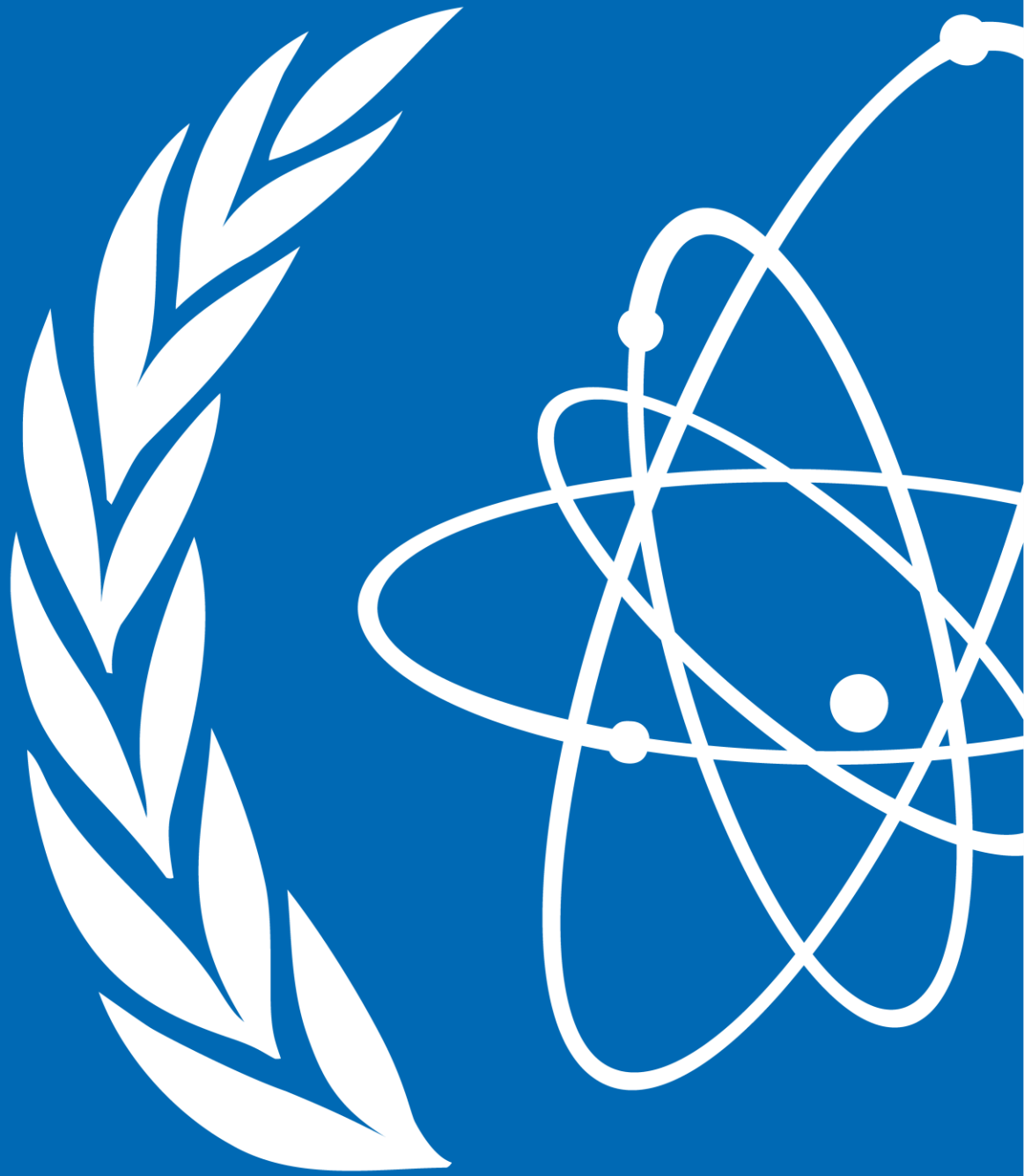


IAEA Safeguards

Safeguards are a set of **technical measures** applied by the IAEA to **independently verify** States' undertakings under their safeguards agreements

