GUIDELINES FOR CONDUCTING MEASUREMENTS AND CONFORMITY ASSESSMENTS OF DECOMMISSIONING MATERIALS FOR FREE RELEASE THROUGH INDUSTRIAL DISPOSAL ROUTES

GUIDELINES

KP-SERAW-003

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Foreword

In 2021, the European Commission (EC) adopted a new proposal for a Council Regulation establishing a dedicated financial programme for decommissioning nuclear facilities and managing radioactive waste. This instrument covers the co-funding of the decommissioning programmes of Bulgaria, Slovakia, and the decommissioning of the Joint Research Centre (JRC). A separate Council Regulation was adopted for the decommissioning programme of Lithuania.

The EC JRC is mandated to foster the spread of decommissioning knowledge across all the European Union Member States and facilitate knowledge sharing arising from implementing the abovementioned decommissioning programmes, funded by the Nuclear Decommissioning Assistance Programme (NDAP).

The decommissioning operators from the NDAP (NDAP Operators) implemented and tested a knowledge management methodology in 2021 through Project ENER/D2/2020-273. Using this methodology, the NDAP Operators can develop Knowledge Products that are currently available to share with other European stakeholders. In addition, this methodology is under implementation in the JRC Nuclear Decommissioning and Waste Management Directorate (NDWMD), which becomes a knowledge generator extracting the knowledge from the ongoing decommissioning activities at the different sites (Geel, Ispra, Karlsruhe, and Petten).

The JRC NDWMD aims to become a Centre of Excellence in nuclear decommissioning knowledge management and develop a decommissioning knowledge platform which allows exchanging information and building on the best practices in the EU inside the multi-annual financial framework (2021 – 2027) strategy. The operational phase of the project is expected to start in 2024 to develop ties and exchanges among EU stakeholders and document explicit knowledge and make it available through multi-lateral knowledge transfers on decommissioning and waste management governance issues, managerial best practices, technological challenges, and decommissioning processes at both operational and organisational level, to develop potential EU synergies.

This is a Knowledge Product prepared by SERAW for the JRC NDWMD.

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PRODUCT DESCRIPTION

The "*Guideline for conducting measurements and conformity assessments of decommissioning materials for free release through industrial disposal routes"* was prepared by a team of experts from SERAW in Bulgaria.

This product provides guidance on the assessment of conformity of the present radioactive contamination in equipment with the levels set forth in regulatory documents or standards. It focuses on measurement and assessment of conformity with free release levels, specifically:

- Measurement process:
  - Measurement using measuring equipment type 4π gamma-chamber.

- Decision-making process for subsequent management:
  - Evaluation of the homogeneity of radioactivity distribution in the package being measured.
  - Assessment of conformity (comparison) with levels specified in the control procedures, regulatory documents, or standards.
  - Decision making on subsequent management – unconditional free release, conditional free release, additional activities on decontamination or disposal.

This product does not cover the overall process of management of materials generated in the decommissioning of nuclear facilities. To get the most out of this guidance it is recommended that the following activities have been completed in advance:

- Sorting of materials by type – metals, non-metals, concrete.
- Incorporation of the materials into packages suitable for measurement or laying out thereof at designated areas.
- Radiological characterization of materials – nuclide vector development.
- Elaboration of control procedures agreed by the national operator (if necessary).

The guidance and recommendations of this product are collected from the experience gained during the execution of the *Decommissioning of Units 1 to 4 of the Kozloduy NPP ("*Guideline for conducting measurements and conformity assessments of decommissioning materials for free release through industrial disposal routes"*)*, funded by the European Commission, as well as by the contributors to the Kozloduy International Decommissioning Support Fund (KIDSF) – Austria, Belgium, Denmark, France, Greece, Ireland, the Netherlands, Spain, Switzerland and the United Kingdom.

The guideline details the experience applied by SERAW in the process of management of streams of materials from dismantled equipment generated during decommissioning of nuclear facilities and aims to assist all EU State Members' decommissioning operators in performing free release of decommissioning materials.

This product was developed as part of an effort to disseminate and share with all EU State Members the knowledge acquired during the decommissioning and radioactive waste management activities performed with NDAP funding, under COUNCIL REGULATION (Euratom) 2021/100 of 25 January 2021 establishing a dedicated financial programme for the decommissioning of nuclear facilities and the management of radioactive waste and repealing Regulation (Euratom) No. 1368/2013.

