



TRINO NPP

Site presentation

Trino, December, 14th 2018

TRINO NPP – Site Location



Security Class:
Internal Use

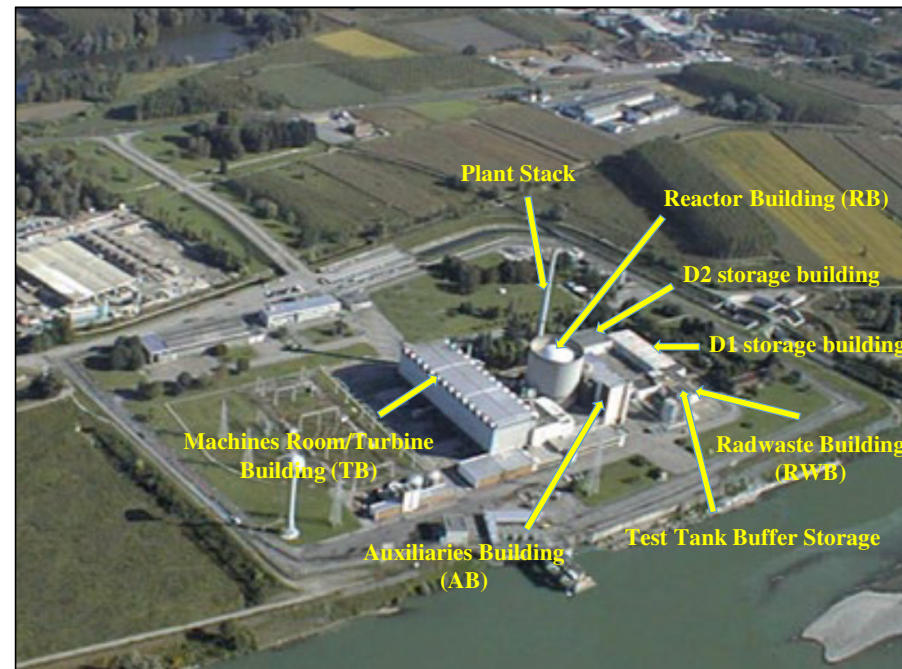
Classes: Public Use, Internal Use, Controlled Use, Restricted Use

TRINO NPP – General Description

1/2
SUGIN

The main buildings and structures composing the Trino NPP are:

- ❖ Reactor Building;
- ❖ Auxiliaries Building (AB) in which the spent fuel pool (SFP) and demineralizers pool (DP) are located;
- ❖ Radwaste Building (RWB);
- ❖ Two temporary storage buildings (D1 and D2);
- ❖ A buffer storage building (Test-Tank);
- ❖ Turbine Building (TB).



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TRINO NPP – General Description

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SUGIN

Trino NPP is equipped with a four loop Pressurised Water Reactor (PWR), designed by Westinghouse and characterized by a gross electric power generated in nominal operating conditions equal to 270 MWe (870 MWt).



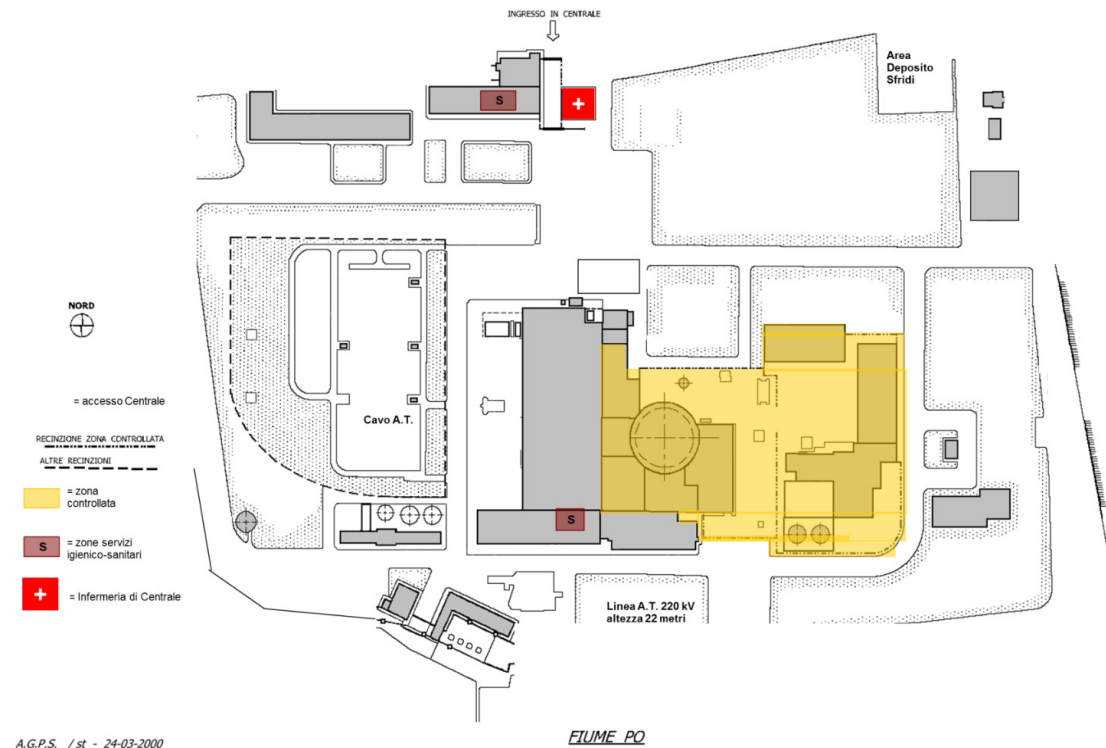
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TRINO NPP – Site layout



Trino NPP site has 1 controlled area (light yellow) for nuclear island + interim radwaste storage + auxiliary systems. The main part of the site is conventional (grey)



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A photograph of the Fukushima Daiichi Nuclear Power Plant. The image shows several large, cylindrical containment domes and a tall, slender cooling tower. The plant is situated near a body of water, with a water tower visible in the foreground on the left. The sky is clear and blue.