States **accept these measures** through the conclusion of safeguards agreements – CSA required under the Nuclear Non-Proliferation Treaty

190 States have SG agreements in force

IAEA Safeguards

- Three generic safeguards objectives apply to all States having a Comprehensive Safeguards Agreement

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 are a State obligation, but implementation of safeguards ***relies upon facility operators***

IAEA Safeguards at a Glance (2023)

safeguards implemented
in **189 States**
&
142 States with additional
protocols in force

nuclear material under SG
accounts for the potential
production of

235,939
nuclear explosive devices

1,367
nuclear facilities & locations
outside facilities under
safeguards

3,136
inspections involving
14,302 days in the field

1056
NDA systems deployed

1,165
samples collected

1,376
cameras installed

Safeguards Technical Measures

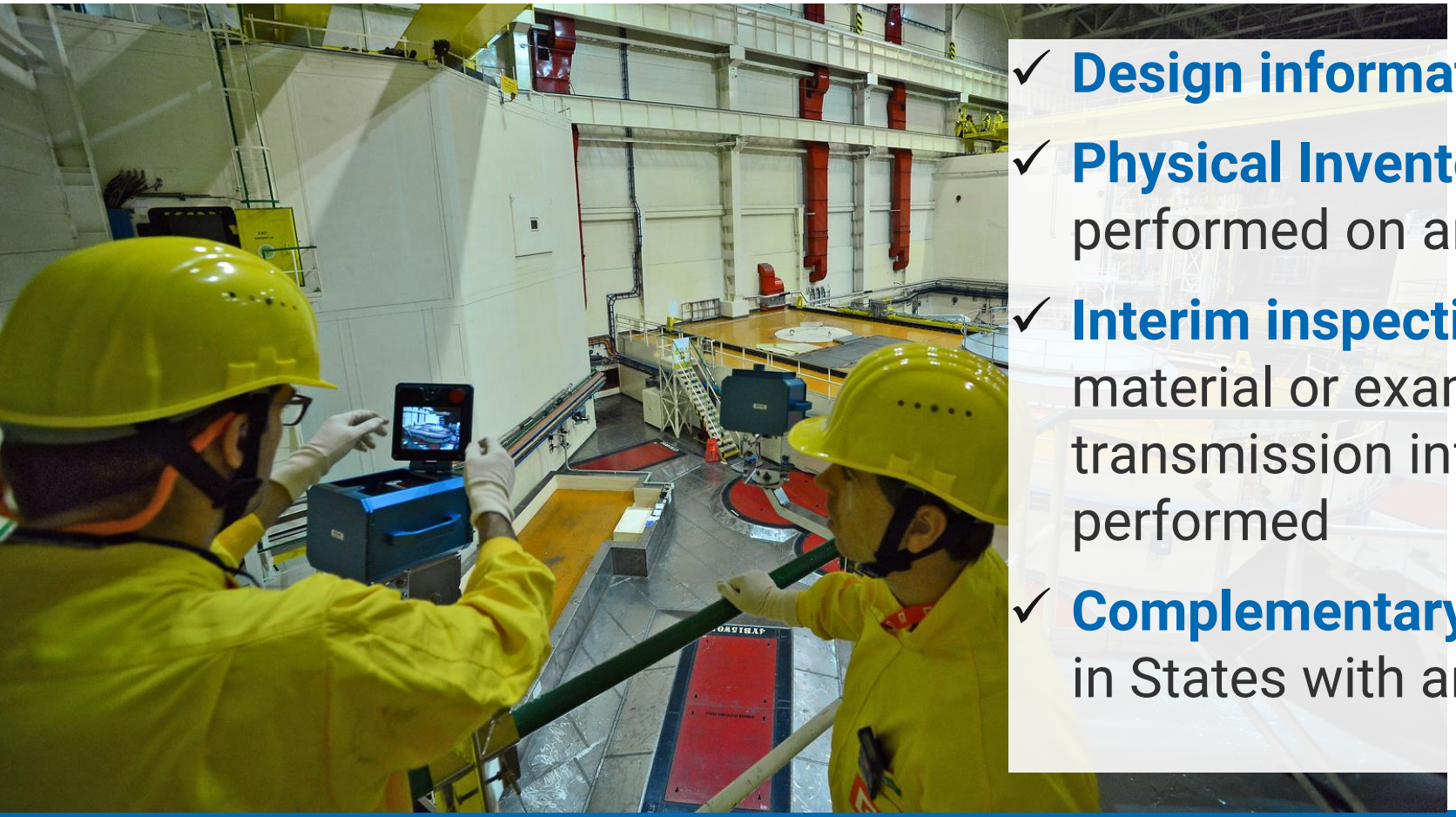
In-field and HQ Safeguards measures

- ✓ Nuclear material accountancy
- ✓ Containment and Surveillance
- ✓ Design Information Verification
- ✓ Sample collection
- ✓ Open source analysis
- ✓ …more

