



European
Commission

Nuclear Decommissioning and Waste Management Programme at the Joint Research Centre, Ispra Site



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Joint
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Centre

D&WM PROGRAMME MISSION

The JRC's Decommissioning and Waste Management Programme is aimed at the progressive elimination of the Centre's Historical Liabilities, i.e. those nuclear R&D facilities and radioactive waste management installations that have no future role in supporting the mission of the JRC. The execution of the Programme will not only protect the environment, public and personnel, but will also enable the JRC to eventually reduce operational costs associated with maintaining its obsolete nuclear plants in a state of safe conservation.

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A story started more than 50 years ago

Birth of the JRC

The EURATOM Treaty, signed in Rome in 1957 by the six EU founding countries (Belgium, France, Germany, Italy, Luxembourg and the Netherlands), created the European Atomic Energy Community (EURATOM). Since its creation, EURATOM supported the establishment and growth of safe nuclear power related industries to contribute to peace, health and prosperity of Europeans citizens. To support this mission, a Joint Research Centre (JRC), with sites located in four Member States, was established to perform top level research, disseminate findings for policy-making and set uniform safe standards.

JRC-Ispra in the 1970's



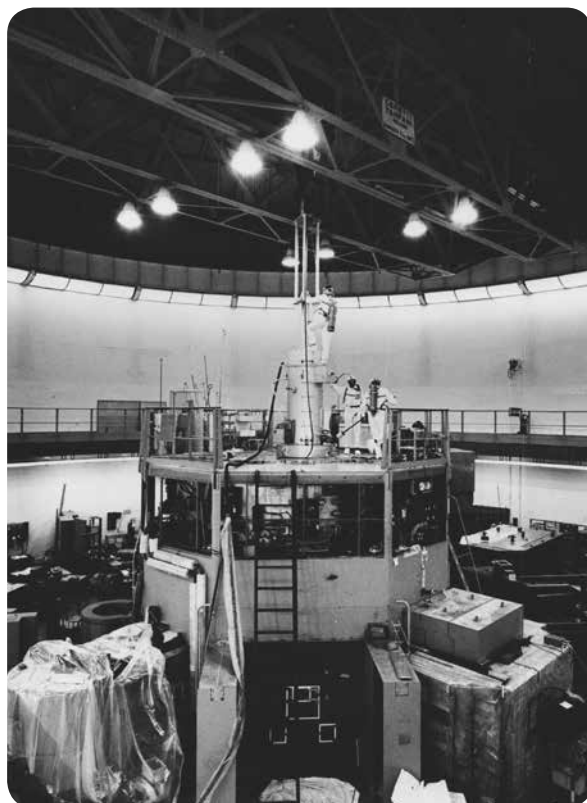
The Ispra nuclear research centre

In 1958 a research centre at Ispra started to be developed. The "Ispra-1" reactor was completed in less than one year.

In March 1959 the reactor started up and in the following month the site was officially inaugurated as a national nuclear research centre by the President of the Italian Republic.

In 1960 Italy ratified the agreement, signed in 1959, to transfer the Ispra Site to EURATOM.

Ispra-1 reactor main hall



From past to present

Development and phase-out of nuclear research

The initial research topics at JRC-Ispira were focused on nuclear reactor and fuel cycle development. As research progressed, a variety of additional experimental facilities, as well as radioactive waste management plant and stores

were completed. The second experimental reactor, ESSOR, whose 80 metres stack is a well-known landmark in the surroundings of the Ispira site, entered its operational phase in 1968. Since the 1980's, the EU Framework Programmes for

research and innovation progressively reduced their focus on nuclear R&D, hence most of the installations on the Ispira site are currently shutdown and in a state of safe conservation.

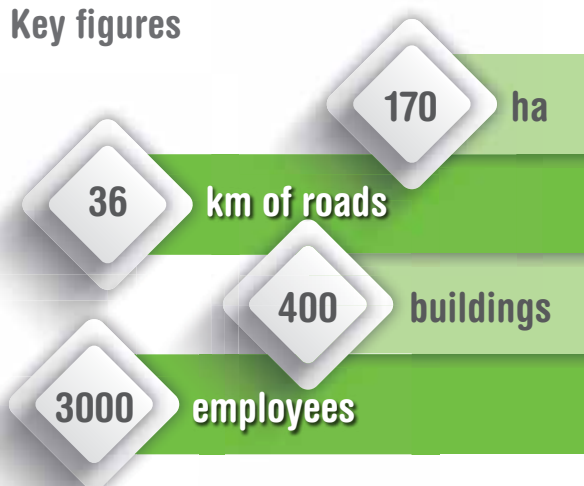
JRC Ispira today

The JRC mission is to provide customer-driven scientific and technical support for the conception, development, implementation and monitoring of EU policies.

