Deliverable 13.5: Quality criteria and training specifications as a reference guide of requirements and expectations of the training courses to be developed

Work Package 13

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Executive Summary

This deliverable summarizes some theoretical background information for EURAD partners and external training providers who have the intention of creating a course within the frame of radioactive waste management. It explains the different steps to reflect upon when designing a training course. It also formulates some quality criteria for self-assessment. Finally, it provides the feedback forms to be used by all EURAD training providers.

Complementary to this deliverable, Work Package (WP) 13 can individually advice the Research, Development & Demonstration and Strategic Studies WPs of EURAD on how to set up an optimal training event.

The proposed quality criteria and training specifications highlighted in this report are mainly based on (i) the IAEA Systematic Approach to Training (SAT) and (ii) some principles of the EC EQF (European Qualification Framework) and ECVET (European credit system for vocational education and training).

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Glossary

EQF	European Qualifications Framework
EURAD	European Joint Programme on Radioactive Waste Management
E&T	Education and Training
IAEA	International Atomic Energy Agency
KSA	Knowledge, Skills and Attitudes
OJT	On the job training
RD&D	Research, Development and Demonstration
RWM	Radioactive Waste Management
SAT	Systematic Approach to Training
WP	Work Package

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1. Introduction

The main goal of European Joint Programme on Radioactive Waste Management (EURAD) Work Package (WP) 13 is the establishment of the 'School of Radioactive Waste Management (RWM)'. The School of RWM will act as the executive body for all training and mobility activities that are organized within EURAD. It will respond to the needs of European RWM organizations concerning training and mobility. The EURAD Roadmap will be used as a guide to map existing training, prioritize trainings based on the identified training needs by the RWM community and publish an overview of past, current and newly developed training courses that are available to the RWM community, which includes the EURAD community. By linking its activities to the EURAD Roadmap, the School of RWM will contribute directly to the strategic knowledge management objectives of EURAD, namely: (i) preservation of generated knowledge (in- and outside of EURAD), (ii) transfer of knowledge towards Member States and between generations and (iii) dissemination of knowledge (by organizing training courses based on identified training needs within RWM). In general, training courses within EURAD will be organized by the School of RWM. This deliverable will outline the quality criteria and training specifications that will be used as a guide for all training courses that will be organized by the School of RWM. The training strategy that will be followed is outlined in a separate document "EURAD KM and networking programme".

The School of RWM will serve as an umbrella for a diverse portfolio of basic and specialized training courses created under EURAD. New training courses will be developed by WP13 in close collaboration with the EURAD Research, Development and Demonstration (RD&D), Strategic Studies WPs and external training providers for implementation in the School of RWM. These new training courses will encompass different research field and technologies in the field of RWM and will be based on the needs of the RWM community. As mentioned above, these training needs will be linked to the Goals Breakdown Structure of the EURAD Roadmap. This way, the training needs and competences that are lacking can be easily identified. Additionally, courses that focus on specific competences can also easily be found via the Goals Breakdown Structure. In the long run, the EURAD Roadmap will provide a unified vision of the various training needs of the various Member States and will harmonize training opportunities offered by the School of RWM with the training offered outside of EURAD in various business models by the mandated actors, members of EURAD or even by waste producers outside EURAD.

It is the task of WP13 to ensure a uniform approach and quality throughout a needs-driven EURAD course portfolio. The end-user needs are given in deliverable D13.1 'List of training needs from RD&D and Strategic Studies WPs'. This current report provides guidelines to ensure this uniformity and quality.

This report describes the quality criteria and training specifications for the development of coordinated training courses in the field of RWM, which will be adhered to by the School of RWM, with following major outcomes in mind:

- Consistent high quality level of all courses developed
- Realistic expectations for newly developed training courses.

An overview of the IAEA Systematic Approach to Training (SAT) system, which describes important elements of quality criteria for education and training (E&T) initiatives and which is implemented by relevant E&T providers, will be provided in the next section ('2. Systematic Approach to Training'). Besides SAT, elements from the European Credit System for Vocational Education and training (ECVET) and the European Qualifications Framework (EQF) will be used. The former is a technical framework for recognition, accumulation and transfer of learning outcomes with a view to achieve a

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qualification during vocational education. The aim of ECVET is to facilitate the process of learning recognition, irrespective of the country or education system in which the learning took place, which is similar to the ECTS system for higher education [1]. The EQF supports European cooperation in education and training. The EQF aims at promoting the mobility of workers and learners, facilitating lifelong learning and qualifications recognition and increasing understanding, and comparison, of the qualifications levels in different European countries through linking national qualifications systems to a common European reference framework [2]. ECVET and EQF share similarities since both rely on learning outcomes. Please note that the School of RWM will not issue certificates or engage in the translation of qualifications, as described in ECVET and EQF documents, nor will EURAD. They are solely mentioned as a reference to describe the methodology that will be used by the School of RWM in organizing training courses.

Based on the SAT system, ECVET and EQF, a list of quality criteria and training specifications is proposed (see section '3. Proposal for quality criteria and specifications in the field of RWM'). These will help in developing and unifying new training courses established in the field of RWM. They will also be implemented by the EURAD RD&D and Strategic Studies WPs for developing new training courses for the School of RWM.