Technical measures are applied in accordance with SG agreements

Safeguards and Fast Reactors

Typical Nuclear Reactor Facility Safeguards Visits

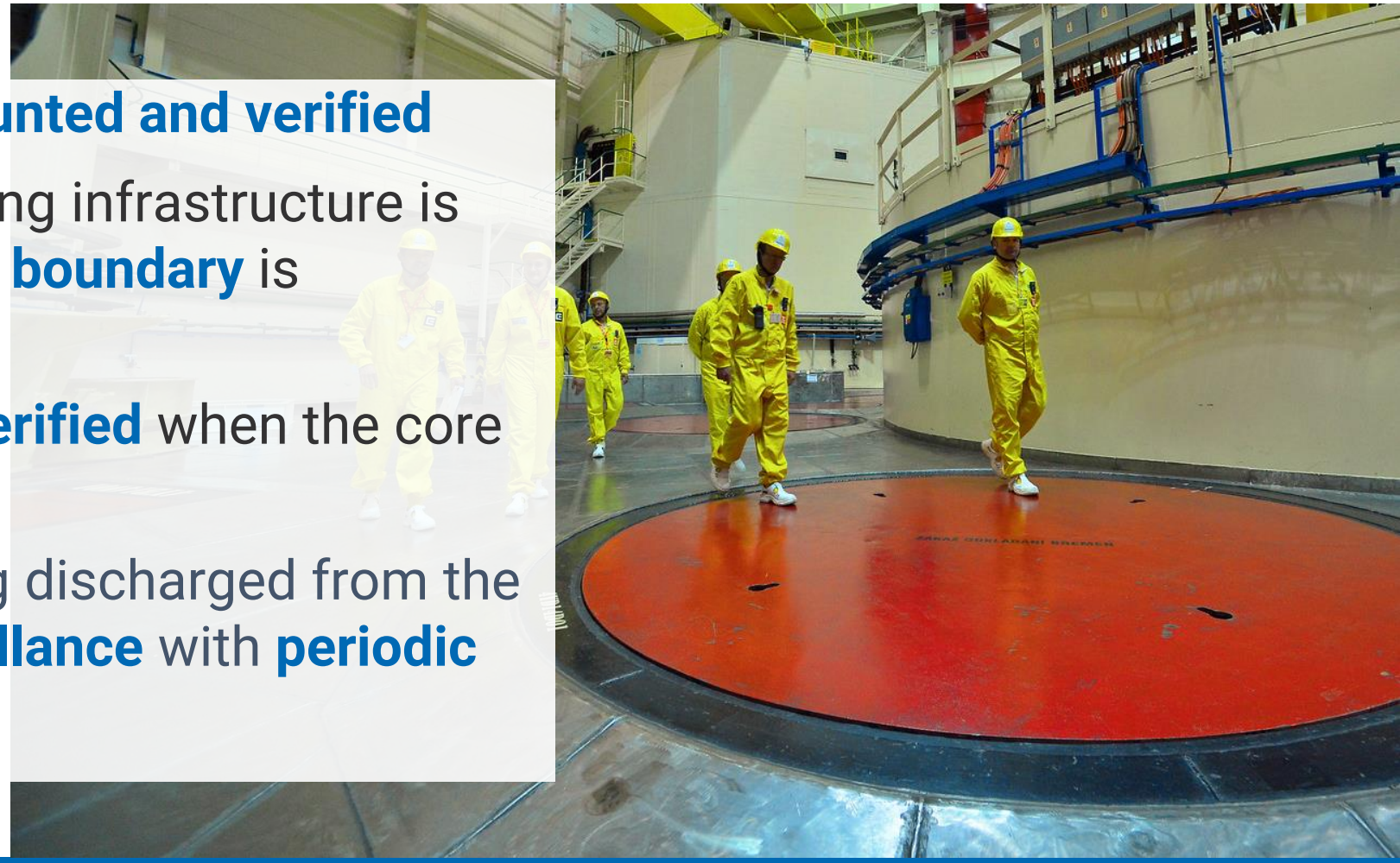


- ✓ **Design information** is routinely verified (DIV)
- ✓ **Physical Inventory Verification** (PIV) is performed on an annual basis
- ✓ **Interim inspections** to verify nuclear material or examine remote data transmission infrastructure may be performed
- ✓ **Complementary access** may be performed in States with an Additional Protocol

SG visits depend on the SG agreement in place and the State-level Approach

Typical Nuclear Reactor Safeguards Activities

- ✓ Fresh fuel assemblies are **counted and verified**
- ✓ The reactor core or surrounding infrastructure is **surveilled** and a **containment boundary** is established
- ✓ Core fuel **assembly IDs are verified** when the core is open
- ✓ Spent fuel is **verified** on being discharged from the core **and placed under surveillance** with **periodic reverification.**