The Ispira site today hosts several research activities in the field of environment and sustainability, health and consumer protection, protection and security of the citizens, energy, transport, nuclear safety and security, nuclear decommissioning.

The site Directorate provides services to facilitate the current and future scientific activities of the research institutes, while ensuring that JRC Ispira acts as a good neighbour to the community at large.

Key figures



The JRC Nuclear Decommissioning & Waste Management (D&WM) Programme

The European Commission is committed to protect citizens and the environment from radiological hazards associated with its activities. To this end in 1999, following a Communication to the European Parliament and the Council of the EU, a Decommissioning & Waste Management (D&WM) Programme was started for all its nuclear sites, including JRC-Ispira. To ensure the efficient execution of the Programme, the JRC is supported by a group of independent and impartial nuclear experts.



Visiting the ESSOR reactor

Addressing the JRC nuclear liabilities

Nuclear liabilities at JRC-Ispra

The Ispra site Decommissioning & Waste Management (D&WM) Programme includes the management of radioactive waste and nuclear materials coming from past research activities (so-called “historical liabilities”) as well as the decommissioning of operational nuclear installations and of the waste management infrastructure (so-called “future liabilities”).

DECOMMISSIONING IN BRIEF

Decommissioning entails a stepwise process, starting with the removal of nuclear materials and non-permanent plant items, followed by the dismantling and removal of the remaining radioactive components. Then, after the reduction of any residual radioactivity and the final radiological survey, it ends with the return of the site to a status with no significant radioactive hazard.

According to the International Atomic Energy Agency (IAEA), there are three possible options at the end of the decommissioning process:

1. storage with surveillance
2. restricted site use
3. unrestricted site use
(the so called “*green field*”).

JRC-Ispra policy is to decommission its shutdown nuclear installations up to the “*green field*”.

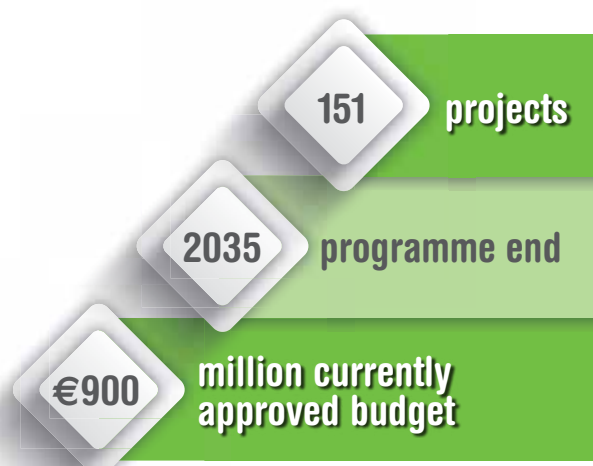
Implementation of the JRC D&WM Programme at Ispra

The implementation of the D&WM Programme is under the sole responsibility of the JRC, as stated by the EURATOM Treaty, and must comply with the national legislation.

Most of the activities are carried out by specialised contractors with internationally recognised expertise in the field.

The highest existing technological standards are applied.

Key figures (April 2019)



The road towards the “green field”