ABSTRACT

Free release of materials of nuclear installations from radiological control has emerged as an important option for the management of material from decommissioning of nuclear facilities. Dismantled equipment generated by the decommissioning of nuclear facilities is a huge source of recyclable raw materials and materials for reuse. It is implicit in the concept of clearance that materials, once cleared, are subject to no further regulatory restriction or control. Consequently, cleared waste may be treated as normal waste; and materials cleared for reuse or recycling may be sold or transferred to any other party and used for any purpose without being considered radioactive.

This guideline describes the sequence, requirements and responsibilities for free release and the method of carrying out control of packages of materials, in the case of fixed geometries (drums/pallets), based on SERAW´s experience during the decommissioning of Kozloduy NPP Units 1 to 4 in Bulgaria.

The steps, tips and experience conveyed in this guideline can provide other organisations with a pathway to prevent radioactive materials spreading into the environment and reduce the costs for decontamination of dismantled equipment.

OBJECTIVE

This product aims at providing guidance to organizations that need to conduct measurements and conformity assessments of decommissioning materials and dismantled equipment for free release through industrial disposal routes. This guidance can help other operators develop their own processes and procedures for free release in accordance with the national and international legislation for management of radioactive materials generated during decommissioning.

APPROACH

The radiological basis for the guidelines is the international consensus on principles for the exemption of radiation sources and practices from regulatory control reached in 1988 and published in IAEA Safety Series No. 89. This product provides specific tips and recommendations gathered from the experience of SERAW during the decommissioning of Kozloduy Units 1 to 4. It conveys practical insights and suggestions to provide ideas and support the development of specific procedures for other operators across Europe. This is not meant to be a formal, high-level guidance on the free release of dismantled equipment, for which there is already valuable and available guidelines in the industry literature.

RESULTS, FINDINGS, AND INSIGHTS

This document provides guidance to support decision making in the free release of dismantled equipment during decommissioning, based on the experience of Kozloduy Units 1 to 4. This product compiles lessons learned and good practices related to:

- The preparation of specific batches of uniquely identified packages for free release.
- The elaboration of an updated inventory of the batch.
- The development of request templates within the of the Conformity Assessment Body (CAB) involved in the control or testing activities.
- The handing over of components and carrying out control in the CAB premises.

TARGET USERS

This product targets decommissioning operators involved in the development of free release management procedures, aiming to dispose of as much decommissioned material as possible through industrial disposal routes rather than radiological disposal routes by using surface measurements and using gamma-chamber for total counting.

APPLICATION, VALUE AND USE

This guideline could be applied by decommissioning and radioactive waste management organizations dealing with release of dismantled equipment generated by the decommissioning process of nuclear facilities. The recommendations given in this guidance are fully compliant with the recommendations of the IAEA and can be used as a complement to the mandatory and specific requirements of the regulatory authority in each country. It focuses on the measurements and conformity assessment, therefore not providing much description about the previous processes of characterization, sorting, and preliminary radiological measurement of candidate materials for free release.

This guidance contributes to the overall objective of ensuring safe control of radioactive materials spreading into the environment and prevention of environmental contamination and risks to human health that could result from uncontrolled release of radioactive materials arising from the dismantling of equipment during decommissioning. It also provides insights on how to reduce the costs for decontamination of dismantled equipment owing to preliminary characterization and sorting by type and minimising the volume of materials requiring long-term storage with its associated ongoing costs.

Users of this product can find specific benefits to:

- ensure compliance with the national and international legislation for management of radioactive materials generated during decommissioning.
- acquire additional vocational qualification of personnel directly involved in free release activities.
- elaborate a plan for radiological characterization of the radioactive contamination of the dismantled equipment,
- facilitate cost planning for expensive radiochemical analyses, defining the easy-to-measure and difficult-to-measure radionuclides.
- elaborate a methodology for deriving the nuclide vector.
- facilitate cost planning for procurement of measuring equipment,
- select a suitable measuring equipment to be used for control of the radioactive contamination of the dismantled equipment,
- elaborate a concept to sort by type and radioactive contamination of the dismantled equipment.
- optimise the costs for construction of storage sites and costs of packages for storage of dismantled equipment,
- optimise the capacity of repositories for disposal of materials characterized as radioactive waste and reducing the costs for construction of such repositories.

