8th edition of the International Summer School on Nuclear Decommissioning and Waste Management

NPP ENRICO FERMI – TRINO (VC)
LIFE CYCLE OF NUCLEAR PLANT

- Design, construction & commissioning
- Operation
- Decommissioning & Environment Reclamation
SOGIN DECOMMISSIONING

- **Centrale di Trino (VC)**
- **Centrale di Caorso (PC)**
- **Centrale di Latina (LT)**
- **Centrale di Garigliano (CE)**
ENRICO FERMI NPP – TRINO (VC)
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**TECHNICAL DATA**

- **Reactor type**: PWR
- **Thermal power**: 870 MW
- **Gross electric power**: 272 MW
- **Efficiency**: 31%
- **Primary pressure**: 140.6 kg/cm²
- **Average temperature**: 272 °C
- **N° of fuel assemblies**: 112 (UO₂)
- **Uranium inventory**: 34500 kg
- **N° of control rods**: 28
- **Total fuel cycles**: 9
- **Cycle average length**: 12000 h
- **Total thermal energy**: 80845 GWh
- **Total electric power**: 25028 GWh
OPERATIONAL DATA

- Site preparation: January 1961
- First reactor criticality: 21 June 1964
- 1st generator grid connection: 22 October 1964
- Commercial operation start: 1 January 1965
- 2nd generator grid connection: 20 July 1965
- Full power longest period: 322 days (W.R.)
- Plant final shut down: 21 March 1987
HISTORY OF THE AFTER SHUTDOWN

- 1986 - CHERNOBYL ACCIDENT
- 1987 - Nuclear Power Referendum
- 1990 - SAFESTORE Resolution
- 1992 - Defueling
- 1995 - Licence Modification for SAFESTORE activities
- 1995 - SAFESTORE General Plan Issuing
- 1999 - Min. Industry Guideline on DECON
- 2001 - Min. Industry Decree on DECON
- 2001 - Production of Licence Application for DECON
- 2003 - Environmental Impact Assessments (EIAs)
- 2008 - Environmental Decree
- 2012 - Decommissioning Licence Decree
DECOMMISSIONING OF THE NPP

- Plant and cost reduction and Decommissioning design
- Spent fuel shipment to reprocessing
- Decontamination and dismantling of system
- Radioactive waste management
- Radioactive waste conferment to National Repository
- Environment monitoring for clearance

THE SITE WILL BE RELEASED WITHOUT RADIOLOGICAL RESTRICTION
Plant and cost reduction
MAIN ACTIVITIES CONCLUDED - 1

Cooling tower dismantling

Dam dismantling
MAIN ACTIVITIES CONCLUDED - 2

Row water supply dismantling

Removal of asbestos from thermal cycle
MAIN ACTIVITIES CONCLUDED – 3

Emergency electric supply dismantling

Thermal cycle dismantling
SPENT FUEL SHIPPING

- The shipment of the spent fuel to the reprocessing plant of La Hague was completed in September of 2015.
- 39 UO₂ fuel elements
- 8 Mox Elements
- Total weight 14.5 t
- 4 casks
- 2 multimodal shipments
Decommissioning activities concluded
Decontamination of primary circuit

**Relevant data:**
- Number Steam generator = 4
- Number U tube for each steam generator = 1.662
- Total contaminated surface = 5.220 m²

**Target:**
- Reduction of occupational dose for the operator for asbestos removal and dismantling of steam generator

**Results:**
- Decontamination factor: 100
- Waste produced 8ionic exchange resin): ~ 20 m³
- Liquid waste (released): ~ 240 m³
- Dose saving for the operator: > 3 man·Sv
Removal and clearance monitoring of contaminated asbestos in classified area

The removal of asbestos from system of classified area, and more in general dangerous material as ceramic insulator, produced about 400 m$^3$ of radioactive waste. After monitoring for clearance 110 m$^3$ were released as conventional waste. The radioactive waste were supercompattted and the final volume now is 115 m$^3$ (401 380l overdrums).
DECOMMISSIONING ACTIVITIES CONCLUDED - 3

Reactor ventilation was updated to the requirement of the decommissioning. The old ventilation was designed for operational parameters and then overstaffed for the current necessity.
DECOMMISSIONING ACTIVITIES CONCLUDED - 4

Removal and clearance monitoring of not contaminated material in classified area

Scrap produced
- 200 t Iron
- 50 t Stainless steel
- 20 t Copper
- 10 t Aluminium
Monitoring release facility for free release

The monitoring of the material for free release is done in three different steps:

- Preliminary step consists in limited sampling of the areas to allow the prevision of the waste production or releasable material;
- Intermediate step consists in radiochemical analyses on samples to determine the scaling factors and measurements on the 100% of the material. In this phase the separation between radioactive and releasable material is realised.
- Final step consists in the monitoring of a statistical quantity of the material wrapped in big bags or 1m³ box to certificate the free release to the authorized rubbish with a box counter.