Programme activities

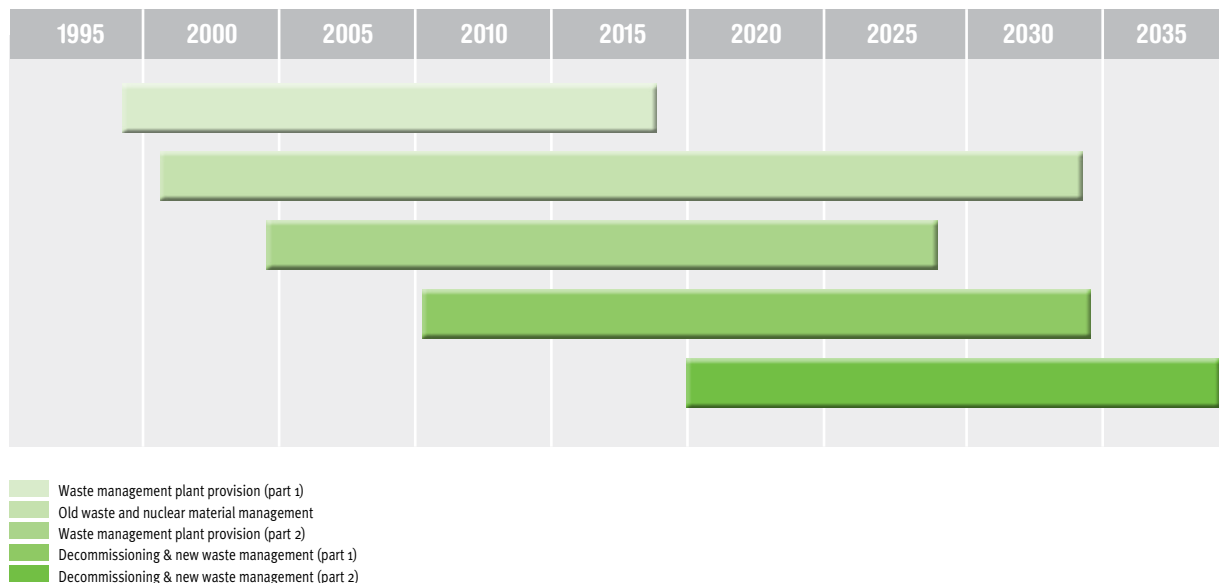
The first stage of the programme focused almost exclusively on waste management issues, with decommissioning work being effectively limited to specific studies and licensing procedures. The existing waste management infrastructure was reinforced and nuclear and special materials were transferred and recycled off-site. The current activities focus on the treatment and

conditioning of the existing waste as well as on the management and removal of the irradiated and residual nuclear materials. The final steps will concern decommissioning of the nuclear installations, the site clean-up and remediation to the “green field” status. The programme is planned to end by 2035, with a total expenditure not exceeding 1B€.

GREEN FIELD

According to an international definition, the *green field* is a condition reached after the decommissioning process where buildings and land are released free of any radiological constraint.

D&WM Programme Evolution



Decommissioning

Nuclear installations in Ispra

All shut down installations on the Ispra site are kept in a state of safe conservation.

Their characterisation has been almost completed and they will be decommissioned up to the “green field”.

After the release of the radiochemical laboratory (RCHL) and the dismantling of the Fuel

Assembly and Release Oven (FARO) facility, the Nuclear Decommissioning Unit plans to proceed with the decommissioning of the hot laboratory (LCSR), the old Liquid Effluents Treatment Station (STRRL) and finally the ESSOR reactor. Other minor installations included in the D&WM

Programme are the ECO building and the Cyclotron laboratory. The decommissioning and dismantling of the Ispra-1 reactor will be the responsibility of the Italian Government, according to an agreement with the European Commission (see page 11).



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ESSOR

The ESSOR Nuclear Island

- Area: 4.5 hectares
- Covered surface: 15 000 square metres
- Volume: 160 000 cubic metres
- Controlled area: 60% of volume

The ESSOR Reactor

- Diameter: 45 metres
- Height: 45 metres
- Thermal power output: 25 megawatts
- Operation start: 1968
- Permanent shutdown: 1983

1 Top view ESSOR reactor

2 Former liquid effluents treatment station

3 Hot cells facility

Key achievements of the D&WM Programme

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JRC-Ispira D&WM Programme
Joint Research Centre, Ispira Site

Key achievements

Several pre-decommissioning and decommissioning activities have been carried out during recent years, including:

- more than 95% of the nuclear materials previously stored at JRC-Ispira have been removed and recycled by third parties abroad;
- decommissioning of the old radiochemistry laboratory (RCHL) was completed in 2010 and the building released from any radiological constraint according to Italian legislation.

The building has been reused to host the JRC Visitors' Centre;

- the fuel Melting test facility (FARO) and the old cementation plant have been completely decommissioned and dismantled in 2014/2015;
- more than 1700 radioactive sources and other hazardous materials including asbestos and alkali metals have been removed from the site and safely disposed or neutralised elsewhere.



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- 1 RCHL Lab. initial status
- 2 RCHL Lab. after removal of equipment and waste
- 3 RCHL Lab. final radiological survey
- 4 JRC Visitors' Center
- 5 A shipment of nuclear material

Key achievements of the D&WM Programme

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TSA project

The TSA (Transit Safe Area) project aims at the safer storage of important quantities of irradiated and nuclear material in a single place, characterized by high safety standards.

