

**LESSONS LEARNED FROM IMPLEMENTING TRAINING AND MOBILITY PROGRAMMES
WITHIN EC H2020 PROJECTS EURAD AND PREDIS**

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ABSTRACT

Both EURAD and PREDIS are addressing research, strategic studies and knowledge management (KM) in the field of radioactive waste management (RWM). PREDIS is focusing on radioactive waste predisposal, while EURAD on overall aspects of RWM with a special focus on geological disposal of radioactive waste. Both are partially financially supported by the European Commission.

Since inception, the KM activities are essential to ensure efficient knowledge transfer among the community. The projects contribute training and mobility aspects, also including the 'School of Radioactive Waste Management', while using available research infrastructures and providing a platform for knowledge exchange.

Besides training courses, both projects regularly organize topical webinars with worldwide participant and facilitate exchange of students and experts between institutes. A number of initiatives are taken to give visibility to students in the R&D programmes, thus supporting their networking and possibilities for mentoring.

Keywords: training, mobility programme, research, students, radioactive waste management, knowledge management.

1. INTRODUCTION

EURAD (European Joint Programme on Radioactive Waste Management, 2019-2024, Grant agreement No. 847593) and PREDIS (Pre-Disposal Management of Radioactive Waste project, 2020-2024, Grant agreement No. 945098) are partially funded by the European Commission and both address research, strategic studies and knowledge management (KM) on radioactive waste management (RWM). While PREDIS is aimed at improved techniques for handling low- and intermediate-level (L/ILW) radioactive waste during pre-disposal activities, EURAD is focused on holistic aspects of RWM, in particular on handling of high level radioactive waste and spent fuel and a corresponding geological disposal.

Since inception, the knowledge management (KM) activities are essential to ensure efficient knowledge transfer and dissemination among the whole RWM community together with a special emphasis on the results gathered within both projects' research and strategic studies. Another aim is to support RWM programmes at early stages through sharing knowledge and practices of the more advanced national programmes.

The intensive cooperation between EURAD and PREDIS in KM allows their support to the Council Directive 2011/70/Euratom [1] contributing to safe, sustainable and timely management of radioactive waste in the national RWM programmes. For all these purposes, the EURAD School of Radioactive Waste Management was launched in December 2020 (<https://euradschool.eu/>). The knowledge management

implemented within both projects is based on previous experience of the many research teams and experts' practices gathered to-date, respecting the current training needs requested by a wide RWM community and considering innovative training tools.

There are different actors engaged in RWM and its decision-making processes, in particular in safety case and related licensing processes within dedicated disposal facility phases. As a main target audience regarding EURAD/PREDIS, training courses and mobility actions were identified by waste management organisations (WMOs), technical safety organisations (TSOs) and research entities (REs) who also represent the main beneficiaries of the projects and their link third parties. Other participants of training courses may also consist of e.g. waste generators, civil society experts and/or regulatory authorities' professionals, depending on the objectives of the training, which may be either general or specific. Special attention is given to the future generation of experts, especially to the students in order to increase the level of their education, to improve their scientific knowledge, to engage them for RWM and also to ensure the knowledge transfer over generations. Both projects are thus contributing to the competence building, establishment of a community-of-practice and are supporting the sustainability of RWM programmes together across Europe.

The collaboration in KM between the EURAD/PREDIS is based on a Joint statement on Knowledge Management [2] which defines a unified approach to KM and thus allows a productive cooperation and sharing of experience with KM programmes implementation, especially within training and mobility capabilities, as discussed below.

2. MATERIALS AND METHODS

The KM programmes implemented in both projects were designed by respecting the EURAD Roadmap [3], taking into account possible waste management routes from radioactive waste origin, through its processing and leading to a final disposal in the facility and, by reflecting each phase of future RW disposal facility lifecycle and programme phases. All these processes and activities require a high level of scientific and technical knowledge, sufficiently developed infrastructure, and need to consider a complexity of socio-economical aspects and long-term scope/scale of RWM.

EURAD deals with KM within three specific KM Work Packages (WP): (i) "State of Knowledge", gathering the current State-of-the-Art (SotA) knowledge with respect to the RWM, developing knowledge base, domain insights documents, etc., (ii) "Guidance", working on developing guidance documents and, (iii) "Training and Mobility", whose main activity is dedicated to implementing training courses and mobility actions, which are executed by the EURAD School of RWM. All KM WPs activities comply with Quality Management Plan [4] and contribute to the EURAD Knowledge Management & Networking Programme [5]. All these WPs regularly interact between each other, the R&D and Strategic Studies WPs and with Project Management Office.