KEYWORDS

DECOMMISSIONING, DISMANTLING, MATERIAL MANAGEMENT, WASTE MANAGEMENT, FREE RELEASE, CLEARANCE, RADIOLOGICAL MEASUREMENT, ASSESSMENT OF CONFORMITY.

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LIST OF ACRONYMS AND DEFINITIONS

NRA:	Nuclear Regulatory Agency
BDS:	Bulgarian State Standard
ASUNE:	Act on the Safe Use of Nuclear Energy
DECOM:	Decommissioning
SSC:	Structures, systems and components
DP:	Decommissioning Plan
RRP:	Regulation on Radiation Protection
RAW:	Radioactive Waste
CAB:	Conformity Assessment Body
NF:	Nuclear Facility
EC:	European Commission
ICRP:	International Commission on Radiological Protection
IAEA:	International Atomic Energy Agency
KIDSF:	Kozloduy International Decommissioning Support Fund

Activity (of a radioactive source)	The ratio of the average number of spontaneous nuclear transformations (decays) in a radioactive substance over a small interval of time to the duration of that interval. A, A=dN/dt. Name of unit: Becquerel. Expressed in: Bq, 1Bq=1s-1.
Mass activity, specific activity	Ami [Bq/kg], the activity per unit mass of a radionuclide.
Uncertainty	A parameter related to the result of a measurement that characterizes the dispersion of the values that could reasonably be attributed to the measurand. Measurement uncertainty, in general, involves many constituents (see *'Combined uncertainty'*).
Relative Uncertainty	Uncertainty relative to the measured quantity value.

LIST OF FIGURES

1. BACKGROUND

The concept of free release was pursued for several years through IAEA working groups under a general heading of 'de minimis', mainly in relation to radioactive waste disposal in marine and terrestrial environments. In 1984, a new programme was started with the specific objectives of developing principles for exemption of radiation sources and practices from regulatory control and of developing guidance on the application of the principles to practical problems. This culminated in 1988 with the publication of Safety Series No. 89 [1], which contains results representing an international consensus on the subject.

Most of the above studies were concerned with the clearance of materials whose fate is predetermined, for example by recycling or by disposal via incineration, and therefore the clearance in such cases is conditional. National regulatory authorities may issue such clearances with clauses limiting the scope of the relevant practice. There is, however, also a need for unconditional clearance. This is because it is not always possible to be sure of the fate of a material once it is cleared and control is lost; for example, it may be disposed of, but it may just as easily be recycled. An unconditional clearance should take account of any reasonably possible scenario by which humans could be exposed to radiation after control of a material has been relinquished. In the event of transboundary movements of released materials such as scrap and waste, guidance on internationally applicable unconditional clearance levels would be needed.

The two basic criteria for determining, from a radiation protection standpoint, whether a radioactive material can be exempted from regulatory control are:

- Individual risks must be sufficiently low not to warrant regulatory concern.
- Radiation protection must be optimized, taking the cost of regulatory control into account.

In addition, exempted sources and practices must be inherently safe, with no appreciable likelihood of scenarios that could lead to a failure to meet the above criteria.

The guiding radiological criteria for exemption and clearance are expressed in terms of dose and cannot be used directly for establishing exemption or clearance levels. Hence, it is necessary to convert them into practical quantities. In this context, for solid materials, useful quantities are mass activity concentration (Bq/g) [1].

1.1. Context and needs in Bulgaria

The radiological concept of clearance can be defined as the release of radioactive materials or buildings from any further regulatory control applied for radiological protection purposes by the competent body.

According to the Bulgarian legislation - Regulation on Radiation Protection (2018), Art 40.(1), the definition of the radionuclide’s activity and specific activity in the material to be free released must be performed by accredited testing laboratories or regulatory bodies.

Accreditation is an official recognition of the technical and organizational competence of the conformity assessment body to perform certain services in accordance with the requirements of the standards. Accreditation provides assurance that the accredited bodies have technical competence and are impartial in assessing products and services against the relevant national and international standards.