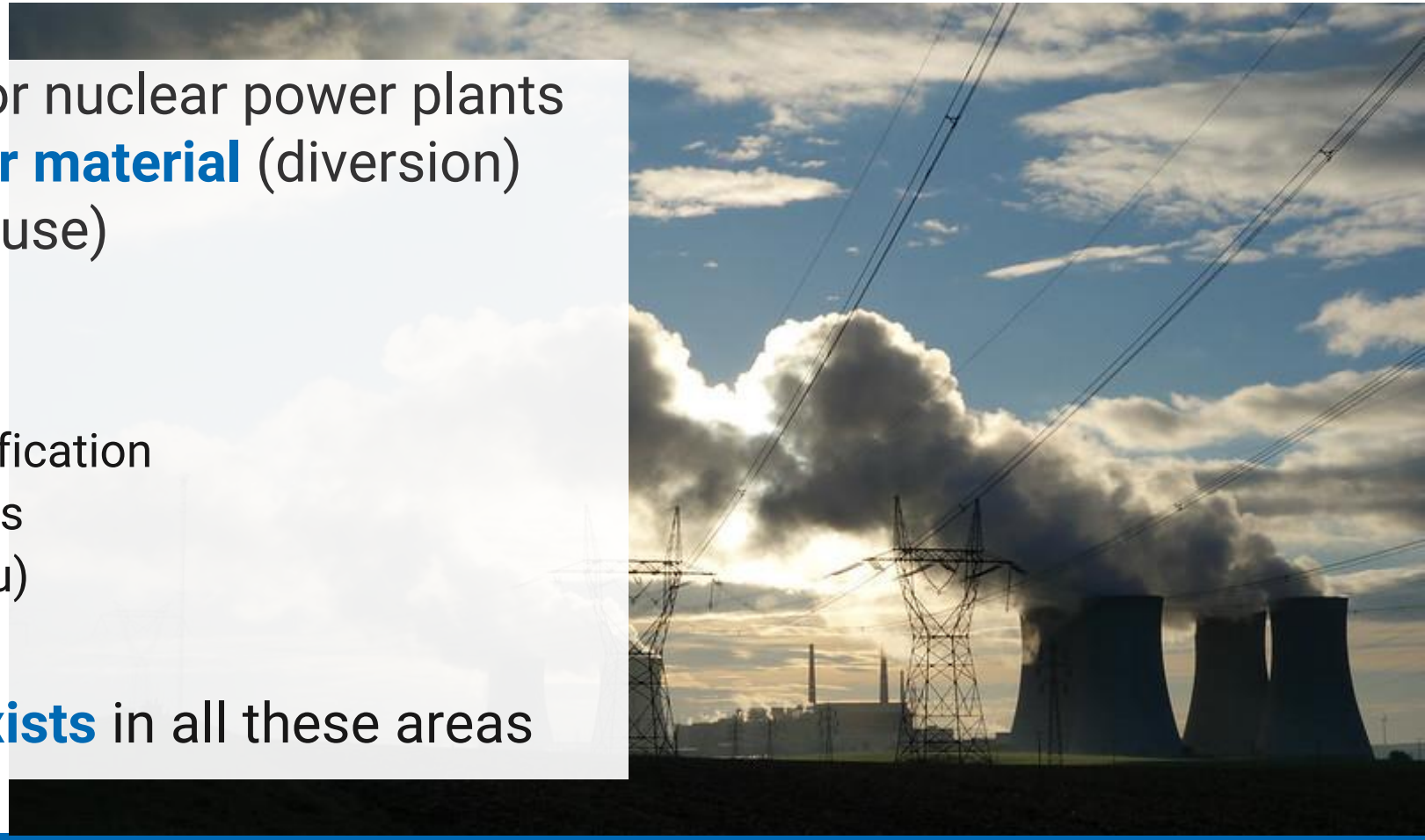
Safeguards and Fast Reactors

- Any time a new facility is built, a **facility-specific safeguards approach** is developed
- The safeguards approach will contain detailed **material flow** information, **diversion and misuse assessments**, and safeguards **measures and activities** to be applied
- Incorporating aspects of that safeguards approach into the **design of the nuclear facility** at an early stage is mutually beneficial

New facilities will be safeguarded in the most efficient and effective way possible

