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Overview of the MICADO project

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Measurement and Instrumentation for Cleaning And Decommissioning Operations

- Development of a system that could become a referenced standard facilitating and harmonizing the methodology used for the in-field Waste Management and Dismantling & Decommissioning (D&D) operations.
- D&D of nuclear infrastructures increasingly demands full traceability of waste material to improve quality management and operational safety. Precise waste management and optimized procedures provide two-fold benefits; reduction of costs associated with D&D, and the minimization of radiation exposure for operators and personnel.
- The absence of a homogenous and straightforward solution to fully characterize all types of materials, with the absence of an integrated solution for digitizing the enormous amount of data produced, is a critical issue. The challenge lies in the operator's ability to maintain high operational skills and quality assurance with precision measurements.

The TEAM



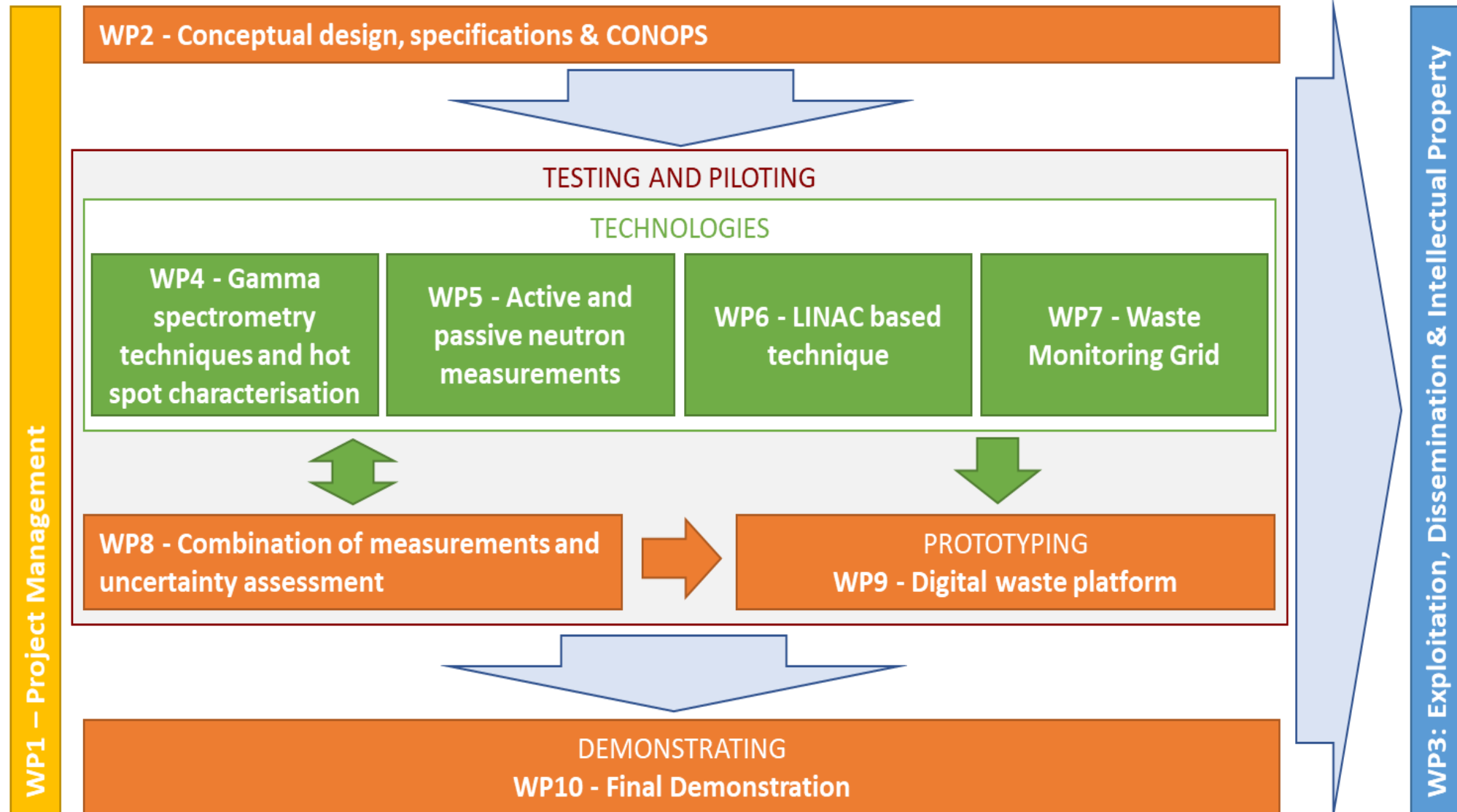
*GM Meeting,
Cadarache – July 2022*

- Project Length: 45 months
- End of the project: end of February 2023
- Budget: 5 M€ total, of which EC contribution of 4.4 M€
- Euratom call NFRP-2018-10, Research and Innovation Action (RI)
- Support/endorsement from: ANDRA, INFN, SwissNuclear, Nucleco, JRC, CEA

9 partners over 5 countries (IT, FR, BE, DE, CZ); a good mix of universities, research centers, one large company and SMEs.

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The Workplan



Investigated techniques

HARDWARE

- **Gamma station:** for the detection, identification and quantification of the gamma emitters (^{60}Co , ^{137}Cs) in the RWP. The identification of hot spots of a higher activity will help on the material handling or repackaging;
- **Neutron station:** for active and passive measurements based on ^3He detectors to evaluate the Pu activity, combined to gamma measurements. Neutron coincidence techniques are also used to measure the spontaneous fission (Pu and Cm) or measure the U and Pu fissile mass and their activities using neutron induced fissions;
- **Photofission measurements** to evaluate the U and Pu activities for high-density waste packages;
- **Long term monitoring system** based on scintillating optical fibers and SiLi6Fi technology and on a Timepix prototype to have a low cost and distributed grid of sensors surrounding the waste packages in the storage repository;

SOFTWARE

- **Pipeline data assessment:** Procedure focused on the uncertainty evaluation of a full process and not on the single element of the pipeline to extract more information and /or optimize the overall measurement uncertainties, combining measurement results obtained from the different detection stations and based on MonteCarlo simulations;