In pursuance of the Bulgarian legislation requirements, on 2nd February 2018 the Bulgarian Accreditation Service Executive Agency officially accredited a specialized unit (Inspection Body Type C "RELEASE FROM REGULATORY CONTROL") at SERAW, Bulgaria.

The compliance assessment must be performed according to accredited controlled parameters:

- Specific surface β-activity.
- Equivalent Dose Rate of gamma-radiation.
- Specific mass activity.

1.2. Relevance of the guidance for other organizations

International experience has shown that acceptable results in terms of quality, throughput, and price, are practically only achievable by using a purpose-built automated measurement unit, working on the principle of total γ counting.

Free release measurement facilities are widely used for measurement of metal scrap, building rubble and various other types of material. The high throughput makes them ideal for releasing larger quantities of metal scrap, building rubble and other bulk materials arising during the decommissioning phase. The containers (usually boxes having a volume of 0.7 m³ or more) are filled with several 100 kg (up to about 1 Mg) of the material and are measured for usually less than 5 minutes in the measurement chamber where the integral gamma flux is detected by e.g.,32 detectors in 4π geometry. The throughput of these devices can reach several tens of Mg per work shift.

As bulk monitors are capable only of measuring the total gamma component, it is crucial to know the appropriate nuclide vector by which the counts delivered by the instruments can be related to volume or mass specific activity values of the radionuclides present.

An important requirement and reporting of homogeneity of activity concentration distribution. The measured activity is considered 'key nuclide equivalent' and activities of all nuclides of interest are evaluated using a measured or an estimated nuclide vector.

This guideline is based on the experience gained by SERAW in the elaboration of a material free release procedure, according to the Act on the Safe Use of Nuclear Energy (ASUNE). This guideline can help other organizations in Europe characterize equipment and components by a Nuclear Vector, perform controls of specific mass activity and gain insights on how to measure packages (pallet or drum) with dismantled equipment, based on SERAW´s experience.

The guideline can help other organization develop their own free release procedures, covering:

- Responsibilities of personnel in charge of the performance of the activity.
- The identification of applicable regulatory requirements.
- The definition of measurable and evaluated physical quantities.
- The justification of measurement methods and equipment.
- The definition of conditions and procedure for conducting of control
- Quality management requirements.
- Documents required in connection with free release order issuance application.

Organizations applying this guideline can also benefit from the experience of SERAW in obtaining accreditation for "RELEASE FROM REGULATORY CONTROL". The practical application of this guidance will need further work from the end user organization to customize the ideas and process to their specific needs and regulatory requirements.

2. SCOPE

This guideline covers several steps in the measurement process and evaluation of compliance for the free release of dismantled equipment. Specifically, it focuses on:

- The measurement of packages and control of mass activity.
- The Conformity Assessment process to support decision making on subsequent material management.

It also highlights the importance of the prior work for materials free release activities that needs to be performed, namely:

- Preliminary sorting by type – metals, non-metals, concrete.
- Radiological characterization – nuclide vector development.
- Establishment and accreditation of specific Inspection Bodies for free release.

3. GUIDELINE

3.1. Overview of the Measurement Process and Evaluation Criteria for Free Release of Materials

A block diagram of the process of formation of batches of packages, measurement and analysis of results is shown in Figure 1. This flowchart can help organizations in Europe develop their own process to measure and justify free release of materials.