As part of this project, nuclear material no longer used for scientific purposes, currently stored into underground pits, was expected to be transferred to TSA, a safer location into a shielded cell. The project reached its peaks in 2017, with the completion of the cold tests, (reproducing the exact conditions of a transfer), the agreement by the Safety national and local authorities, and the completion of the first transfer of six, in December 2017. All remaining transfers have been completed in 2018.

Due to the very sensitive and hazardous nature of the irradiated nuclear material, only the highest quality standards been applied for the design of the whole system, such as:

- the engineering studies, based on ASME nuclear quality standards;
- the construction and refurbishment of the mechanical equipment, able to guarantee remote handling of the hazardous materials and minimising any risk of radiation to the operators;
- transfers of nuclear material itself fulfilling the ADR prescriptions.

Completion of the transfers of nuclear material will allow pursuing the decommissioning programme. Indeed, it represents an important step forward for the whole JRC-Ispra D&WM programme, which was dependent on the authorization by the Italian Safety Authority and the condition to safely recover and store the hazardous nuclear material. This step achieved, JRC-Ispra can start new projects related to the decommissioning and dismantling of nuclear facilities.



Handling of the TSA revolver by telemanipulators in ADECO



Handling of irradiated nuclear material with the shielded transfer container

Key achievements of the D&WM Programme

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JRC-Ispira D&WM Programme
Joint Research Centre, Ispira Site

The decommissioning of Ispra-1 reactor

Ispra-1 reactor, built in the late '50s, is shut down since 1973 and in a state of safe conservation.

On November 2009 a “Settlement Agreement” was signed between the Italian Government, represented by Ministry for Economic Development, and the European Atomic Energy Community, represented by the JRC.

The purpose of the Agreement was to regularize the situation of the historical nuclear liabilities on the Ispra site, by transferring the responsibility for the Ispra-1

reactor decommissioning to the Italian Government and taking over by the European Commission all other remaining liabilities on the site.

On December 29th 2017, thanks to JRC intense and dedicated diplomatic interaction with Italian authorities, the Italian Parliament approved in its budget the handover of Ispra-1 nuclear plant to SOGIN SpA (Società Gestione Impianti Nucleari) by the end of 2018.

On May 08th 2019, the Italian Official Journal published the

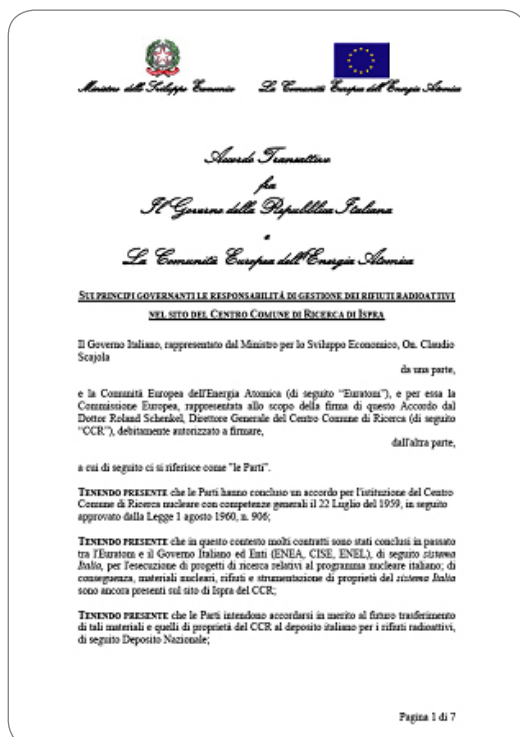
ratification of the Settlement Agreement of 2009 between Italy and the European Commission.

The legislative process is now complete and the Settlement Agreement is now in full force.

This project represents the very first experience of this kind in Europe and can be considered as a “pilot project”, as it has been conducted without reference to similar projects or guidelines.

The outcomes of this activity can be taken as “lesson learned” for future similar projects related to others nuclear facilities.