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TRINO NPP – History after the Plant Shutdown



- 1986 - CHERNOBYL ACCIDENT
- 1987 - Nuclear Power Referendum
- 1990 - SAFESTORE Resolution
- 1992 - Defueling
- 1995 - License Modification for SAFESTORE activities
- 1995 - SAFESTORE General Plan Issuing
- 1999 - Min. Industry Guideline on DECON
- 2001 - Min. Industry Decree on DECON
- 2001 - Issuing of Decommissioning License application for DECON
- 2003 - Environmental Impact Assessments (EIAs)
- 2008 - Environmental Decree
- 2012 - Decommissioning License Decree (DL) and Decommissioning Plan approval

TRINO NPP – Post operation strategy and activities



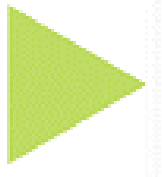
Taking into account the presence of spent fuel on site and the future requirements for decommissioning, post operation strategy aimed at:

- Plant and cost reduction (e.g. removal of non contaminated materials => safety improvement)
- Primary System decontamination => lower dose rates for operators
- Operation radioactive waste management => volume reduction
- Environmental monitoring for clearance => lower environmental impact
- Spent fuel shipment for reprocessing => safety&security procedures
- Plant characterisation improvement and decommissioning design

TRINO NPP – Main Activities carried out before 2012

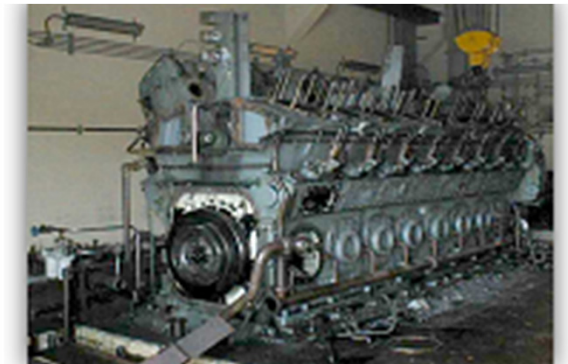
1/5 SOGIN

Cooling Towers Dismantling:



- Steel: 400 t
- Concrete: 2200 m³

Emergency Diesel Generators Dismantling:

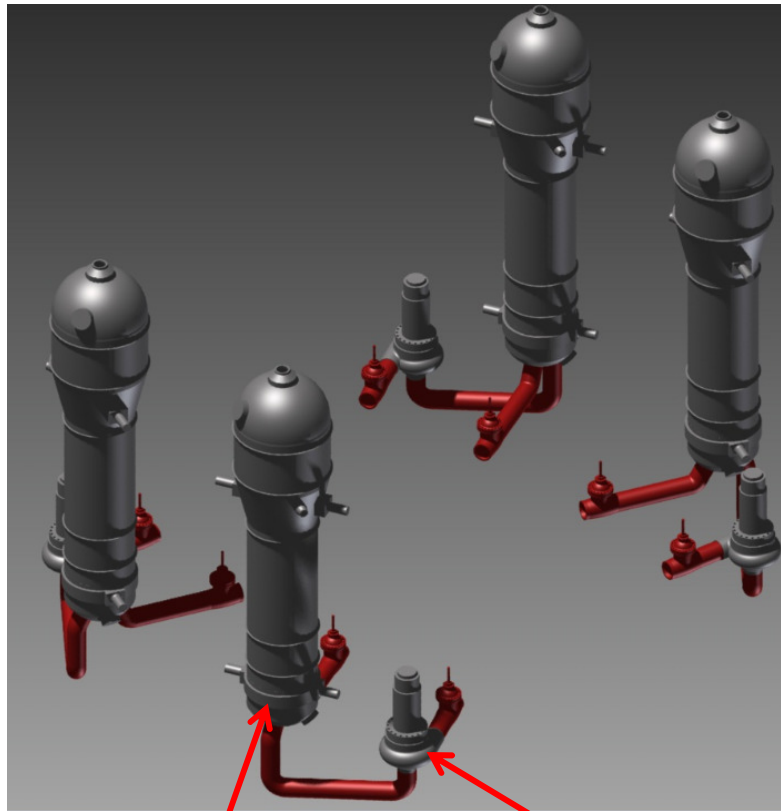


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TRINO NPP – Main Activities carried out before 2012

On-line Chemical Decontamination of the Primary Circuit:



Steam Generator

Main pump

- Steam generators: 4
- U tubes/steam generator: 1662
- Total contaminated surface: 5220 m²
- Decontamination cycles: 16
- Activity removed: $\approx 7\text{E}+11$ Bq
- Waste: 15 m³ ion-exchange resins
- Decontamination Factor (DF): ≈ 100
- Dose saving: about 3 man*Sv

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TRINO NPP – Main Activities carried out before 2012

Dam Dismantling:



Thermal Cycle (secondary circuit) Dismantling:



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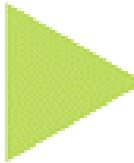
TRINO NPP – Main Activities carried out before 2012

4/5
SOGIN

Water Intake System Dismantling:



Hazardous Waste/Asbestos removal and monitoring for clearance:



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TRINO NPP – Main Activities carried out before 2012

5/5
SOGIN

Components removal and demolition works inside the Radwaste Building:



Components removed and areas cleared to install the WOX facility for contaminated resin treatment

Removal of not-contaminated materials from the Controlled Area:



Removed material:

- 200 t Iron
- 50 t S-Steel
- 20 t Copper
- 10 t Aluminium

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TRINO NPP – Decommissioning Strategy



The Decommissioning License obtained in 2012 has approved a strategy based on the following main phases (described in the Plan of Operations, part of the Decommissioning License Request documentation):



- a) Dismantling Phase (until June 2031); -> **INTERIM STATE**
- b) Management and operation phase of the on-site temporary storage buildings (from January 2021 to June 2032);
- c) Site restoration and release from regulatory control (from July 2032 to January 2036) -> **GREEN FIELD**

TRINO NPP – Main Constraints and Requirements

The main constraints and requirements driving the Trino NPP decommissioning activities could be summarized with those contained within the:

- Legislative Decree No. 230/1995, and its subsequent amendments and additions, mainly concerning the **radiation protection and nuclear safety** issues
- Legislative Decree No. 152/2006, and its subsequent amendments and additions, concerning the legislation for **environment protection**
- National regulations concerning **health and safety for workers** in workplace (in particular Law No. 81/2008 and its subsequent amendments and additions)
- Requirements of the **Environmental Impact Assessment** procedure (Environmental Compatibility Decree, issued by MATTM in December 2008)
- Trino NPP **Decommissioning License** issued in August 2012 (with its technical and management requirements)

TRINO NPP – Technical and Managerial Requirements in the Decommissioning License



The main requirements are:

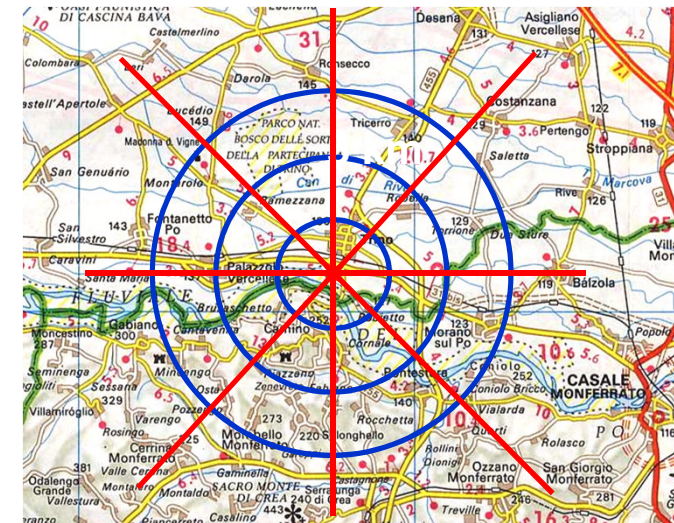
- **The nuclear island dismantling can start only after the removal of the spent fuel from the plant and the availability of on-site temporary storage buildings for radwaste waiting for their transportation to the National Repository;**
- The activities relevant for nuclear safety and radiation protection should be described in **specific reports** (named “PdD - Progetti di Decommissioning”), to be submitted for **approval by the Safety Authority** (ISIN, former ISPRA);
- All the operational decommissioning phases, connected to the dismantling of parts of the plant and the management of materials and waste, must be conducted on the basis of **Operational Plans**, to be transmitted with adequate notice to ISIN in order to allow identification of those subjects needing approval before their implementation

TRINO NPP – Environmental impact of decommissioning



The environmental impact of decommissioning is expected to be very limited:

- **Less than 10 $\mu\text{Sv}/\text{year}$** for the reference groups of population;
- Additional sampling points and matrices implemented in the existing radiological grid;
- From the conventional point of view, a detailed *ante operam* analysis has been performed in order to monitor the evolution of the main environmental during decommissioning



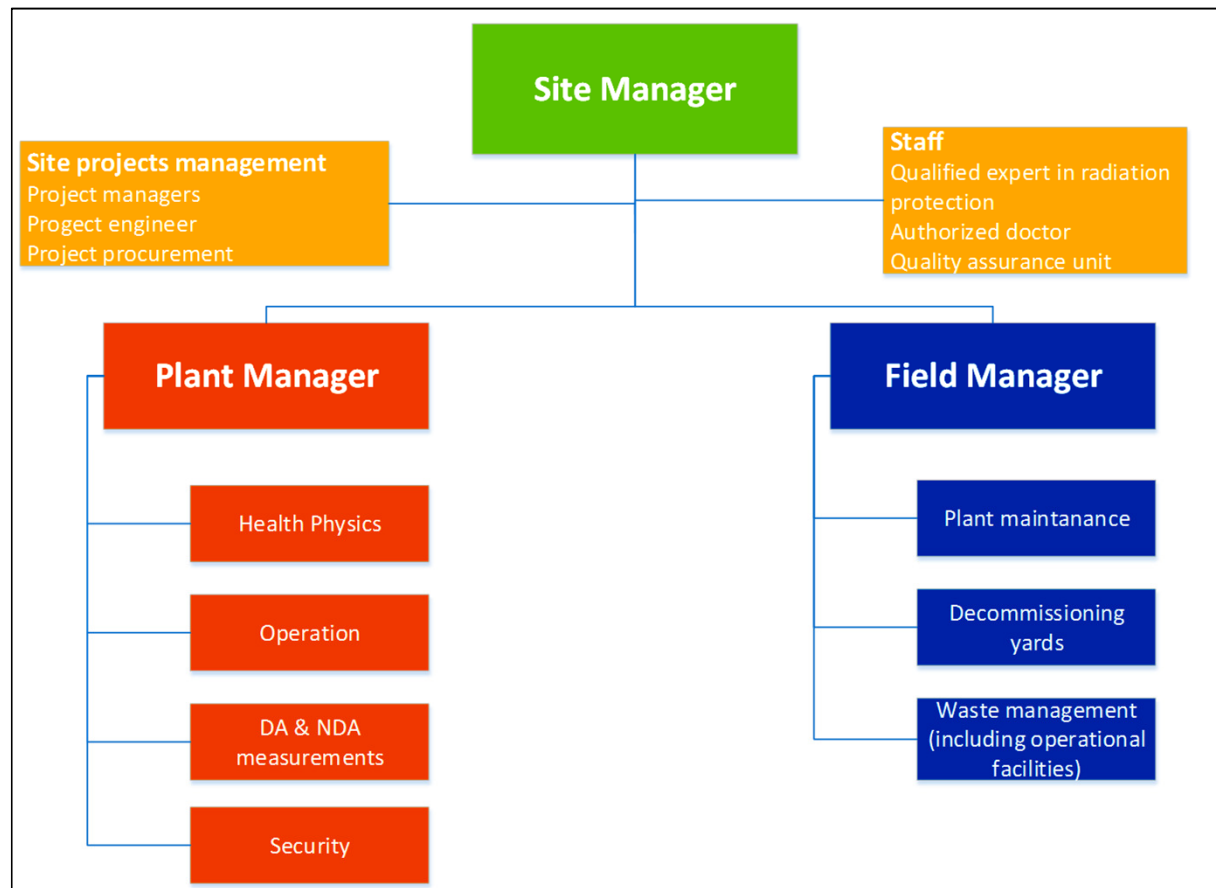
TRINO NPP – Organisation, projects and activities for decommissioning



In order to follow the strategy and to comply with the constraints and technical and managerial requirements driving the Trino NPP decommissioning, several projects/activities have been completed or are currently on going:

- Treatment of historical and operational waste (on going)
- **Spent fuel shipment for reprocessing (completed)**
- Availability of on-site suitable storage buildings for radwaste and suitable treatment & conditioning facilities & liquid radwaste system (on going)
- Availability of monitor release facility for material clearance **(completed)**
- Preparatory activities for nuclear island dismantling (on going)

TRINO NPP – Site Organization for decommissioning



TRINO NPP site organisation is compliant with IAEA recommendations for decommissioning