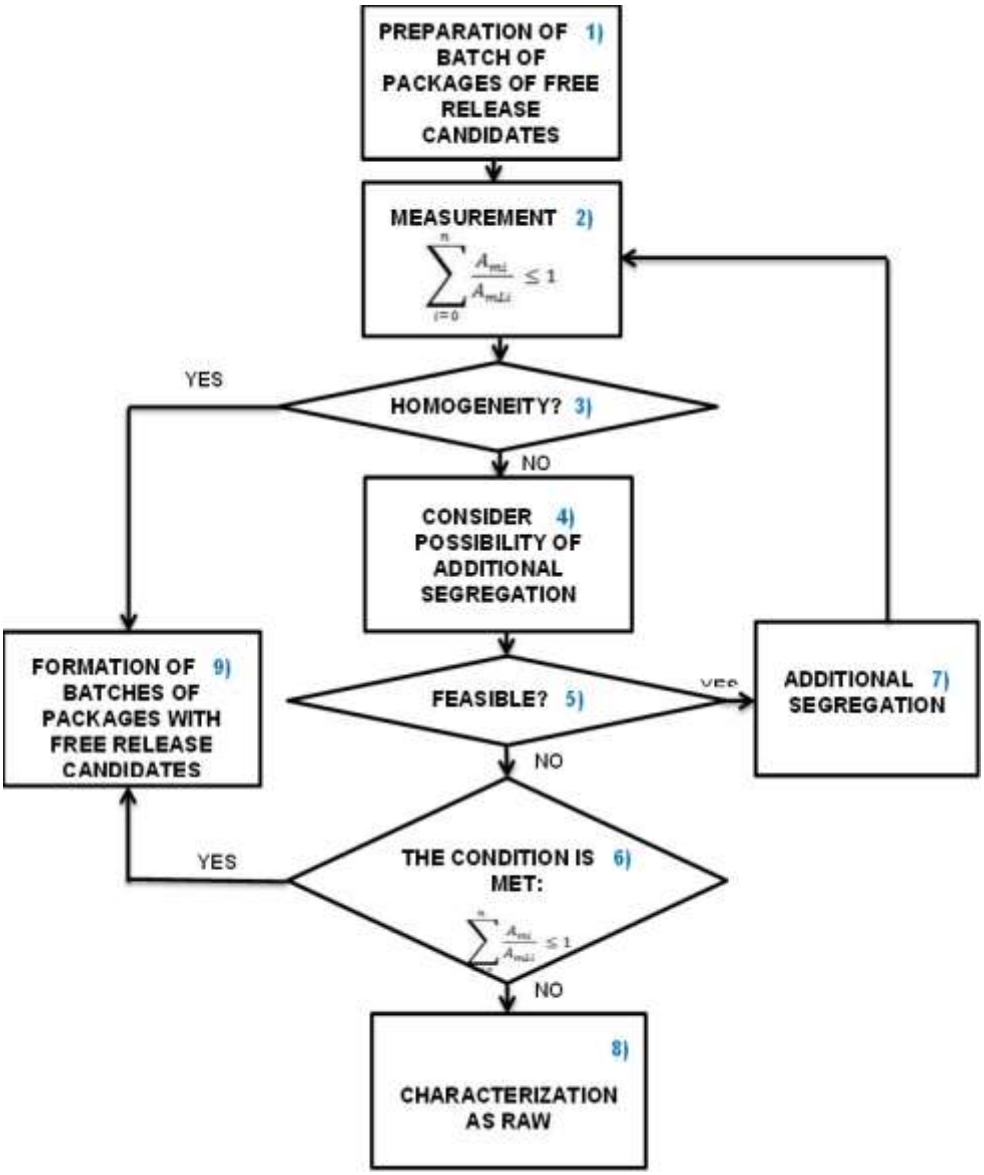

Figure 1 – Measurement process and evaluation of compliance with the criteria

STEP 1

- Consider the measurement of packaged components using MI type 4π gamma-chamber, calibrated against the quantity of specific (mass) activity [Bq/g], for each of the key gamma nuclides.
- Scope of control: 100%, on all packages in the case of Kozloduy Units 1 to 4 .

STEP 2

- Based on the origin of the components, the radiological characterization, and the corresponding updated nuclide vector, calculations are performed using the formula:

$$\sum_{i=0}^{n} \frac{A_{mi}}{A_{mLi}} \leq 1$$

where:

A_{mi} [Bq/g] is the calculated specific activity of the i-th nuclide;

A_{mLi} [Bq/g] is a threshold level, according to Art. 38, par. 1, Annex No. 3, Table 2 (unconditional release from regulatory control), and levels according to Art. 39, par. 3, Annex No. 3, Table 4 (conditional release from regulatory control) of the Bulgarian Regulation on Radiation Protection.

It is advisable to take into account inhomogeneity in the distribution of the measured activity if it is detected during measurement of the packages.