Settlement agreement between Italian Government and European Commission



The Ispra-1 reactor



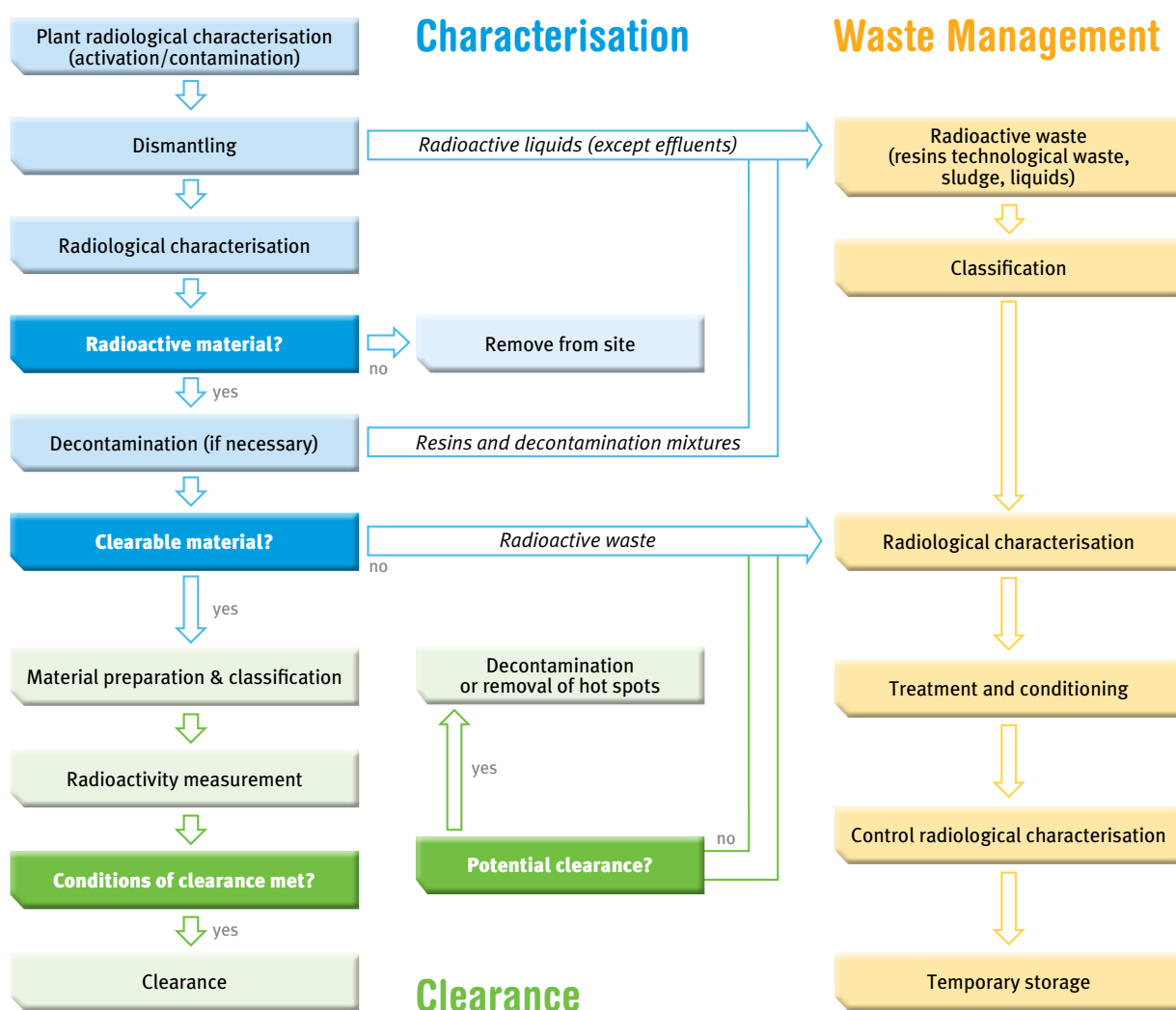
Radioactive waste management

Waste management

Waste management covers all technical and administrative activities involved in the handling, sorting, characterisation, treatment, conditioning, storage, transportation and disposal of radioactive waste from a nuclear installation.

The waste management policy of JRC-Ispra is based on three main pillars:

1. minimise the amount of radioactive materials by recycling them within the industry;
2. maximise the quantity of radioactive waste that can be removed from regulatory control;
3. reduce the volume of remaining radioactive waste for temporary storage on the Ispra site, waiting for transfer to the Italian national repository.



Waste management facilities

Waste management activities require the implementation (including design, construction and commissioning) of facilities for characterisation, (pre-) treatment, conditioning and temporary storage of JRC-Ispra waste. Such facilities are based on proven technologies and are specifically designed for use

by the D&WM Programme. The facilities will be decommissioned and dismantled at the end of the Programme. Wherever considered cost-effective, external waste treatment service providers will be employed to reduce the amount of future liabilities.