Security Class:
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Classes: Public Use, Internal Use, Controlled Use, Restricted Use

TRINO NPP – Main Activities for decommissioning

Treatment of Historical and Operational Waste (2012 – 2018):

- Radwaste sorting;
- Filling in new drums;
- Supercompaction and filling in overpacks;
- Shell and shielding clearance



Drums treated	3235
Drums obtained	892
Initial volume (m ³)	850
Final volume (m ³)	339
Volume reduction achieved	60%

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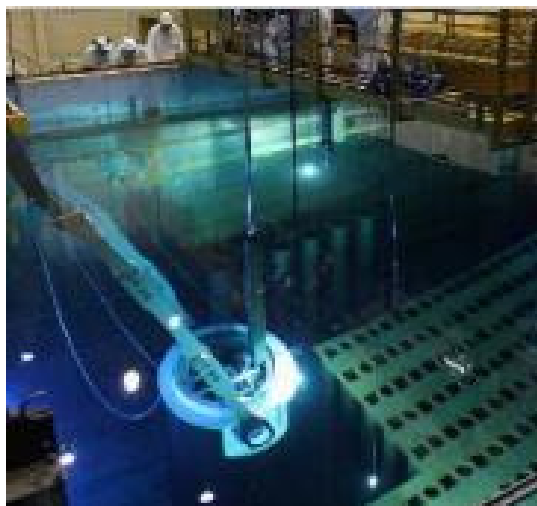
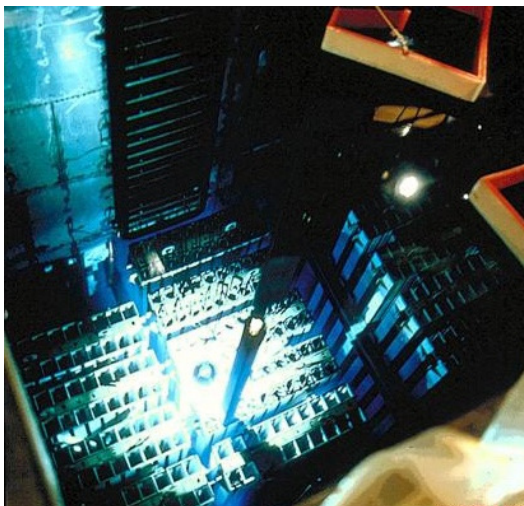
Classes: Public Use, Internal Use, Controlled Use, Restricted Use

TRINO NPP – Main Activities for decommissioning

2/4 SOGIN

Spent fuel removal (2015):

- 47 spent fuel elements for 14.5 tonn UO_2 ;
- Intermodal shipping (roadway + railway);
- On site activities fully performed by Trino NPP personnel



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The Monitoring Release Facility (MRF)

- Is in operation and allows the final radiological characterisation of the potentially releasable materials coming from safe-keeping and decommissioning activities.
- Multi-detector instrumentation measures the residual gamma-activity and evaluates the alfa+beta contribution by suitable scaling factors sets.
- Materials can be released without any radiological constraint and removed from the plant if radioactivity levels are lower than those indicated in the Decommissioning License Decree.



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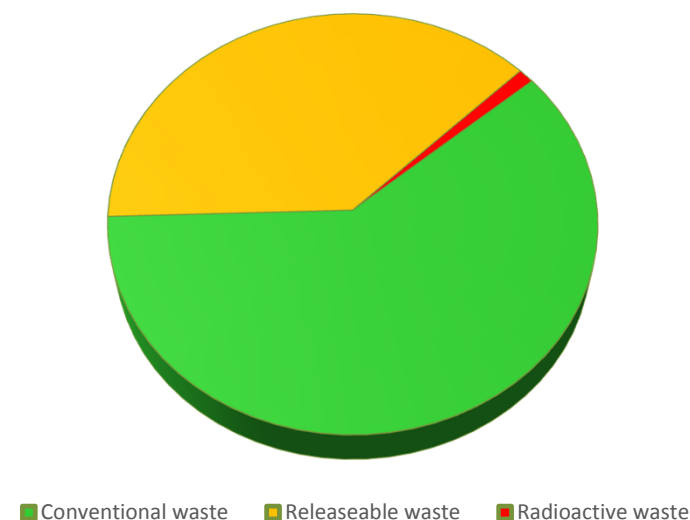
TRINO NPP – Waste production from decommissioning



Waste management and Monitoring Release Facility (MRF)

- Waste from decommissioning activities are expected to be 214.000 t;
- Only **2.000 tonnes** are expected to be **radioactive waste** to be shipped to National Radwaste Repository;
- waste: 100% through MRF; Releasable
- Conventional waste: $\geq 10\%$ through MRF

Total waste amount from decommissioning
214 000 t



TRINO NPP – Main Future Facilities

Decommissioning License requires the **availability** of **storage buildings**, **treatment and conditioning facilities** and of a **suitable radwaste system** to manage waste and liquid effluents before starting decommissioning activities:

On-site Temporary Storage Buildings:



**Test-Tank
Buffer Storage Building
(in operation)**

**D2
Storage Building**

**D1
Storage Building**

Main Treatment and Conditioning Facilities:

**Alternative
Radwaste System
(ARWS)**

**Waste Management
Facility
(WMF/SGM)**

**Cementing Station
(CS/SC)**

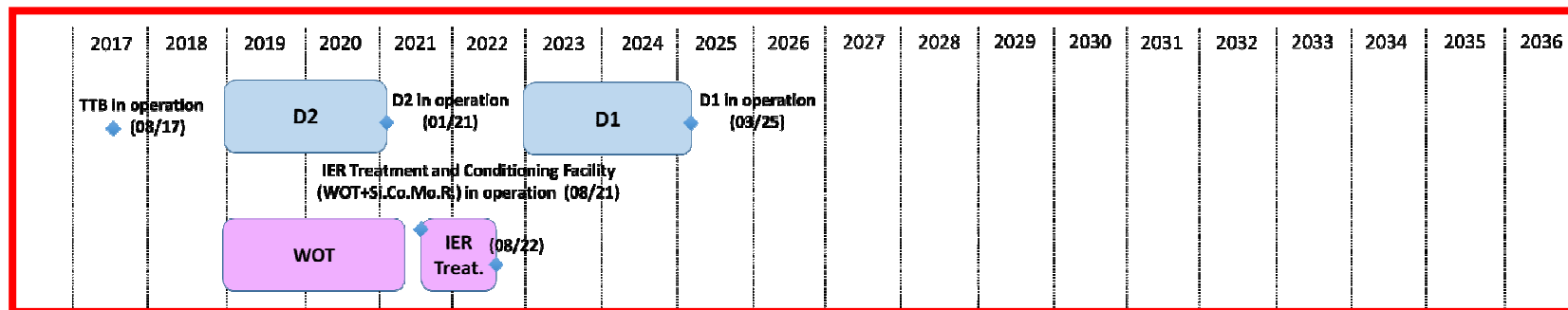
**Resins Treatment
and Conditioning
Facilities
WOT +
Si.Co.Mo.R.**