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2. Systematic Approach to Training

In this section, an overview of the main principles of IAEA's SAT system, as well as elements from the ECVET and the EQF, is provided. In the end, this overview, which describes best practices for managing training programmes, will be used to formulate quality criteria and training specifications for new training courses for the School of RWM (see section 3 'Proposal for quality criteria and specifications in the field of RWM') and in the field of RMW in general.

2.1 Definition of the Systematic Approach to Training (SAT)

The SAT is a methodology for the management of training programmes. It provides a logical progression from the initial analysis of which competences (= knowledge, skills and attitudes (KSA)) are to be developed with the trainees, to the design, development and implementation of training courses to obtain these competences. Afterwards, an evaluation of the training is performed to provide feedback for all phases [3].

In general, the SAT includes the following phases [4]:
- **Analysis** of the training needs and the competences required;
- **Design** of the training keeping in mind the identified competences;
- **Development** of the training materials;
- **Implementation** of the training using the developed training materials;
- **Evaluation** of the training course, which generates feedback to be implemented in the other phases.

2.2 Analysis of training needs

In the analysis phase, the training needs and competences (e.g. required for a particular job and/or to reach a predefined goal) are identified and listed. From these competences, the necessary KSA are determined. In order to identify the training needs [4, 5]:
- An overview of the results of a competence analysis of the required competences, content analysis and/or goal-approached analysis (i.e. identifying the needs based on a certain goal that needs to be reached), which are based on an analysis performed by subject matter experts, needs to be available (i.e. in case of EURAD, the State of Knowledge documents from the EURAD Roadmap contain an analysis of subject matter experts);
- State-of-the-art scientific knowledge, technical knowledge and feedback from other sources (e.g. IAEA, EURAD Colleges or subject matter experts) could be analysed in order to modify the competence inventory;
- Competencies could be selected both for initial as for continuous professional training;

In the end, this analysis results in an overview of the relevant:
- Training needs;
- Target audience;
- Competences to be acquired;
- Content topics.

2.3 Design of the training

An effective training design facilitates the appropriate information to be provided to participants and allows the training to meet the participants' expectations. Training design could contain the following [3]:
- Aims of the training;
- Learning outcomes of the training;
- Pre-requisites of the training course;
- Content outline;
- Delivery strategy;

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- Evaluation strategy.

2.3.1 Aims of the training

The aims of the training are determined by taking into account the training needs of all interested parties, which includes the regulatory requirements. The training aims could include one or more of the following [3]:

- Identification of the content to be included in the training;
- Specification of the regulations, guides or other requirements relating to the topics covered;
- Explanation of the work practices, equipment usage and procedures for which the training is to be provided.

2.3.2 Learning outcomes of the training

After determining the aims of the training, the learning outcomes can be defined. Learning outcomes are described by the European Qualifications Framework (EQF) *as statements of what a learner knows, understands and is able to do on completion of a learning process* [2]. They are the knowledge, skills and attitudes (= competences) that the learners are expected to have attained and mastered upon successful completion of the training course. Typically, learning outcomes have measurable outcomes and can be assessed through some type of testing procedure. Therefore, a list of learning outcomes appears as a series of statements that can be described in a full sentence as follows [3]:

"*Upon successful completion of this training course, participants should be able to…*"

This sentence is than usually followed by an action verb which is specific to the type of learning outcome in terms of knowledge and skills. Examples of these action verbs can be found in Bloom's taxonomy, which is one of the best aids to writing good learning outcomes (see Appendix A) [6]. Learning outcomes ideally are maintained up-to-date to establish essential training content, the desired progression of learning and the expected standards of trainee performance.

The EQF and ECVET describes learning outcomes in terms of knowledge, skills and competences, where competences are described in terms of autonomy and responsibility of the learner [1, 2]. In its SAT the IAEA defines competences as the ability to apply knowledge, skills and attitudes (KSA) in order to perform an activity and/or job to specified standards in an effective and efficient manner. Both approaches can be considered similar, but use different jargon. Within the School of RWM IAEA's SAT approach will be used. Therefore, learning outcomes will be expressed in terms of KSA.

2.3.3 Pre-requisites for the participants

The entry-level requirements of the participants need to be considered when identifying the learning outcomes [6]. These can be linked to the eight EQF levels, such as:

- Level 4 :   equivalent to Secondary education
- Level 5:   equivalent to Higher education (professional bachelor)
- Level 6:   equivalent to (Academic) Bachelor degree
- Level 7:   equivalent to Master degree, post-graduate
- Level 8:   equivalent to Doctoral degree, or equivalent (third cycle of higher education)

Other pre-requisites could be knowledge or skills that must be acquired before enrolling in a particular course. For example: completion of a basic course on the origin of ionizing radiation, interaction of

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radiation with matter and basic radiation protection principles should be followed before enrolling in an advanced course on RWM.

2.3.4 Content outline

The content outline is developed to reflect the aims and learning outcomes of the training. The content may be divided into modules [3]. When preparing the training course:

- The SAT is used to identify the required content. Existing information in the form of guidelines, procedures, training materials, etc. could be taken into account when identifying the content;
- The first time a training course is organized, it is based on the competence/content requirements and/or goals identified in the analysis phase;
- Continuous professional training maintains and improves the KSAs of the learners and ideally includes training course evaluation feedback, the latest scientific and technical findings (if relevant), and practical experience from the work floor (from advanced countries).