EURAD's School of RWM aims to assist end-users in acquiring, developing, disseminating, using, sharing and preserving knowledge and skills relevant to achieving specified objectives. Therefore, the School support the building of competences, which are comprised of knowledge, skills and attitudes. It is done through (i) offering portfolio of training courses, based on end-user's needs and gaps in the Roadmap, (ii) organizing a dedicated mobility programme, (iii) organizing webinars on broad and specific topics (e.g. Lunch & Learn sessions), (iv) maintaining a library of recordings of these webinars so that their content can be disseminated among the RWM community and, (v) an active support the EURAD PhD community through involving them specifically in EURAD events, all in close cooperation and interaction with PREDIS KM activities.

KM in PREDIS is implemented through one overall devoted WP3 – "Knowledge Management", having the same complimentary goals as EURAD to development and transfer the knowledge and competence across Member States in the area of the project scope.

2.1 Training programme

The Training programme reflecting scientific content of both projects have been designed with respect to the EURAD Roadmap [3] where seven themes have been identified by EURAD as the most critical and which knowledge and related capabilities (as competences and infra-structures) need to be well developed in order to support a successful implementation of any national RWM programme. The list of themes consists of (i) National Programme Management, (ii) Pre-disposal, (iii) Engineered Barriers Systems, (iv) Geoscience, (v) Design and Optimisation, (vi) Siting and Licensing, (vii) Safety Case. Each theme considers the different phases of a RWM programme: Phase 1: Policy, framework and programme establishment; Phase 2: Site evaluation and site selection; Phase 3: Site characterisation; Phase 4: Facility construction; Phase 5: Facility operation and closure.

The needs for training topics were identified through surveys performed within both projects' full stakeholder communities. In the survey frame, the respondents also identified the expected audience, preferred format of training courses, urgency and expected duration. This information has been considered when new trainings modules are developed and arranged.

In EURAD, there were 80 respondents identifying 363 training needs, from which close to 260 topics were classified as difficult to find [6]. Next to the general topics of RWM, there were also indicated the urgent needs for training on specific topics as e.g. uncertainty management, safety case development and review. Concerning target audience the largest identified group should consist of junior professionals, who are just entering the field of RWM, Other end users groups are also considered depending on the scope of the training course.

Within PREDIS, there were 33 organisations participating in the survey and identifying several gaps in accessible training, e.g. topics dedicated to geopolymer matrix, waste

characterisation, etc. [7]. An important result of the survey analysis is that close to 80% of proposed topics for training can be provided by PREDIS experts and thus do not need external lecturers. Based on the survey findings, the majority of potential participants in training courses should be recruited from PhD students, postdocs and junior professionals.

In 2021, the mapping exercise of existing training courses in the area of RWM available in Europe was performed in close cooperation between EURAD/PREDIS [8]. There were over 150 existing trainings identified and consequently compared with training needs identified by this EURAD/PREDIS mapping. As a result, it was seen that there is a sufficient amount of trainings on topics related to the RWM in general, but a lack of specific trainings, e.g. safety case, uncertainties management. This fact lead to the decision to create a list of priority trainings topics [9], [10] and to start developing new training courses through EURAD School of RWM, which are complimentary to existing material. Based on the inputs mentioned above, the development of new training courses by the EURAD School and PREDIS started.

With goal to ensure a high quality of new training courses and a unified approach to all trainings developed within EURAD, the School on RWM defined quality criteria [11] based on the Systematic approach to training, published by the International Atomic Energy Agency (IAEA) [12]. This methodology consider several steps: (i) analysis of the required competences (knowledge, skills and attitudes), (ii) design of a training programme based on a translation of competences into learning outcomes and objectives, (iii) development of training materials to meet the pre-defined learning objectives, (iv) implementation of the training, (v) evaluation of the training effectiveness, which serves as feedback to step 1 'Analysis'. This methodology also allows for further improvement of training courses when they are repeated..