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- 1 X-ray digital radiography system
- 2 Waste characterization system
- 3 Abrasive blasting decontamination facility
- 4 Material clearance facility

Radioactive waste storage

Temporary storage

An Interim Storage Facility (ISF) was built in 2013 for the temporary storage of very low and low level conditioned radioactive waste. To this end a grouting station to immobilise solid waste is going to be built. The ISF is a key asset for the Decommissioning and Waste Management Programme and will boost its completion.

It will only host JRC-Ispra waste, coming either from past research activities or produced from the decommissioning and dismantling activities. In order to properly store waste, *ad hoc* containers have been designed. They will be stacked in layers up to 5 high in the four storage compartments.

The associated final waste packages have been qualified in compliance with Italian UNI Standards.

The final destination of JRC-Ispra radioactive waste will be the future Italian national repository.



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- 1 Interim Storage Facility external view
- 2 Interim Storage Facility internal view
- 3 Handling of waste packages
- 4 A dummy waste package after tightness test

Final disposal

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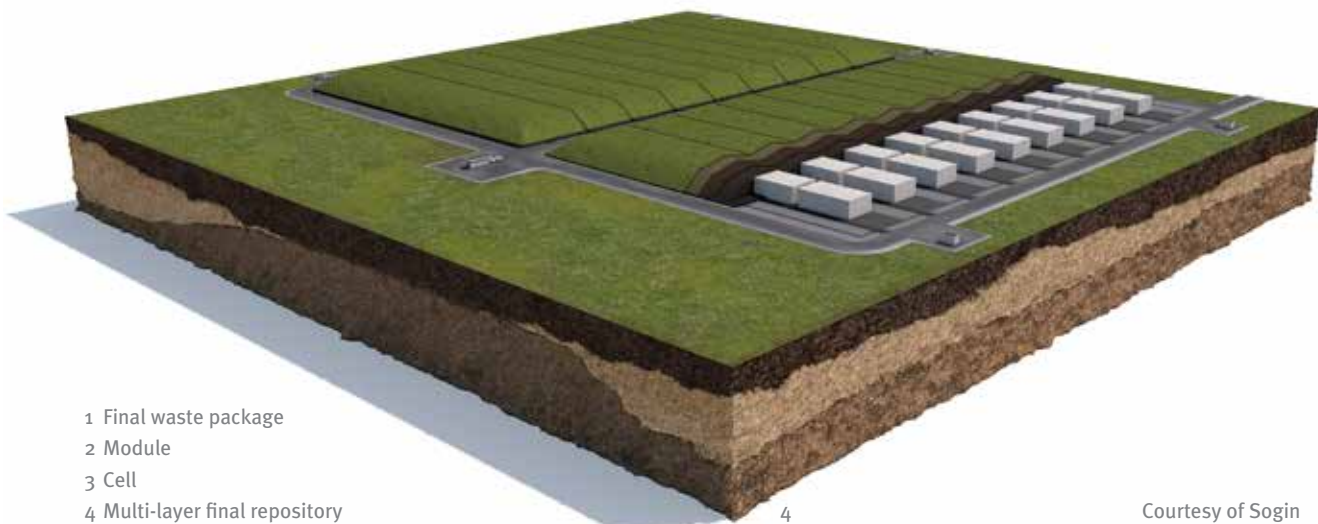
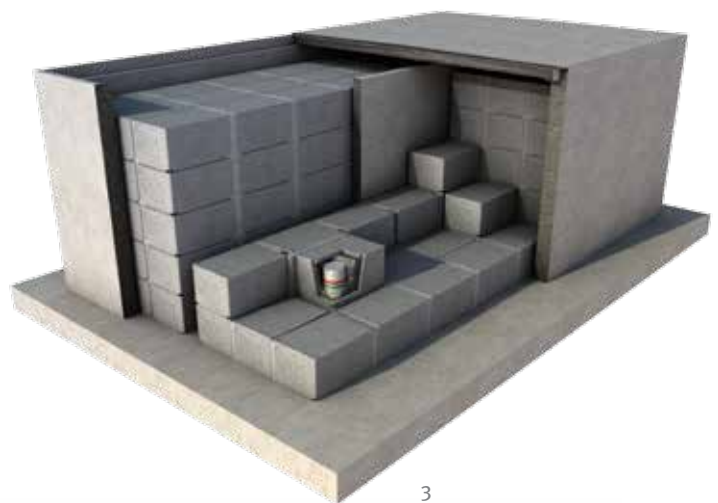
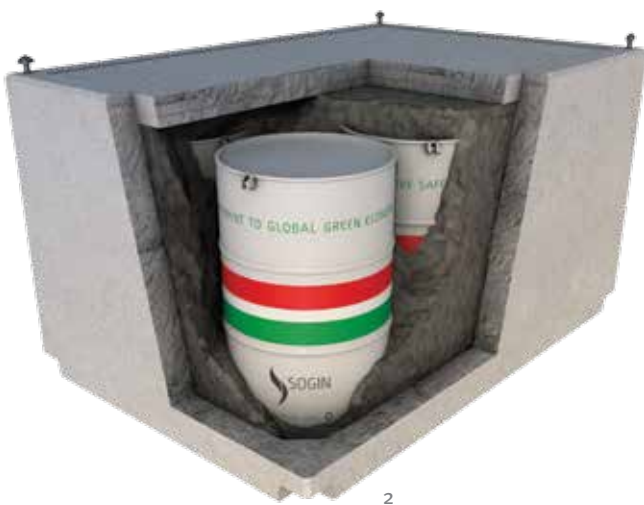
JRC-Ispira D&WM Programme
Joint Research Centre, Ispira Site