2.3.5 Delivery strategy

Several types of training settings and methods are widely used and have proved to be more effective in attaining the learning outcomes when appropriately chosen. The following could be considered [4]:

- **Classroom-based training (face-to-face training)**. The most frequently adopted training setting. Its effectiveness could be enhanced by using the appropriate training methods such as lectures, discussions, role-playing, critiquing and briefing. Classroom instruction can be supported via training aids and materials (e.g. slides, written materials, audio and video materials);
- **On the job training (OJT)**. One-to-one training on the work floor under guidance of a supervisor. OJT is ideally provided by incumbent staff who have been trained to deliver this type of training method;
- **Practical sessions.** For example: laboratory, mock-up and workshop training;
- **Distance learning**. Webinars and/or e-learning modules could be developed when the target audience is international (no travel costs) or in case of self-study (e.g. in preparation of a certain course, to meet minimum level of understanding).

The chosen teaching methodology ideally takes following into account:

- The level of training (based on the eight EQF levels such as BSc level, MSc level, PhD level, etc.);
- The pre-requisites (e.g. practical skills that have been acquired before);
- The envisaged type of learning outcomes, for example:
  - Classroom-based training or distance learning for knowledge-based outcomes;
  - Practical exercises for skill-based outcomes;
  - On the job training for attitude-based outcomes
  - Etc…
- The number of participants (with respect to the capacity of the training room and trainers, as well as the pedagogic efficacy).

Whatever delivery strategy is chosen, the most effective training activities encourage direct learner participation in the learning process [3]:

- Trainers use teaching techniques appropriate to the training objectives and training content;
- Sufficient guidance and supporting materials are to be provided to achieve the learning outcomes when individualized instruction is used (e.g. OJT);

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- In classroom-based learning, it is recommended that the content is limited to a maximum of 6 hours and that several breaks are included in the programme;
- When developing a training course, it is recommended that practical sessions and exercises are included, and ample time is foreseen for interaction and Q&A.

2.3.6 Evaluation strategy

In this section, the general principles of the evaluation strategy are discussed. In section 2.6 the evaluation procedure is discussed more into detail.

Evaluation of training is a critical part of SAT, since it provides feedback towards the analysis, design, development and the implementation of a next or follow-up edition of a training programme. For evaluating the training programme's effectiveness, the Kirkpatrick evaluation model (1959) is a very influential model for goal-oriented approaches [7], WP13 proposes it for further use in the School of RWM. It consists of four different evaluation levels, namely:

- Level 1: Learner satisfaction i.e. did they enjoy the training course, did it meet their expectations?
- Level 2: Learner performance i.e. did they meet the learning outcomes? Have they retained the necessary knowledge?
- Level 3: Learner behaviour, i.e. do they implement the newly acquired knowledge in their job?
- Level 4: Training impact, i.e. did the new knowledge of the learner affect the learner's organization on a broader level?

For the first level, i.e. learner satisfaction, written and oral feedback can be requested from the trainees upon completion of the training programme. This allows learners to provide feedback on the lecturers, supervisors, course materials, practical organisation etc.. With this information the *efficiency* of the training course can be determined.

The second level, i.e. learner performance, can be assessed through written, oral and/or performance exams. Ideally, a limited evaluation is scheduled at the start of the course to establish baseline knowledge/skills and then a final exam is taken upon completion of the training. This way, the knowledge/skills gained by the learner can be easily evaluated. With this information the *effectiveness* of the training can be evaluated.

Level three and four require involvement of managers of the learner's organization to observe the learner's performance before and after completion of the training programme and how the new knowledge/skills are transferred within the organization. These levels yield the most accurate indication of training effectiveness, however in practice these are often complex to organize and evaluate. For training courses organized by the School of RWM for EURAD, the trainings are driven by the training needs from the RWM community, which can be measured through surveying RWM organizations. Therefore the level of implementation of acquired knowledge (i.e. level 3) is expected to be high.

2.4 Development of training materials

The development of training is based on the initial design (See 2.3 Design of the training) and involves preparation of the following items [3, 9]:

- Training schedule and lesson plans
- Training materials
- Practical training sessions
- Assessment (of the participant) procedures

It is advisable to conduct training try-outs [9], especially for unexperienced training providers organizing a course for the first time.

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2.4.1 Training schedule and lesson plans

Training schedules are based on the syllabus. It is advised to structure the schedule so as to maintain the interest of the participants for the duration of the training and to build on previous knowledge and experience (if applicable). For OJT it is important to prepare a training schedule that takes into account the availability of equipment and the operation of the facility [3].

A lesson plan gives further guidance to the trainers or supervisors to ensure that the learning outcomes are achieved and typically includes the following information [3, 9]:

- Specific content and key points to be emphasized;
- Order of learning so that new material will, in most cases, build on previously presented materials;
- Details of the key points to be included in the assessment of the course, and when this should take place;
- Suggested training tools (e.g. demonstrations and practical work);
- A list of available resources (e.g. videotapes, computer simulations, reference material, technical equipment, local or regulatory rules and procedures).