In order to learn and improve from trainings organisation, all participants of a training course are asked to provide their feedback through a unified form. This form consists of the questions related to: (i) Content (what is balance between theory and practice, is the content up-to-date and what is a practical outcome use of the training), (ii) Course material (its clearness, completeness and the quality of slides), (iii) Organisation of training (time schedule, course environment training facilities and quality catering). The last part of the feedback is dedicated to the general questions such as reasons for participation, recommended frequency and overall judgement of the course. Every lecture is evaluated from the point-of-view of: (i) clearness, (ii) possibility for questions and interaction, (iii) scientific knowledge, (iv) topical interest.

Lecturers also provide their feedback on the course through a special form where question are aimed at (i) Participants - qualification for background education when attending the course, how was the interaction with participants, the level of the participants interest, (ii) Course programme - structure, course content and balance of topics, (iii) Organisation, (iv) Overall judgement. In case of lecturers, the evaluation is related to the day/s when they were participating in the training as most of

them are present only for limited time within the training duration.

2.2 Mobility programme

The EURAD/PREDIS Mobility programmes [13], [14] aim to contribute to building practical skills (i.e. tacit knowledge) and professional growth. As such they are considered to be complementary to the training programmes (i.e. explicit knowledge mostly). The Mobility programmes are aligned with the EURAD Roadmap. Furthermore, they are designed to set equal conditions for participation in the mobility actions and to ensure a unified approach and objective assessment of the mobility programme applications [15] [16]. Therefore, both programmes are using the same online platform for the submission of the applications and subsequent evaluation: EVALATO. This platform is maintained by the EURAD School (<https://2185.evalato.com/>) and the PREDIS KM WP (<https://3346.evalato.com/>). It also contains necessary information for applicants, including the overall mobility guides, application and review templates, funding conditions, evaluation criteria, and application deadlines.

Considering the duration of EURAD, a detailed analysis was performed on how the EURAD Mobility programme could evolve over time to meet EURAD objectives and to fulfil the needs and expectations of EURAD participants [13]. This analysis resulted in a tiered approach, in which the Mobility Programme is implemented in four stages (I – IV). Based on these stages potential scenarios were proposed with respect to the intended type of mobility actions which were covered and for whom. Based on an analysis of the performance of the Mobility Programme at any given time, it could progress to the next stage, with each stage extending the number of types of mobility that are covered and the number of eligible end-users groups.

The intension of EURAD Mobility Programme is to financially support junior and senior professionals as well as PhD students and post-docs from EURAD beneficiaries and provide support of following actions: (i) visit infrastructures from EURAD partners and organizations not necessarily involved in EURAD, (ii) undertake internships/exchange programmes between institutions within EURAD, but also between organizations which are active in RWM and not necessarily involved in EURAD, (iii) follow training courses in the field of RWM and, (iv) attend conferences aimed at RWM. The mobility actions supported through EURAD mobility grant depend on stage of the programme identified in the scenarios.

In the case of PREDIS, the Mobility programme is focusing mostly on PhD students and post-docs, as well as junior scientists from within the PREDIS beneficiaries. It supports them in the following types of actions: (i) visit of partners institution or industrial partners; (ii) perform internships and/or exchange programmes; (iii) participate in international and/or national training courses; and (iv) attend events as conferences, workshops, etc.

The EURAD survey described earlier also gathered important information about research infrastructures offered by the EURAD community, and such access is now available to

mobility programme participants. The list of available infrastructures is provided on the EURAD School of RWM website (<https://euradschool.eu/infrastructures/>). Of course, these infrastructures are also available for the PREDIS Mobility programme.

3. RESULTS AND DISCUSSION

3.1 Training programme implementation

Seven training courses have been successfully organized by EURAD since 2020 on the topics: (i) Multiphysical couplings in geomechanics, (ii) Introductory course to EURAD and Radioactive Waste Management, (iii) Education & Training Event on the scientific basis and safety relevant aspects of radionuclide transport and retention, (iv) Information session and discussion on the Spent Fuel State-of-Knowledge document, (v) EURAD Training course on Safety Case Development and Review, (vi) Geochemical and Reactive Transport Modelling for Geological Disposal, (vii) EURAD Training course on Uncertainty Management. Due to the COVID-19 pandemic face-to-face training courses were limited/prohibited. Therefore some of these were offered online, despite face-to-face training courses are prioritised for most RWM topics as this is considered to be more beneficial for both – trainees and lecturers compared to online training courses.