Safeguards and Fast Reactors

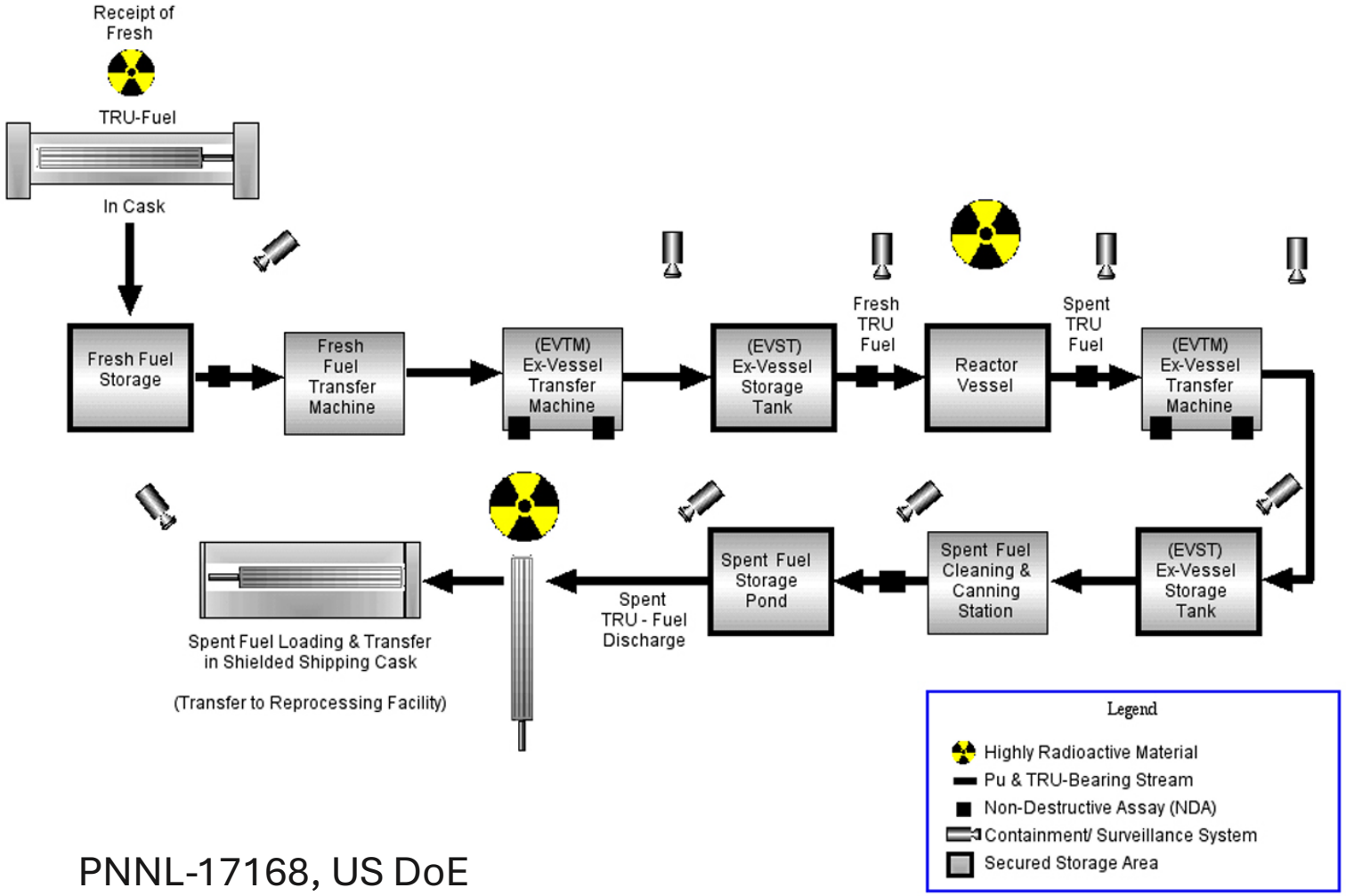
- Safeguards approaches for nuclear power plants are focused on the **nuclear material** (diversion) and the **reactor itself** (misuse)
- Fast reactors
  - Breeding potential
  - Access to spent fuel for verification
  - More complicated fuel cycles
    - Fuel – direct use NM (Pu)
    - Recycling
- **Safeguards experience exists** in all these areas



Safeguards follow the nuclear material

Safeguards and Fast Reactors – an example (Monju)

- **Declared flow** of nuclear material from fresh fuel receipt to spent fuel shipment is **monitored - containment/ surveillance system**
- **Non-destructive assay** to confirm flow
- Potential routes of **undeclared nuclear material** covered by C/S



PNNL-17168, US DoE

Safeguards follow the nuclear material

Safeguards-by-Design

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

Completely **voluntary**, initiated by the vendor

SBD improves the effectiveness and efficiency of safeguards implementation

SBD Resources: Vendor Engagement

- Vendors are encouraged to reach out to the IAEA to engage on SBD
- Engagement is possible through Member State Support Programme (MSSP), or separately
- Current MSSP tasks: Russia, RoK, US, Canada, Finland, France, China, UK, Belgium, Sweden
- Technologies include Floating Nuclear Power Plants, Transportable Nuclear Power Plants, integral PWR, Molten Salt Reactors, Pebble Bed-High Temperature Reactors, microreactors

SBD Resources: IAEA guidance

www.iaea.org/topics/assistance-for-states/safeguards-by-design

Thank you!