For OJT the same approach can be used, but it is advised to place the emphasis on the practical nature of the training [3].

2.4.2 Training materials

For classroom-based training, it is recommended that the lecture notes correspond to the content of the syllabus, and that the level of information in the lecture notes is consistent with the level of training provided. Where practicable, the notes could be illustrated with figures and diagrams. The scripts for practical exercises and group work need to be clear and concise. Model answers could be provided to the participants at the end of any activity [3].

The trainers should have the necessary training aids and equipment at their disposal. When using technical reference materials, they should be current and readily available to trainees and instructors [8].

When developing training materials, the type of material is influenced by the learning outcomes and the methods of instruction [9].

2.4.3 Practical training sessions

Theoretical information can be reinforced by the effective use of demonstrations, laboratory exercises, case studies, simulations and technical visits. If carefully scheduled, these events introduce variation into the course day and help sustain the interest of the participants. Practical training sessions can also be included in distance learning and OJT [3]. Some advices on practical training sessions are listed here [3, 8, 9]:

- As with all training, OJT should be provided by incumbent staff who are qualified to perform the job and who have been trained to deliver this type of training method;
- Training facilities and equipment meet current training needs and are adequately maintained;
- Laboratories adequately support training activities;
- OJT should be delivered by using approved and current training materials;
- Trainers should use appropriate teaching techniques when conducting exercises and OJT;
- Assessment should be performed by an independent, qualified assessor;
- Training should be enhanced by the use of pre-exercise briefings, post-exercise critiques, and self-assessments;

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- Individual participant performance should be assessed regularly by training personnel against established learning outcomes by using appropriate methods and performance criteria to ensure that the participant has obtained the learning outcomes associated with the training course.

2.4.4 Assessment (of the participant) procedures

Assessment of the competences of the participants could take place at the end of, and sometimes during, the training. Examinations, tests and evaluations of practical work allow to determine whether the learning outcomes were met. The degree of difficulty is set as such that a properly selected participant who attends all sessions and successfully performs all assignments can readily pass the evaluation [3].

2.5 Implementation of training

The learners are the most important factor for the implementation of training. Similarly, the most relevant output is competent personnel. Therefore, it is necessary to establish conditions which allow learners to give maximum attention to the training process [8]. It is important to create an environment suitable for learning and to address any concerns of the participants to the largest possible extent [3].

2.5.1 Selection of the trainers and supervisors

The careful selection of the individuals qualified to train or supervise is a critical aspect of successful training. Following criteria are to be considered when selecting them [3]:

- Technical abilities. The trainer is technically competent in the subject matter being taught. He/she does not only know the subject, but also knows the context of the subject in larger fields of RWM
- Teaching abilities. The trainer is an experienced instructor with good communicational skills and a demonstrated record of success in teaching. For new trainers or less experienced trainers it is advised to first follow a lesson with an experienced trainer.
- Language skills. The trainer is fluent and understandable in the language in which the training course is offered.
- The involvement of international trainers and trainers from other centres can have significant benefits for the participants.
- Trainers maintain the educational, technical and experience qualifications required for their respective positions.

If training is provided by multiple trainers, the coordination of the lectures in a specific course is a fundamental consideration. Coordination is assured by the course organizer. In the end, trainers are responsible for ensuring that [3]:

- Their lectures meet the aims and learning outcomes and that the lectures are tailored to the largest possible extent background of the participants;
- Up to date information is provided;
- The presentation is consistent with the current regulations (if applicable);
- The lecture notes and oral presentations are clear, objective and easily understandable.

2.5.2 Selection of participants

When selecting participants for a training course the following factors are relevant [3]:

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- The educational (EQF) level of the participants (see 2.3.3). This relates to the pre-requisites of the training course and whether or not the participant has the educational background to understand the content of the training course.
- Responsibilities relative to the training to be provided. Will the participant execute tasks for which he needs the knowledge he/she will gain during this training course, or will he/she supervise employees who perform such tasks?
- Language. Is the participant's ability to read, understand and speak the language in which the training course is given adequate?

2.5.3   Conducting the training

Effective training requires general adherence to the predefined schedule and lesson plans and an adequate understanding of the learning process. Trainers can supervise participants more effectively if they have a working knowledge of the learning process. Participant's motivation can be enhanced by providing an effective training environment, which can be achieved by adhering to the learning outcomes and by presenting the content in an organized and concise manner. During the lectures/practical sessions, trainers should continuously monitor the participants' mastery of the learning outcomes [9].

2.6 Evaluation of training

The aim of an evaluation is to determine the effectiveness and impact of the training course.
Evaluations during and at the completion of a training course provide input on competence gain with the learner and efficiency of the training itself, allowing for modifications and improvements to be made. The evaluation process is based on the Kirkpatrick evaluation model (see 2.3.6) [3, 7, 8]:
- Feedback from the participants immediately following the training, which gives participants the opportunity to comment on the course – level 1;
- Assessment of the extent to which the learning outcomes have been met, which includes the assessment of the participants' competences – level 2;
- Evaluation of the impact of the training course, which can be used by the participant's organization to determine to what extent the KSA gained in the training course are implemented in their organization – levels 3 & 4;
- Independent audits: an independent evaluation may be considered from time to time.