STEPS 4 – 5 - 7

- The costs expressed in the efforts, time and resources invested in sorting and/or subsequent segregation of free release candidate materials, shall be economically justified.
- The possibility of further actions (shifting and/or additional decontamination), the hazards and risks to personnel associated with segregation and separation of the components, the future management of the materials, as radioactive waste (LLW, VLLW), or as candidate materials for conditional release from regulatory control, shall be assessed.

STEP 6

- In this step, organizations must evaluate whether the conditions for free release are met.
- If proven impossibility and/or economically unjustified costs of carrying out further actions (sorting, shifting, decontamination) in order to achieve activity distribution homogeneity in the package are justified, but the ratio is fulfilled:

$$\sum_{i=0}^{n} \frac{A_{mi}}{A_{mLi}} \leq 1$$

then the conditions under Art. 33 par. 1, of the Regulation on Radiation Protection – 2018 will be met, and the packages can be requested for free release.

STEP 8

- If the conditions are not met, then package is characterized as RAW.

STEP 9

- If the conditions are met, the organization may go ahead with the development of a batch of packages of free release candidates.

3.2. Prior Work for Materials Free Release Activities

It is of paramount importance to strictly comply with the national legislation regarding release from regulatory control of materials arising from dismantling activities of nuclear facilities. According to the Bulgarian legislation:

- The undertakings shall establish and maintain a documented system for the management of radioactive materials which are intended to be cleared from regulatory control, including information on their processing, decontamination, storage, transportation, measurement, delivery, traceability, and recording.
- Determination of specific activity of the radionuclides contained in the material subject to clearance from regulatory control shall be carried out by accredited inspection bodies.

Prior work for materials free release activities, include, among others:

- Preliminary sorting by type – metals, non-metals, concrete.
- Radiological characterization – nuclide vector development.
- Establishment and accreditation of specific Inspection Bodies for free release.

In 2016, a new structural unit was established within the structure of SERAW – Inspection Body of Type C – Free Release.

In 2018, the Inspection Body of Type C – Free Release successfully defended and obtained accreditation to ISO/IEC 17020:2012 [2] which specifies **requirements for the competence of bodies performing inspection and for the impartiality and consistency of their inspection activities**.

In 2019, the Inspection Body of Type C – Free Release successfully extended its scope of accreditation by adding a new parameter – specific mass activity.

All activities on measurement and assessment of conformity with levels set out in normative documents are in compliance with ISO/IEC 17020:2012:

- Availability of sufficient number of trained and competent personnel.
- Availability of suitable premises for the purpose of performing of control.
- Availability of sufficient number of measuring instruments, calibrated against the respective quantity (Bq/g, Bq/cm2, H*10[Sv];)

Consider accreditation of a specialized team as an official recognition of the technical and organizational competence of the conformity assessment body to perform certain services in accordance with the requirements of the standards. Accreditation provides assurance that the accredited bodies have technical competence and are impartial in assessing products and services against the relevant national and international standards.

The applicable regulatory requirements and preconditions described above reflect the sequence of preliminary activities implemented at Kozloduy prior to undertaking free release measurement activities. These may vary with different organizations/Decommissioning Operators subject to the local site conditions, national legislation, and regulatory requirements.

3.3. Characterization by a Nuclear Vector

In the Section 4.2.1 of the international standard ISO 11932:1996 – “Activity measurements of solid materials considered for recycling, re-use or disposal as non-radioactive waste”, it is clearly set forth that the radioactive mixture of the present contamination on equipment dismantled from nuclear facilities, should be known in advance. Due to that reason:

- All dismantled equipment is sorted by type: metal, construction waste, concrete, non-metals, etc.

- All dismantled equipment from Units 1-4 of Kozloduy NPP has been characterized by a Nuclide Vector (NV) and radiologically surveyed.
- Prior to packaging, each of the components was radiologically characterized by As [Bq/cm2] and H*10 [Sv].

It is recommended to use an array of nuclide vectors depending on the equipment dismantling location – Turbine Hall or Controlled Area. During decommissioning of Kozloduy NPP Units 1 to 4, the equipment was characterized by means of 4 nuclide vectors.

3.4. Measurement of Packages. Control of Mass Activity

International experience has shown that acceptable results in terms of quality, throughput, and price, are practically only achievable by using a purpose-built automated measurement unit, working on the principle of total γ counting. An important requirement is the reporting of homogeneity of activity concentration distribution. In addition:

- All dismantled equipment is sorted by type: metal, construction waste, concrete, non-metals, etc.
- All small components after decontamination are placed in a drum or pallet type packages.