The Italian national repository

The ultimate destination of JRC-Ispira radioactive waste will be the future Italian national repository (as established in the agreement between the European Commission and the Italian Government, signed in 2009 and according to the Directive 2011/70/EURATOM, transposed by the Decreto legislativo 4 marzo 2014, n. 45).
On June 4th 2014 the Italian Nuclear Regulatory Authority issued the final repository siting criteria (developed in the Technical Guide n. 29).

The process for identifying the location of the Italian final disposal site is currently ongoing. The Italian national repository will be a centralised surface infrastructure aimed at managing all radioactive waste produced in Italy ensuring the highest safety, security and environmental standards. It will be part of a technological park, open to international collaboration, with laboratories devoted to research activities

and training on radioactive waste management and radiation protection.



- 1 Final waste package
- 2 Module
- 3 Cell
- 4 Multi-layer final repository

Courtesy of Sogin

Support to research & development

The decommissioning and waste management market is growing fast, in particular in Europe. There is likely to be a significant impact on employment with an increased requirement for nuclear staff in the decommissioning field, as well as increased R&D needs. The JRC, thanks to the experience gained in decommissioning

activities, will play a key role in partnership with other national and international organisations, especially in the following areas:

- knowledge management and sharing;
- development of innovative technologies and techniques;
- standardisation;
- training.

1 Artist's impression of the INS3L building

2 Augmented Reality and Virtual Reality test



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Completion of nuclear research infrastructure: INS3L project

The financing for the construction of the new INS3L building (Ispra Laboratory for Nuclear Safeguards, Security and Standardisation) has recently been confirmed. The new building is designed to host all nuclear research and training activities on the Ispra site and to support the JRC-Ispra Decommissioning and Waste Management programme in its implementation. The public tender for the construction works is expected to be awarded by the end of 2019.

3D project, Augmented Reality and Virtual Reality experiences

JRC Nuclear Decommissioning Unit is working on a project to offer an Augmented Reality experience to public attending JRC big events (Open Day, School Days etc.) or simply visiting the Visitors' Centre. Wearing HoloLens glasses, the visitor will be able to see a 3D hologram of the site, while hearing the explanatory story of how the decommissioning will proceed from present up to the green field. The major JRC-Ispra nuclear plants has been scanned in 3D to develop a digital platform, composed of various tools and technologies dedicated to decommissioning activities, aiming to digitally represent physical and functional characteristics of the processes. Exploiting that huge imaging database, JRC developed a Virtual Reality experience for public to make people able to virtually JRC visit nuclear facilities.

Training and knowledge sharing

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JRC-Ispra D&WM Programme
Joint Research Centre, Ispra Site

ELINDER initiative

The European Learning Initiatives for Nuclear Decommissioning and Environmental Remediation (ELINDER) is a training programme in nuclear decommissioning coordinated by the JRC in collaboration with several partners, including European universities and institutes specialised in the nuclear sector.

ELINDER is organised in a set of complementary training courses, providing a common qualification:

- 5 Generic Courses which serve as a general introduction to nuclear decommissioning;
- 7 Specific Courses which address more in depth a topic linked to decommissioning;
- e-learning, which provides a complementary introduction to the nuclear discipline.