2.6.1   Feedback from the participants – Level 1

During and after the training, participants can provide their feedback on the training through the use of a questionnaire or other appropriate means. This feedback information shows what the participants thought of the training, including the quality of the training materials, the training methods used, the technical content, the proficiency of the trainers, administrative manners and the extent to which their needs and expectations were met [3, 7].

2.6.2   Assessment of the participants – Level 2

Participant performance and progress during training should be monitored very closely and continuously. Assessment of the participants could occur during each module and at the completion of the training course, as scheduled in the training schedule. Therefore, it is advisable that the schedule for tests is known by the participants in advance. All examinations are based solely on the learning outcomes which were determined in the design phase (2.3 Design of the training) [8]. If, in the end, the majority of the participants meet the initially defined learning outcomes, it can be assumed that the course has been a success. Alternatively, if over half of the participants do not meet the learning

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outcomes, it is recommended that the training course is carefully analysed to revise and modify the training course [3]. Suggestions concerning assessment methods are listed next [3, 7, 8]:

- Mastery of the learning outcomes is assessed by written and/or oral examinations and tests;
- Grading is done in a consistent manner;
- Questions are designed to test the understanding and correct application of the course content, rather than testing memory;
- During practical assessments, a specific checklist of skills that the participant is expected to demonstrate is used by the evaluator.

2.6.3 Evaluation of the impact of the training course – levels 3 & 4

The effectiveness of the training course is evaluated in order to build competences. This type of evaluation is typically longer term and should use trending data or performance indicators [3, 5, 7].

2.6.4 Independent audits

Independent assessments of training courses by subject matter experts and experts in training methodology is recommended. Such reviews could include the evaluation of the training in terms of [1]:

- Course content;
- Presentation methods;
- Qualifications of the trainer;
- Course organization;
- Lesson plans;
- Training materials;
- Participant assessment;
- Record keeping;
- Administrative procedures.

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3. Proposal for quality criteria and specifications in the field of RWM

Based on the SAT system, which is described in detail in the previous section (2. Systematic Approach to Training), quality criteria and specifications for new training courses developed for the School of RWM and in the field of RWM are described next. In EJP EURAD, for example, new courses for the School of RWM will be developed in close collaboration with experts from the RD&D, Strategic Studies WPs and external training providers. However, the training strategy for EURAD will be outlined in a separate document, entitled "EURAD KM and Networking programme".

Note that criteria from the analysis, design and development phases are meant to be met before the start of the training course. Within EURAD, only courses that meet these criteria will be published on the official EURAD School of RWM website.

3.1 Analysis phase

Prior to organizing a training course, an analysis should be made as described in section '2.2 Analysis of Training Needs'. This will be illustrated with how this was done in EURAD.

The analysis phase for training courses within EURAD is closely linked to the EURAD survey on training initiatives. This survey was performed by EURAD WP13 between March 2020 and June 2020 and questioned EURAD partners on: which training courses they currently organized in the field of RWM, which training they plan to organize within EURAD, what their training needs are and which infrastructures are available in their institute for technical visits/internships. The results from this survey will serve as input for following WP13 deliverables:

- D13.1: List of training needs
- D13.2: Mapping the available course materials
- D13.3: Alignment of the available course materials with the Roadmap
- D13.4: Priority list and schedule for training and mobility

Of these, D13.1 and D13.4 are direct inputs for the analysis phase since they provide information on the training needs as well on the level of priority of these needs. The information from these deliverables will feed into the EURAD Roadmap. Therefore, the Roadmap provides an overview of existing knowledge, training offers as well as knowledge gaps/training needs. Additional input on training needs and state-of-the-art knowledge can be obtained via the EURAD Colleges and EURAD WP11 State-of-knowledge, respectively. Compiling all this information can be used to identify the target audience, the content topics and the envisaged competences.

Note that the training needs of different Member States will differ depending on the current stage of their RWM programme. Therefore, an analysis based on the different phases of the RWM programmes needs to be performed to develop relevant training materials for each stage.

An example of an analysis phase for Member States with early stage RWM programmes may look like this:

- *Training needs:*
  - *Determination of the site for radioactive waste disposal*
  - *Licensing of the site*
  - *National and international regulations regarding radioactive waste disposal*
  - *Facility design*
  - *Safety analysis and safety case development*
- *Target audience:*
  - *Regulatory authorities*
  - *Operators of the (planned) facility*
- *Content topics:*
  - *Implementation of a RWM programme*

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- o *Regulations and legislation*
- o *Siting and licensing procedures*
- o *Safety assessment*

3.2 Design phase

During the design phase, it is recommend to keep following criteria in mind:

- ▪ Training aims

  The training aims are formulated based on the training needs and ideally provide an overview of the KSA that will be addressed during the training course. The relevance of the training aims (and learning outcomes (see below)) should be adjusted to the competency and qualification needs of waste producers, waste management organizations and technical support organizations.