- **RCMS DigiWaste Software:** a software structure connected to database, RFID technology and GUI for the user characterization data storage and visualization.

Objectives from proposal to the final results

- **Flexibility:** it assures the complete characterization of many types of waste with gamma/neutron passive and active measurement. => **4 detection stations for active and passive measurements addressing waste packages for 50 l to 400 l**
- **Transportability:** different technologies embedded in ISO containers. The containers will be designed to be connected in sequence to make a full characterization line of the nuclear waste. => **Neutron station moved from France to Italy, Monitoring grid sensors tested in La Hague, Nucleco storage sites and in different laboratories as well fast gamma spectroscopy and gamma camera system moved from different laboratories. Design of the ISO container architecture available with 3 characterization stations + a control room. The design was not implemented within the project (out of the scope and costs) but checked the mobility and the possibility to fix the system in containers (shielding studies also included)**
- **Digitization:** execution in real time the digitization of the waste package under measurement with a direct real-time data storage on a customizable database and integrating information of the producer combined to data of the performed measurements. => **RCMS DigiWaste platform ready and available for partners. All data of the final demo and for all detection systems are integrated and easily accessible. Report file also available for all database items (Waste Packages)**
- **Quantification:** execution final quantification of fissile, fertile mass and the content of the actinides to fully characterize the nuclear waste using an artificial intelligent SW solution that could support the “expert analysis”. => **AI used in the hotspot and id reconstruction of the gamma camera data. Gamma and neutron stations provides the quantification in term of 239 and 240 PU mass or gamma activity of the radionuclides identified**
- **Traceability:** Platform Software a Database with a complete tracking of the waste movements using the RFID technology as well as the waste disposal monitoring technology for long term verification of the good status of the containment. => **RFID included and used as database item ID where location of the waste package is stored, as well measurement time etc.... Monitoring of the radioactivity trends (gamma & neutron) evaluated for the waste packages stored for the long term monitoring**

And now let's go deeply into the project



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Thanks for your attention