TRINO NPP – Temporary Storage Buildings



The following main phases are expected:

1. **D2 storage building refurbishment:** waste will be transferred into the **Test-Tank** buffer storage building (already refurbished and provided with its operation license);
2. Waste back to D2 storage building;
3. **D1 storage building refurbishment:** the exhausted resins will be treated and conditioned and other radioactive waste will be transferred partly into the **Test Tank** building and partly into D2 storage building;
4. Waste back to D1 storage building.



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TRINO NPP – Main Activities for decommissioning

3/4 SOGIN

Test-Tank building Refurbishment completed and interim storage in operation



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TRINO NPP – Main Future Facilities

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Buffer Storage Building**
(in operation)

**D2
Storage Building**

**D1
Storage Building**

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**Alternative Radwaste
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**Waste Management
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**Cementing Station
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**Resins Treatment and
Conditioning
Facilities
WOT + Si.Co.Mo.R.**

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TRINO NPP – Treatment and Conditioning Facilities



Alternative Radwaste System – ARWS:

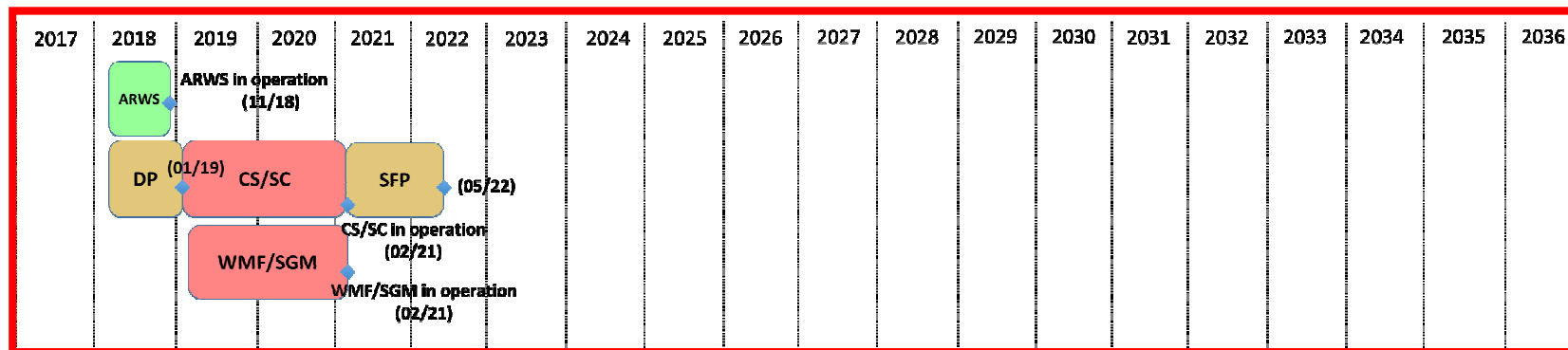
It will be based on the evaporation of the aqueous phase of the liquid effluents and concentration of the solid residue that will be properly cemented.

Waste Management Facility – WMF/SGM:

A specific facility will be used for sorting, treating (volume reduction and decontamination), radiological characterization and packaging operations, in particular of materials arising from the decommissioning activities.

Cementing Station – CS/SC:

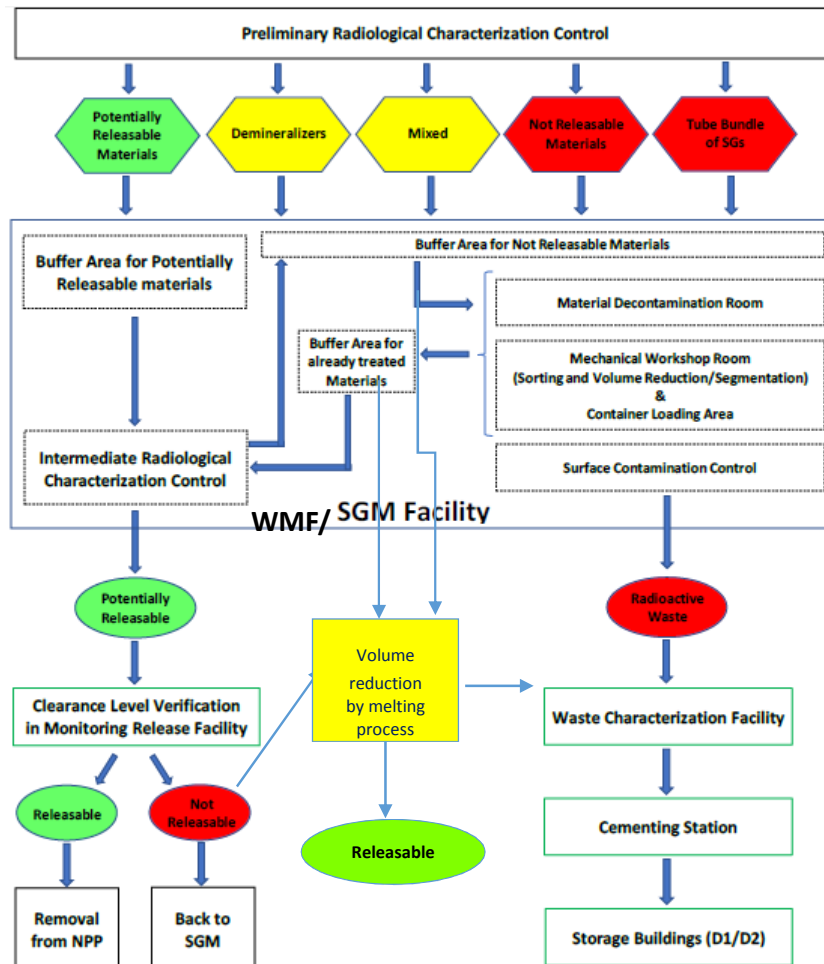
Dry solid radioactive waste will be immobilized in standard containers by means of heterogeneous cementation (grouting) and qualified mortars.