- ▪ Learning outcomes of the training

  Learning outcomes need to be clearly identified. They are a reflection of which training the participant is going to receive. That way, they help manage the expectations of the participants and gives an overview of the KSA and competences they will acquire upon completion of the course. Furthermore, the learning outcomes will help in designing the course as well as the evaluation of the participants. Within EURAD, WP13 can assist training organizers in identifying and defining the learning outcomes.

  An example of learning outcomes for a course on radioactive waste characterization and conditioning could be:
  "Upon successful completion of this training course, participants should be able to:
  - o *List the different classifications of nuclear waste and the basic principles of radioactive waste management;*
  - o *Translate these basic principles of radioactive waste management into good practices;*
  - o *Describe the different steps in radioactive waste characterization;*
  - o *Give examples of conditioning techniques;*
  - o *Describe how radioactive waste characterization and conditioning are linked to general radioactive waste management."*

- ▪ Pre-requisites

  The background knowledge and skills necessary to follow the course have to be identified, as well as the educational level (i.e. the EQF level). This allows for easy selection of participants and it is an indication of the level of training the participants will receive.

  An example for a course on engineered barrier systems could be:
  "Participants are required to have a Master's degree in engineering, a basic understanding of the principles of RWM and should be able to solve complex integrals and exponential functions."

- ▪ Content outline

  The content outline needs to be clearly defined and needs to be adjusted to the defined learning outcomes.

- ▪ Delivery strategy

  The teaching methodology should be adapted to the learning outcomes and training content. It is recommended that the methodology encourages learner participation. In EURAD, WP13 can assist other WPs in deciding upon the best delivery strategy.

  The following are examples for delivery strategies based on training content:

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- o *Classroom-based: training on the legal and regulatory framework of RWM (= knowledge-based)*
- o *Practical sessions: training on waste characterization techniques (= skill-based)*
- o *OJT: proficiency training on how to transport category A waste for a new employee by an experienced colleague (= attitude-based)*

Practical sessions and OJT ideally take place in specialized laboratories (e.g. underground research labs, radiochemistry and/or thermodynamic labs).

Please note that for (most) training courses ideally a combination of these delivery strategies is used. A training on computer modelling can consist of classroom-based learning for the theoretical basics, combined with practical sessions to put theory into practice.

- ▪ Evaluation strategy
  The trainers could include time slots for the assessment of the trainees, so that the participants are timely informed of these evaluations. Ideally, assessments take place after each module and upon completion of the training course. Feedback can be gathered on participant satisfaction (i.e. Kirkpatrick level 1), but also on the participants' knowledge (i.e. Kirkpatrick level 2). The latter, ideally, should be evaluated at the beginning and at the end of the training course. The assessment methods (e.g. questionnaire, multiple choice test) should be clearly defined prior to the beginning of the training course. WP13 can assist EURAD partners in setting up adequate assessment procedures.

3.3 Development phase

Following criteria are defined for the development phase of a training programme in the field of RWM:
- ▪ Training schedule.
  The schedule is adapted to the identified learning outcomes. WP13, as well as WP Leaders, can provide assistance in setting up the training schedule for training courses developed for the EURAD School of RWM.

- ▪ Training materials.
  The syllabus that is offered to the participants needs to be complete and adapted to the identified learning outcomes. For the EURAD School of RWM, both the WP Leaders as well as WP13 can provide help in developing the training materials.

- ▪ Practical training sessions
  Practical training sessions are adapted to the identified learning outcomes. The training facilities and materials used are current and up to date. The training facilities are adequately maintained and equipped for delivering training. WP Leaders can help identify the most suited facilities based on the training aims and learning outcomes for courses organized for the School of RWM.

- ▪ Assessment procedures
  Written, oral and/or performance evaluations are developed aimed at assessing if the identified learning outcomes were met. WP13 can assist EURAD partners in setting up adequate assessment procedures.

  An example of an evaluation could be (see the example of the learning outcomes in 3.2 Design phase) to rephrase the learning outcomes as questions (e.g. "Can you list the different

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classifications of nuclear waste?"). This allows to create an assessment quickly and it helps indicating whether the participants have met the identified learning outcomes.

3.4 Implementation phase

Implementation of the training is a key aspect of a high quality training course. Therefore, following criteria and specifications should be met:

- Participant selection policy.
  It is advised to foresee a list of detailed selection criteria (i.e. pre-requisites (see 3.2 Design phase)) to select participants, especially if there are limited places in a course (e.g. for practical training).

- Trainers and supervisors.
  Teaching staff needs to demonstrate the necessary didactic skills as well as relevant scientific and technical skills related to the course topics. They need access to sufficient resources to assure high quality training for the participants. it is recommended that they are trained in different teaching methods so that they can perform the training as effectively and efficiently as possible. EURAD WP Leaders, WP13 and/or the PMO can help identify specialists in certain topics who can be contacted to provide specific lectures during a training course based on their area of expertise.

- Training methodology
  The training methodology should be adequate to achieve the defined learning outcomes. The responsibilities of trainers and participants should be clearly stated at the start of the training course. For the EURAD School of RWM, WP13 can advise training organizers on which methodology is most suitable to reach certain learning outcomes.