Among the generic courses, the ELINDER 'Decommissioning Summer School' is addressed to students with a graduate degree pursuing a master in the area of engineering, science and technology. The Summer school aims at strengthening education on planning and operating nuclear decommissioning and waste management activities, including safety and legal framework.

The courses, including visits and practical studies, are provided by each partner in different European countries.

Within ELINDER relevant trainings organised at the different European locations are pooled, harmonised and complemented with new topics, in order to ensure high quality of the trainings.

Knowledge sharing & collaboration at International level

The JRC-Ispra is very active in collaboration activities in the field of knowledge sharing in nuclear decommissioning and waste management. Its approach is shared with other JRC sites and its experience put in common at national and international level.

JRC-Ispra:

- part of the OECD/NEA Co-operative Programme on nuclear decommissioning;
- shares Italian D&WM experience through a close dialogue with national stakeholders;
- shares EU experiences through the JRC D&WM Expert Group;
- cooperates with the IAEA (International Atomic Energy Agency);
- cooperates with European Universities, Research Centres and Industry within the ELINDER initiative;
- participates in the works of the Italian standardisation committee in the drafting of norms related to nuclear decommissioning.



Elinder's course "Metrology for Waste Characterisation and Clearance" JRC Ispra 2019



2019 Summer School on Nuclear Decommissioning

“Art Spaces” exhibition

In 2017 the JRC-Ispira organised at the Interim storage facility, the exhibition “Art Spaces. Nuclear decommissioning: science at the service of future generations”, in order to present to the public the decommissioning and radioactive waste management programme in an innovative way, combining art and science.

On one hand, the artistic path is around the topic of the drum, generally used to contain radioactive waste and used by artists, through different expressive methods and techniques, to convey a message on the topic. On the other hand, for the

scientific part, an informative path about nuclear decommissioning has been developed. This brings visitors along the different steps, from nuclear research to the green field.

The exhibition became later a travelling exhibition and it is now at its fourth edition in Italy (Ispira, Masnago – Varese, Venice, Genoa).

Moreover, the exhibition got some awards, such as “Mecenati of the XXI century – The best practices in the collaboration between the institutional world and the Art world”, given by the European Parliament in 2018.



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1 Art Spaces Exhibition – JRC Ispira Conference

2-3 Art Spaces Exhibition – Masnago Castle (Varese)

4 Art Spaces Exhibition – I magazzini del Sale, Venice

Activities in the next future

Grouting station

The New Grouting Station is the facility where the solid radioactive waste of the JRC-Ispira will be conditioned and grouted in dedicated containers to make the Final Waste Packages to be disposed in the future Italian

National Repository. It will be installed in existing buildings which had already hosted a radwaste cementation plant in the past. This old plant was dismantled in the years 2013-2016 and the buildings

were completely refurbished in 2018, according to the last technical standards. The installation and commissioning of the new grouting station equipment started in 2019.

Bitumen drums retrieval

The bitumen drums represent, in terms of volumes, the most important family of historical waste produced and stored at the JRC Ispira site in the period 1966-1988.

They contain low activity conditioned waste coming from past routine nuclear activities and are buried in three trenches filled with earth in Area 40.

The project of construction of a retrieval facility and associated equipment to recover the 6000 drums was launched in 2019. Its completion is expected in 2020.

JRC Knowledge Centre on nuclear decommissioning

Nuclear knowledge management has become an increasingly important element of the nuclear sector in recent years.

In countries with stagnating or fading nuclear programmes, the challenge is to secure the human resources needed to sustain the safe conservation of shut-down nuclear installations, their subsequent decommissioning and related programmes for spent fuel and waste. Replacing retiring staff and attracting the young

generation to a career in the nuclear field are key challenges.

JRC focuses on developing methodologies for planning, designing and implementing local nuclear knowledge management programme. It strives to facilitate nuclear education, networking and experience exchange. In doing so, it promotes the use of state of the art knowledge management technologies and platforms.

The in-house generation of knowledge associated with the operational and R&D activities will lend credibility and authoritativeness for JRC to act as “point of accumulation” for knowledge generated externally by industry and international research programmes as well as manager of knowledge for the European Commission, for the EU Member States and globally.

The European Commission's science and knowledge service

Joint Research Centre

JRC Mission

As the science and knowledge service of the European Commission, the Joint Research Centre's mission is to support EU policies with independent evidence throughout the whole policy cycle.



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