The evaluation form for collecting feedback from training course participants has been implemented successfully. It allows an independent evaluation of the course as the forms are anonymous and can also serve to improve training courses in the future. In addition, it allows the course organisers to better identify end-users needs, which improves the selection of the target audience and the training content. The usefulness of these feedback forms can be illustrated by following example. When looking at the reasons for participating to a specific training course, it is clear that these reasons differ depending on the training course. For example, in the safety case training course, 23% of the participants participated out of own interest, 36% because the course was recommended, and 41% on demand of the employer. In the modelling training course, on the other hand, 62% of the participants participated out of own interest, 25% because it was recommended, and 13% on demand of the employer. The overall judgement of both courses was very similar (excellent – 67%, good – 33%). Based on this example, the course organisers learned that depending on the topic, the reasons for attending may differ. If the content of a course could be of interest to the entire organisation (e.g. safety case) there is a higher probability that the employer will demand personnel to participate.

PREDIS has organised over 15 webinars with public participation as a form of learning as well as three dedicated training courses: (i) PREDIS Overview: Innovations in Pre-disposal Radioactive Waste Management with 81 registered participants (with over 20% coming from outside the PREDIS consortium, (ii) LLW/ILW training, completed with visits to facilities dedicated to pre-disposal activities, and (iii) Waste characterisation methodologies, merging theoretical lessons with

practical exercise. From the feedback received, all courses were rated as highly valuable and successful, with more than 4 out of 5 points scored by 90% of the attendees.

3.2 Mobility programme implementation

In addition to training, improving practical skills can be ensured through mobility actions, which are implemented in both projects using available research infrastructures, in many cases offered by projects beneficiaries. The portfolio of infrastructures consists in particular of underground research laboratories, analytical laboratories, research reactors, codes for modelling issues. This portfolio represents a large spectrum of possibilities to be used by interested applicants.

Within the EURAD Mobility Programme, 43 applications have been submitted since April 2020, when it was launched, 31 mobility actions have been approved and 19 of them have been completed (less than expected due to COVID-19). PREDIS Mobility Programme has already accepted 27 mobility actions since opening the mobility portal in September 2021. As there is still remaining mobility budget in both projects, other mobility actions will continue to be supported, in order to contribute to students and researchers in their professional development.

3.3 Webinars

One of the pillars of the School of RWM is dedicated to the organisation of webinars. They are arranged as a part of EURAD Lunch & Learn sessions, open to a broad audience and free of registration fee. Each Lunch & Learn session focusses on a selected topic related to the RWM (the topic can be very general, or specific), take 1 hour, and, after the presentation, provides remaining time for discussion. The School of RWM has organized 21 seminars as of February 2022. On average, about 60 people attend the live webinar, another 60 view the post-event recording.

PREDIS is also regularly organising topical webinars, providing information on various topics related to the predisposal of radioactive waste, aligned with the work performed within PREDIS WPs, both scientific and strategic. Webinars are free of charge, open to PREDIS partners and stakeholders, with duration at about 3 hours and taking place every 2 months. The number of participants varies between 70 to 120, usually half of them coming from outside of PREDIS. Since March 2022, there have been 15 webinars organised.

Both sets of EURAD/PREDIS webinars are recorded in order to preserve knowledge and facilitate its dissemination. All Lunch & Learn sessions records are available on line <https://www.youtube.com/playlist?list=PLahXOQn-bremN911IEEn0w8yAzQyuUR3ky>. PREDIS is providing its webinars records and summary documentation on <https://predis-h2020.eu/events/>.

3.4. Students community

EURAD/PREDIS support their respective student communities, which consists of more than 130 students including master, PhD students, and postdocs. A number of initiatives are taken in both projects to give visibility to students

in the R&D programmes. thus supporting their networking and possibilities for mentoring.

The School of RWM hosts an open forum for students to exchange among each other as a one of its pillars. This way the School supports transfer of knowledge between students and engages them for their future work in RWM. Several specific sessions have been organised within EURAD Annual events and PREDIS Annual public workshop events in order to provide PhD students an opportunity to present their research work and also to get to know each other. There are more than 100 students involved in EURAD and 30 students in PREDIS.

Both projects are supporting their students communities, by providing (i) information on available/upcoming training courses, (ii) possibilities to participate in mobility actions, (iii) overviews of all PhD research performed in EURAD/PREDIS and highlight these within the projects' newsletters, (iv) a list of events of interest for PhD students, (v) involvement in events, meetings and workshops such as KM management meetings, (vi) a forum to create self-representing groups to give feedback on the projects' training programme tools and opportunities. The actions towards students and other next generation experts are of high interest of both projects, as students and junior researchers being the future workforce and management in the PREDIS and EURAD communities.