- Management.
  Trainers/supervisors need to assure a high quality for the entire training course. They make sure all resources are available to achieve the expected learning outcomes. EURAD WP Leaders and WP13 can assist in managing training courses for the EURAD School of RWM.

3.5 Evaluation phase

The evaluation phase of the training course can take place during and/or after its completion. To achieve a high quality evaluation, following criteria could be used (note that not all levels of the Kirkpatrick model have to be evaluated, but it is highly recommended to evaluate at least level 1 and 2):

- Participant satisfaction – Kirkpatrick level 1. (recommended)
  An example of such feedback form can be found in Appendix B.
- Participant performance – Kirkpatrick level 2. (recommended)
  For an example of questions to be used in a knowledge-based evaluation, see 3.3 Development phase.
- Impact of the training course on the learner – Kirkpatrick level 3. (optional)
- Impact of the training course on the learner's organization – Kirkpatrick level 4. (optional)
- Quality assurance.
  A training course should be reviewed by independent auditors. In the case of the EURAD School of RWM, this can be performed by the Steering Committee. Adequate mechanisms should be provided to improve the design, delivery and resources allocated to the training course.

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4. Conclusion

The EURAD School for Radioactive Waste Management needs quality criteria and training specifications in order to deliver high quality training courses. These must be implemented coherently within the diversity of the involved course providers, i.e. the RD&D WPs, Strategic Studies WPs and external training providers.

The envisaged criteria that the EURAD School of RWM has adapted mostly follow key elements from the criteria used in the field of (nuclear) training as described in the IAEA's Systematic Approach to Training. This SAT describes a methodology for the management of training programmes, which, in the end, ensures that people are prepared for their job by having obtained the necessary competences, i.e., knowledge, skills and attitudes.

These criteria and specifications can be used for all training courses that are organized in the field of RWM. All EURAD beneficiaries that will organize training courses for the School of RWM should implement the proposed quality criteria and specifications. All course organizers within the EURAD School of RWM should use the feedback form (Appendix B) for monitoring the participants' evaluation in a uniform way. This form may be complemented with course-specific questions of interest to the course organiser.

A short "quality check-list" is given below. It forms the basis of the evaluations performed by WP13 and can be used by the EURAD School of RWM course organisers as self-assessment tool.

	EURAD training requirement according to SAT, ECVET and EQF
1	The E&T event is linked to the training needs identified in the EURAD project
2	The training aims are clearly defined
3	The learning outcomes are clearly formulated (preferably in terms of knowledge, skills and attitude)
4	The prerequisites are clearly formulated (preferably in terms of background knowledge, as well as educational level according to EQF)
5	The training course outline (training programme) is clearly defined
6	The delivery strategy (training methodology) is clearly defined and are coherent with the learning outcomes
7	The evaluation strategy is clearly defined and fits the aims and the learning outcomes of the training
8	The participant satisfaction (feedback according to Kirkpatrick level 1) is evaluated
9	The participants performance is evaluated (assessment according to Kirkpatrick level 2)
10	The quality assurance system of the training provider is described with respect to record keeping, qualification of trainers, and participant administration.

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Appendix A. Bloom's Taxonomy [6]

COGNITIVE DOMAIN (thinking, knowledge)

	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation
Definition	*Remembers previously learned material*	*Grasps the meaning of material (lowest level of understanding)*	*Uses learning in new and concrete situations (higher level of understanding).*	*Understands both the content and structure of material.*	*Formulates new structures from existing knowledge and skills.*	*Judges the value of material for a given purpose.*
Example Verbs	define identify label list name recall state	describe discuss explain locate paraphrase give example translate	apply carry out demonstrate illustrate prepare solve use	analyze categorize compare contrast differentiate discriminate outline	combine construct design develop generate plan propose	assess conclude evaluate interpret justify select support

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PSYCHOMOTOR DOMAIN (doing, skills)

	Perception	Set	Guided Response	Mechanism	Compete over response	Adaption	Organization
Definition	*Senses cues that guide motor activity*	*Is mentally, emotionally, and physically ready to act.*	*Imitates and practices skills, often in discrete steps.*	*Performs acts with increasing efficiency, confidence, and proficiency.*	*Performs automatically.*	*Adapts skills sets to meet a problem situation.*	*Creates new patterns for specific situations.*
Example Verbs	detect hear listen, observe perceive recognize see sense smell taste view watch	achieve a posture assume a body stance establish a body position place hands, arms, etc. position the body sit stand station	copy duplicate imitate manipulate with guidance operate under supervision practice repeat try	complete with confidence conduct demonstrate execute improve efficiency increase speed make pace produce show dexterity	act habitually advance with, assurance control direct excel guide maintain efficiency manage master organize perfect perform automatically proceed	adapts reorganizes alters revises changes	designs originates combines composes constructs

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AFFECTIVE DOMAIN (feeling, attitudes)

	Receiving	Responding	Valuing	Organization	Internalizing
Definition	*Selectively attends to stimuli.*	*Responds to stimuli.*	*Attaches value or worth to something.*	*Conceptualizes the value and resolves conflict between fend other values.*	*Integrates the value into a value system that controls behavior.*
Example Verbs	accept acknowledge be aware listen notice pay attention tolerate	agree to assist care for communicate comply conform consent contribute cooperate follow obey participate willingly respond visit volunteer	adopt assume responsibility behave according choose commit desire exhibit loyalty express initiate prefer seek show concern show desire to see resources to	adapt adjust arrange balance classify conceptualize formulate group organize rank theorize	act upon advocate defend exemplify influence justify behavior maintain serve support