Figure 2 - Components placed on pallet type packages at SERAW

Measurement of packages (pallet or drum) with dismantled equipment were performed with gamma-camera type measurement instruments in Kozloduy. SERAW used these instruments to demonstrate compliance with the levels for free release.

Unlike gamma-spectrometric measurement, which for low activities can take hours, the total γ counting is a fast, accurate and reliable method.

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The experience gained at SERAW demonstrates that it is possible to measure up to 25 tonnes of metals in 8 hours (at maximum load).

Thus, at an average load, about 5,000 tonnes of materials (mainly metals) can be measured and assessed for conformity. A larger volume of measured packages may be achieved by using two or more measuring systems.

> Packages filled with soils may also be measured, which is a very good method for the release from regulatory control of adjacent areas to the buildings of the nuclear facilities

Practically, various types of materials (metals, construction waste and others) are measured in a pallet of volume of 0.74 m^3.

The SERAW-used measuring equipment type γ camera is calibrated against the key nuclides 60Co and 137Cs. Homogeneity of activity distribution in the packages being measured is performed automatically by the measurement processing software.

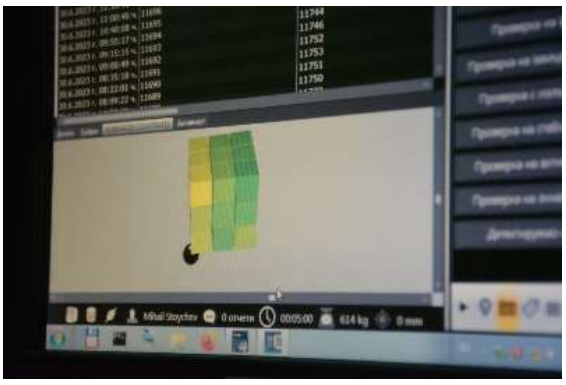
Packages are transported to the measurement area

Packages are placed in the measurement chamber

The package is moved into the measuring chamber

Measuring the mass of the package

Pulses of each of the camera detectors



Distribution of activity in the package

Figure 3 - Measurement of packages

It is recommended that measuring equipment (4π gamma-chamber) is calibrated against the respective radionuclides. The calibration shall be carried out according to a preliminarily developed Calibration Programme.

Considerations on calibration times:

- Personnel shall be trained in use of each specific measuring instrument.
- SERAW decided to go for a 3-year re-calibration period of the γ chamber currently in use. The re-calibration period of the measuring equipment should not go beyond one pre-accreditation interval, which is 4-year. This period was selected based also on the results of daily measurements (performing a verification) in the chamber with a calibration source.
- Prior to initiating a measurement, the chamber is verified on a daily basis by carrying out a point-source measurement in its centre.
- The measured activity of the point-source should not differ by 20% of its activity as of the measurement date.
- Specifically, the γ chamber being in use at SERAW, is capable of performing a self-diagnostic and does not allow starting a measurement of packages before having all its parameters initially verified.

3.5. Conformity Assessment

In the case of proven impossibility and/or economically unjustified costs of carrying out further actions (sorting, shifting, decontamination) in order to achieve activity distribution homogeneity in the package, ***but the ratio is fulfilled***:

$$\sum_{i=0}^{n} \frac{A_{mi}}{A_{mLi}} \leq 1,$$

then the packages can be requested for free release.

Otherwise, the materials are characterized as radioactive waste and transferred for disposal in a disposal facility.

Since 2018 – obtaining accreditation for an Inspection Body Type C "RELEASE FROM REGULATORY CONTROL"– a conformity assessment has been performed and more than 10,000 tons of materials – metals, concrete blocks and construction waste have been free released.

10 Ktons of materials – metals, concrete blocks and construction waste have been free released at Kozloduy NPP

4. CONSIDERATIONS FOR THE IMPLEMENTATION OF THIS GUIDANCE

The guidelines are applicable to all cases of management of radioactive materials arising from the decommissioning of nuclear facilities.