To avoid problems with disposal site, each truck transits between a great surface detector.
Work in progress
WASTE PRODUCTION

All activities will produce about 214,000 t of materials

130,000 t will be conventional waste without radiological restriction

82,000 t of material will be released after radiological monitoring for clearance

Only 2,000 t will be radioactive waste
Waste produced reclassification

Waste produced during operations and re-classified after 31/12/2015, according to IAEA categorisation and after re-treatment (quantities m$^3$).

- 3$^{rd}$ Cat. GT 26: 54 m$^3$
- 2$^{nd}$ Cat. Tab.1 GT 26: 873 m$^3$
- 2$^{nd}$ Cat. Tab.2 GT 26: 1876 m$^3$
- Low activity to disposal to National Repository: 1450 m$^3$
- Very low activity to release after short time of decay: 475 m$^3$
WORK IN PROGRESS - 2

Waste re-treatment

Purpose

- Volume reduction and optimisation
- Sorting of material
- Radiological, chemical and physics characterisation
- Free release of decayed Waste

Waste re-treatment
Vessel head asbestos removal

This is a preparatory activity for dismantling the primary system and to design the vessel sequence of dismantling.
Reconstruction of the test tank

Test tank will be updated to temporary waste buffer to allow the update of the existing repository.
Future activities
FUTURE ACTIVITIES - 1

Temporary repository update

Temporary repository n. 2
FUTURE ACTIVITIES - 2

Support facilities

The supporting facilities are:

- waste management facility;
- grouting facility;
- waste monitoring facility
- sleepe facility;
- Liquid waste treatment system;
FUTURE ACTIVITIES - 3

Primary system dismantling

The components to dismantle are:

- steam generators;
- pressurizer;
- relief surge tank
- main coolant pumps;
- loops;
- auxiliary system;
Vessel dismantling

The vessel is composed of:

- All the actHead
- Internals
- Reactor container

activities will be performed under water to limitate doses to the operators.

All the waste produced will be of activated material classified as medium activities waste.
FUTURE ACTIVITIES - 5

Pool dismantling

There are three pools that will be decontaminated and dismantle:

- Reactor cavity
- Spent fuel pit
- Purifier pool
Wet oxidation

- The exhausted resins storaged into D1 are the most important radiological waste into the Trino Nuclear Power Plant.

- After a strong analysis of the several treatments alternatives, Sogin will use the WOX Treatment to concentrate the radiological waste and reduce the resine’s volume in order to transfer the «concentrate waste» to SiCoMor Plant for the final cementation.

- WOX Treatment is used for conventional waste, Sogin and «Ansaldo Nucleare» improved the WOX technology for the radiological waste. WOX Treatment is the best solution for the Trino resines composition.

- The final result of the WOX-SiCoMoR treatment will be 300 Overpack (440l)
Environment impact
Environmental impact of decommissioning is expected to be very limited:

- From the radiological point of view, the impact on reference groups of population is $<< 10$ microSv/year
- The existing radiological control grid has been recently implemented with additional points of sampling and new environmental matrices
- From the conventional point of view, a detailed ante operam characterisation of the Site has been performed in order to monitor the evolution of the main environmental variables
Emergency

The External Emergency Plan takes into account all the possible accidents and foresees trained personnel in order to measure, evaluate and mitigate the consequences of the possible accidents.

Most critical accident is the fire in the Radwaste interim storage.
All the plant radionuclides are taken into account for free discharge in the air or in the Po river according the following formula:

\[ \sum_{i=1}^{n} \frac{A_i}{A_{i-10 \mu Sv}} < 1 \]

- \( A_i \): Activity of \( i \)-radionuclide to be discharged into the environment;
- \( A_{i-10 \mu Sv} \): Discharged activity of \( i \)-radionuclide entailing 10 \( \mu \)Sv effective dose to the reference groups of population.
Distribution of sampling points around the Site

The whole environment chain has been taken into account.
RETURN TO 1964 – “FORWARD TO THE PAST”
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THANKS FOR YOUR ATTENTION