Both KM programmes have built their own knowledge base and training course portfolio by collecting knowledge from their own research and work on strategic studies, but successfully interact with each other in order to handle the complexity of the knowledge required in RMW and also complement each other, in particular within the upcoming EURAD 2 project proposal. In that respect, reconciliations with IAEA, NEA and the national programme organisations are also of crucial importance.

4. CONCLUSION

Training and mobility programmes represent an essential part of EURAD/PREDIS knowledge management activities and the overall Euratom programme supported by the European Commission and Member States. Based on up-to-date experience in EURAD/PREDIS cooperation and with respect to the large variety of already implemented training courses and mobility actions and feedback received, it is obvious that all KM activities described in this paper actively contribute to competence building in the field of RWM, both for pre-disposal and disposal, and improve practical skills of involved participants.

It is beneficial to evaluate the experience gained and consider this when designing a potential future EURAD 2 Training and mobility programme, to build on the best practices and lessons learned from the existing foundation of the EURAD/PREDIS knowledge management activities.

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REFERENCES

[1] Council Directive 2011/70/Euratom establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste, European Commission, (2011).

[2] EURAD/PREDIS Joint statement on Knowledge management, https://predis-h2020.eu/wp-content/uploads/2021/10/Joint-Statement-on-KM_EURAD-PREDIS.pdf

[3] Beattie T. at al., EURAD Roadmap, extended with Competence Matrix. Final version as of 27.09.2021 deliverable D1.7 of the HORIZON 2020 project EURAD. EC Grant agreement no: 847593, <https://www.ejp-eurad.eu/roadmap>, (2021).

[4] Garcia M. at al., EURAD Quality Management Plan. Final version as of 17.09.2020 of deliverable D1.5 of the HORIZON 2020 project EURAD. EC Grant agreement no: 847593, (2019).

[5] EURAD Knowledge Management & Networking Programme, <https://www.ejp-eurad.eu/publications/eurad-knowledge-management-and-networking-programme>

[6] Belmans, N., Coeck, M., List of training needs from Research, Development and Demonstration and Strategic Studies Work Packages. Final version as of 12.04.2021 of deliverable D13.1 of the HORIZON 2020 project EURAD. EC Grant Agreement n° 847593, (2020).

[7] Valls, A. , Design and Definition of PREDIS training program (WP3). Deliverable 3.4 of the PREDIS project. EC Grant Agreement n° 945098, (2021).

[8] López del Prá C., Llorente C., Marco M., Christiansen B., Mapping of available course materials as of 12/07/2021 of deliverable D13.2 of the HORIZON 2020 project EURAD. EC Grant agreement no: 847593, (2021).

[9] Belmans N., Coeck M., López del Prá C., Llorente Herranz C., Priority list and schedule for training/mobility. Final version as of 05/07/2021 Deliverable D13.4 of the HORIZON 2020 project EURAD. EC Grant agreement no: 847593, (2021).

[10] Valls, A., Deliverable D3.5 Implementing specialized training courses (WP3) Date 31.10.2022 Version 1.0, (2022).

[11] Belmans, N., Coeck, M., Quality criteria and training specifications as a reference guide of requirements and expectations of the training courses to be developed. Final version as of 13.01.2021 of deliverable D13.5 of the HORIZON 2020 project EURAD. EC Grant Agreement n° 847593, (2021).

[12] International Atomic Energy Agency (IAEA), IAEA Guidebook on Nuclear Power Plant Personnel Training and its Evaluation, Technical Reports Series N° 380, (1996).

[13] Miksova J., Belmans N., Vasicek R., Specification of the content, material and learning outcomes of mobility training. Final version as of 15.11.2022 of deliverable D13.7 of the HORIZON 2020 project EURAD. EC Grant agreement no: 847593, (2022).

[14] Havlova V., Deliverable 3.6 Priority list and mobility formats 31.5.2021 Version Final, (2021).

[15] EURAD Manual for Mobility Programme, https://www.ejp-eurad.eu/sites/default/files/2020-04/eurad_mobility_programme_manual_final.pdf, (2020).

[16] Havlová V. at al., Mobility manual. PREDIS EU document. PREDIS Mobility Manual, (2021).