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Appendix B. Feedback form for participants

Title of the training course

Date | Location

Tick the boxes (4 = excellent; 3 = good; 2 = sufficient; 1 = poor)

Content	Balance theory | practice 4 3 2 1 ☐ ☐ ☐ ☐	Up-to-date 4 3 2 1 ☐ ☐ ☐ ☐	Practical use of the training 4 3 2 1 ☐ ☐ ☐ ☐
The degree of difficulty in comparison with the proposed level is:	☐ higher	☐ lower	☐ as expected
In your opinion, which topics were missing to have an effective course on the stated topic?			
Remarks:			

Course material	Clearness 4 3 2 1 ☐ ☐ ☐ ☐	Completeness 4 3 2 1 ☐ ☐ ☐ ☐	Quality of the slides 4 3 2 1 ☐ ☐ ☐ ☐
Remarks:			

Organisation	Time schedule 4 3 2 1 ☐ ☐ ☐ ☐	Course environment training room 4 3 2 1 ☐ ☐ ☐ ☐	Catering, coffee breaks, lunch 4 3 2 1 ☐ ☐ ☐ ☐
Remarks:			

General			
Why did you follow this course?	☐ own interest	☐ recommended	☐ on demand of the employer
Would you recommend this course to other persons?	☐ yes	☐ no	

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Why (not)?
What would be the target public?
What would be the optimal frequency to organize this course?
Remarks:

Overall judgement of the course	4 3 2 1 ☐ ☐ ☐ ☐	

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Tick the boxes (4 = excellent; 3 = good; 2 = sufficient; 1 = poor)

(Please note that this table is for multiple instructors. Please adjust to the number of instructors in your training course)

Instructors			Clearness	Possibility for questions, interaction	Scientific knowledge	Very interesting topic	Less interesting topic
Lecture title	**Date**	**Time**					
			4 3 2 1 ☐ ☐ ☐ ☐	4 3 2 1 ☐ ☐ ☐ ☐	4 3 2 1 ☐ ☐ ☐ ☐	☐	☐
			4 3 2 1 ☐ ☐ ☐ ☐	4 3 2 1 ☐ ☐ ☐ ☐	4 3 2 1 ☐ ☐ ☐ ☐	☐	☐
			4 3 2 1 ☐ ☐ ☐ ☐	4 3 2 1 ☐ ☐ ☐ ☐	4 3 2 1 ☐ ☐ ☐ ☐	☐	☐
			4 3 2 1 ☐ ☐ ☐ ☐	4 3 2 1 ☐ ☐ ☐ ☐	4 3 2 1 ☐ ☐ ☐ ☐	☐	☐
			4 3 2 1 ☐ ☐ ☐ ☐	4 3 2 1 ☐ ☐ ☐ ☐	4 3 2 1 ☐ ☐ ☐ ☐	☐	☐
			4 3 2 1 ☐ ☐ ☐ ☐	4 3 2 1 ☐ ☐ ☐ ☐	4 3 2 1 ☐ ☐ ☐ ☐	☐	☐
			4 3 2 1 ☐ ☐ ☐ ☐	4 3 2 1 ☐ ☐ ☐ ☐	4 3 2 1 ☐ ☐ ☐ ☐	☐	☐
General judgement on instructors:			4 3 2 1 ☐ ☐ ☐ ☐	4 3 2 1 ☐ ☐ ☐ ☐	4 3 2 1 ☐ ☐ ☐ ☐		
Remarks:							

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Appendix C. Feedback form for trainers

Title of the training course

Date | Location

Trainer name

Tick the boxes (4 = excellent; 3 = good; 2 = sufficient; 1 = poor)

Participants	Background education of the participants 4 3 2 1 ☐ ☐ ☐ ☐	The interaction with participants: 4 3 2 1 ☐ ☐ ☐ ☐	Level of interest of the participants: 4 3 2 1 ☐ ☐ ☐ ☐
Remarks:			

Organisation	Time schedule 4 3 2 1 ☐ ☐ ☐ ☐	Course environment training room 4 3 2 1 ☐ ☐ ☐ ☐	Catering, coffee breaks, lunch 4 3 2 1 ☐ ☐ ☐ ☐
Remarks:			

Course programme	Logical structure: 4 3 2 1 ☐ ☐ ☐ ☐	Course content: 4 3 2 1 ☐ ☐ ☐ ☐	Balance of topics: 4 3 2 1 ☐ ☐ ☐ ☐
Were all specified learning outcomes achieved?	☐ yes		☐ no
Teaching methods appropriate to achieve learning outcomes?	☐ yes		☐ no
Remarks:			

General			
Any issues arose during the course?	☐ yes	☐ no	
Which one(s)?			
What, in your opinion, would be the optimal frequency to organize this course?			
Trainer comments			
Overall judgement	**4 3 2 1** ☐ ☐ ☐ ☐		

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