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TRINO NPP – Materials and Waste Management Strategy



- **Preliminary Characterization**
- **Intermediate Characterization (WMF/SGM)**
- **Treatment processes:**
 - Volume reduction at Nucleco facility and/or in the Waste Management Facility (supercompaction, segmentation, disassembling, etc.);
 - Decontamination processes.
- **Final Characterization:**
 - Waste Characterization Facility;
 - Monitoring Release Facility.
- **Packaging in specific final containers:**
 - LLW (Prismatic or Cylindrical containers);
 - ILW (Cylindrical and Special Shielding containers).
- **Conditioning processes:**
 - Grouting;
 - Solidification in cementitious matrix.
- **On-site Storage**, waiting for the transport to the National Repository **or release and removal from the plant.**

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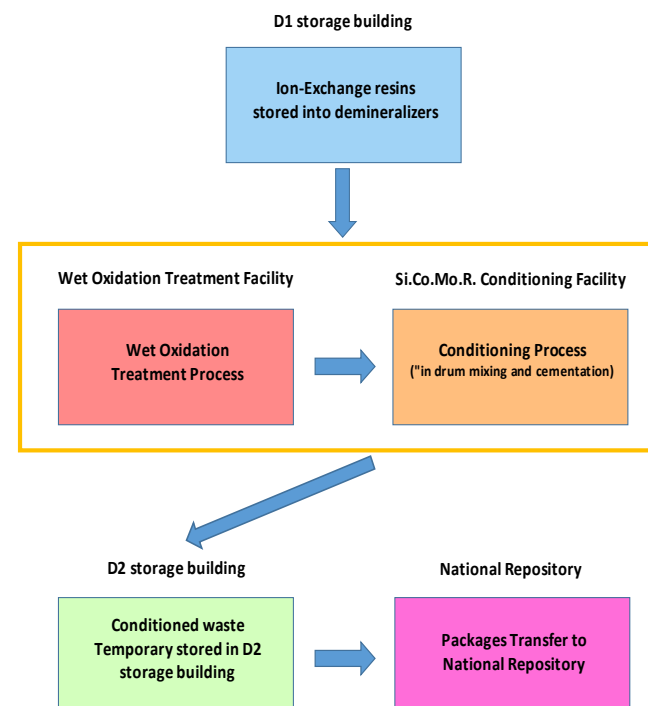
TRINO NPP – IE Resins treatment and conditioning



Standard cementation recipes have been proved to be **ineffective** for treatment and conditioning of ion-exchange resins, characterized by a **significant boron content**.

For this reason, the application of the **Wet Oxidation Technology (WOT)**, has been established.

The **residues** will be **conditioned** by means of «**Si.Co.Mo.R.**» facility that will perform an in-drum mixing and cementation process in cylindrical containers (CC-440 type).



Security Class:

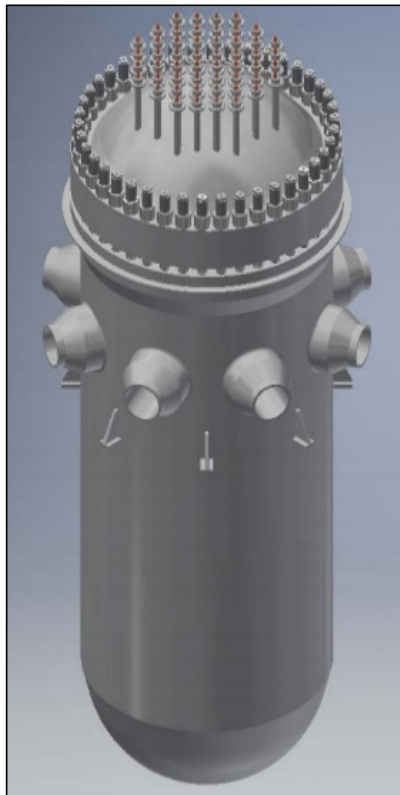
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TRINO NPP – Preparatory activities for nuclear island dismantling



➤ Reactor Pressure Vessel (RPV) and Internals (RVI) dismantling:

The new company strategy aims at anticipating activities concerning the reactor pressure vessel and its internal structures.



Currently the dismantling of Vessel and its Internals is expected to take place in **three phases**:

- Phase 0/1 (currently on-going):
 - Preparatory activities (revamping of the auxiliary systems in order to flood the reactor cavity and to open the vessel, segregation of the Vessel from primary system, maintenance of the crane, systems integrity restoration, etc.);
 - Vessel Opening, Upper Package removal, dummies removal and transfer to the Spent Fuel Pool (SFP);
 - Characterization and removal of the Barrel, Vessel characterization and Barrel repositioning within the Vessel.

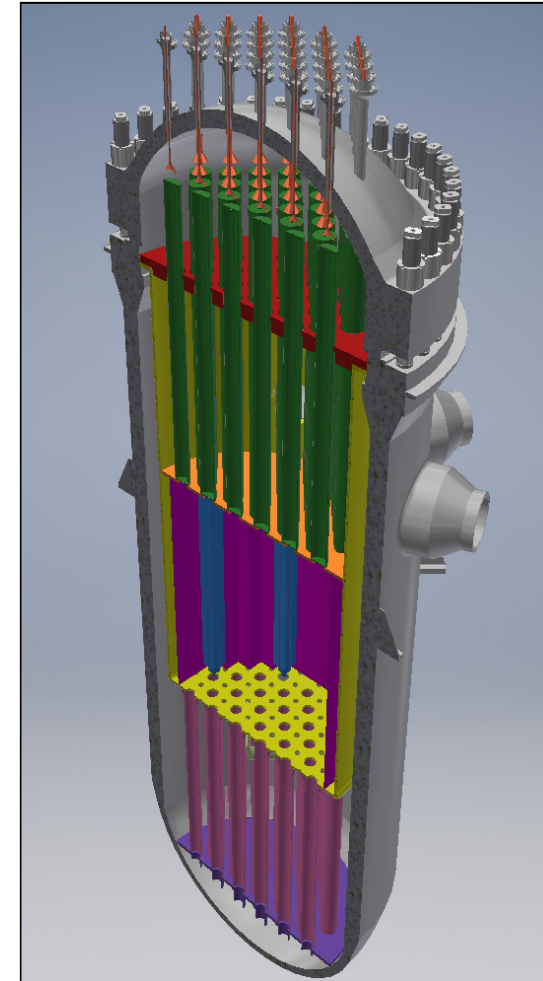
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TRINO NPP – Reactor Pressure Vessel Dismantling



- Phase 2 (design phase to be started):
 - Vessel head dismantling (removal of CRDM and head segmentation);
 - Upper Package dismantling and removal from the Reactor Building.
- Phase 3 (design phase to be started):
 - Barrel dismantling (segmentation and packaging) to be performed underwater;
 - Vessel dismantling (segmentation and packaging) to be performed underwater or in dry environment depending on the outcomes of the characterization campaign (Phase 1).