Here are some considerations that must be considered when applying this guidance:

4.1. Preliminary Conditions

This guideline can only be effectively implemented under the following conditions:

- Preliminary characterization of all the dismantled equipment by nuclide composition (nuclide vector).
- Preliminary sorting of the dismantled equipment by type (metal, non-metal), origin (Turbine Hall, Controlled Area).
- Existence of operational procedures agreed with the national regulator (if necessary and applicable).
- Trained and competent personnel (if necessary, accredited to ISO/IEC 17020, ISO/IEC 17025 [3]) for working with the instruments.
- Availability of appropriate measuring instruments (4π gamma-chamber).

4.2. Safety & Environmental Considerations

The presented approach strictly follows the recommendations of the IAEA for the management of radioactive materials arising from the decommissioning of nuclear facilities. It ensures protection of human health and life, as well as non-spreading of radioactivity into the environment.

It is essential not to allow spread of radioactivity into the environment. That is why it is therefore important to apply the respective national legislation in the field of free release.

Revise specific national legislation in the field of free release and ensure that your procedures are compliant with national regulatory safety standards

4.3. Organizational Considerations

- Establish a specific organization / unit in charge of the measurement of materials – free release candidate materials and conformity assessment.
- Accreditation is an official recognition of the technical and organizational competence of the conformity assessment body to perform certain services in accordance with the requirements of the standards. This approach worked well when applied in the process of decommissioning of Units 1 to 4 of Kozloduy NPP.

It is a good idea to seek for official accreditation of the technical and organizational competence of the conformity assessment body

4.4. Quality Considerations

- Ensure that the procedures you develop based on this guidance are in accordance with the requirements of the processes/procedures for Document Management, Record

Management, Management of Measuring instruments and Human Resources Management shall apply.

- Quality control when performing radiation control of dismantled equipment/packages shall be carried out by monitoring and/or measurement.
- The working practices of the operating personnel shall be monitored for compliance with the specific requirements when performing control.
- The completeness and accuracy of the original data records shall be checked on an ongoing basis so that no information is found to be missing at a later stage.
- A random sample of already measured packages shall be re-measured to validate the control results.
- An ongoing check with a calibration source shall be performed on the measuring instruments used before starting work.
- Identified deviations or disruptions in the work process shall be identified as nonconformities to the specified requirements and are managed according to the QMS of the person performing control. The corrections and/or corrective actions taken aim to improve the quality of work. With the same objective in view, as early as at the stage of planning the control activities, appropriate preventive measures could be foreseen and taken to prevent non-conformities.

5. SUMMARY OF KEY RECOMMENDATIONS

- The parameter 'Specific mass activity' is a basic radiological characteristic of materials arising from dismantling activities of nuclear facilities that are candidate materials for free release from regulatory control.
- Accordingly, it is extremely important that the quantification of this parameter is carried out by trained and competent personnel who are accredited. Accredited bodies have technical competence and are impartial in assessing products and services against relevant national and international standards. It is important that measurements are made using a reliable and efficient measuring equipment.
- Very often, materials and equipment, deemed to be radioactively contaminated, are irregularly shaped. Due to that reason, measuring of radioactive contamination by performing surface scanning with portable measuring instruments is almost impossible since the entire area is not accessible.
- Such materials and equipment shall carefully be sorted by type, fragmented, and placed into packages with a regular shape – pallet or drum type package. The so formed packages are measured by specific mass activity in gamma chamber measuring equipment.
- The accurate quantification of activity by mass activity and comparison with levels laid out in legislation, subordinate legislation, regulations, standards and technical specifications ensures that uncontrolled release of radioactivity into the environment will not be allowed.
- Consequently, the life and health of the public will not be endangered by the harmful influence of radioactive waste generated as a result of the use of state-of-the-art technologies.

6. CONCLUSIONS

This guideline summarizes the recommendations and key lessons learned by SERAW in the development and implementation of a process for the free release of materials at Kozloduy Units 1 to 4. It focuses on the measurement process and the conformity assessment criteria to support decision making for other operators in Europe that are planning on conducting activities for the free release of materials.

Since 2018, SERAW has obtained an accreditation for Inspection Body of Type C - Free Release, a conformity assessment that had allowed the free release of more than 10,000 tonnes of materials – metals, concrete blocks and construction waste.

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