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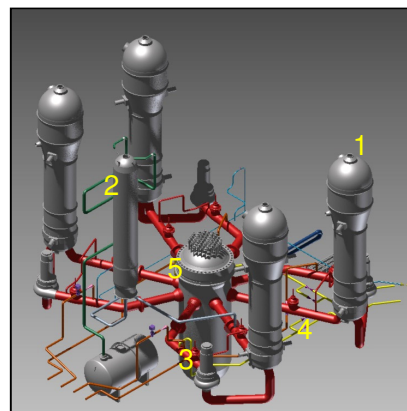
TRINO NPP – Nuclear Island Dismantling



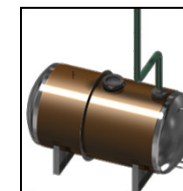
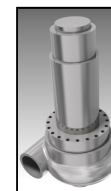
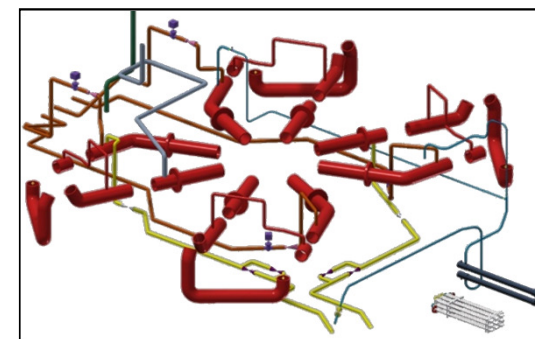
➤ Primary Circuit and Auxiliary Systems Dismantling (work in progress):

The contract for the executive design and execution of activities has to be assigned to an external contractor.

The project is currently under review in order to be compliant with the new company strategy aiming at anticipating activities concerning the reactor pressure vessel and its internal structures



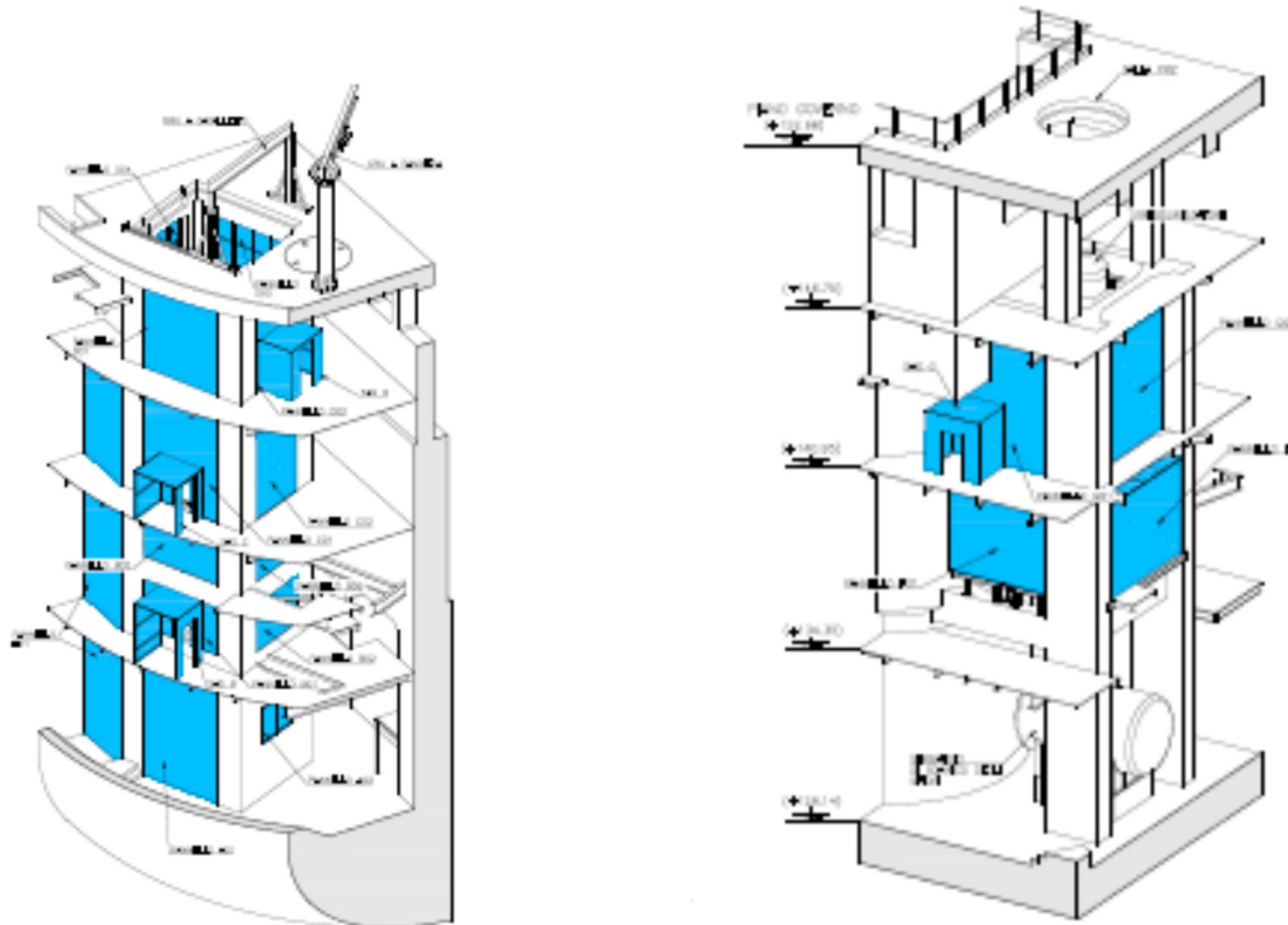
- 1 : Steam Generator
- 2 : Pressurizer
- 3 : Circulating pump
- 4 : Piping and valves
- 5 : RPV



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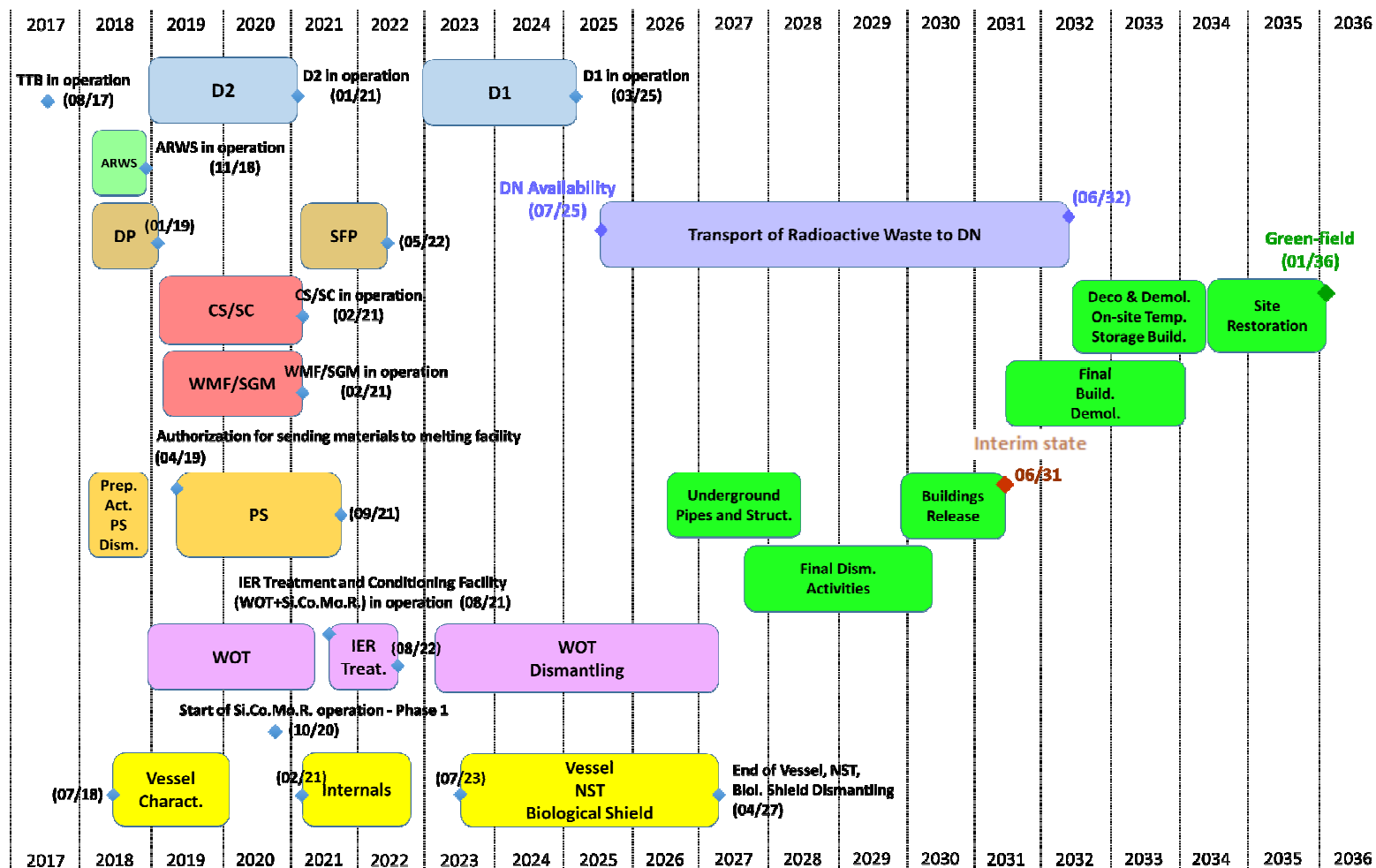
TRINO NPP – Steam generator and Pressurizer Dismantling



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TRINO NPP – Main future activities

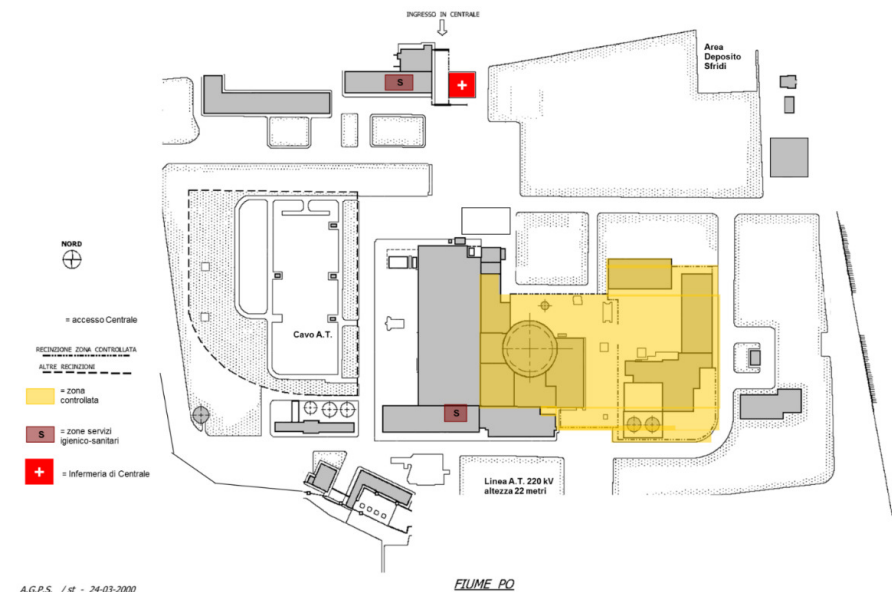


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TRINO NPP – Nuclear Plant tour

- Controlled Area entrance procedures
- Visit of Radwaste Interim storage 2
- Radwaste Interim storage Test Tank
- Reactor Container Building
- Reactor cavity and vessel
- Controlled Area exit procedures



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TRINO NPP – Radiation protection rules for the nuclear plant tour



- Personal dosimetry and personal protective equipment
- Please do not touch anything
- No smoking/eating/drinking
- Radioprotection controls at controlled area exit
- In case of emergency, a supervisor will guide you



We protect the present
We guarantee the future