

IAEA Safety Standards

for protecting people and the environment

Decommissioning of Facilities Using Radioactive Material

Safety Requirements

No. WS-R-5



IAEA

International Atomic Energy Agency

IAEA SAFETY RELATED PUBLICATIONS

IAEA SAFETY STANDARDS

Under the terms of Article III of its Statute, the IAEA is authorized to establish or adopt standards of safety for protection of health and minimization of danger to life and property, and to provide for the application of these standards.

The publications by means of which the IAEA establishes standards are issued in the **IAEA Safety Standards Series**. This series covers nuclear safety, radiation safety, transport safety and waste safety, and also general safety (i.e. all these areas of safety). The publication categories in the series are **Safety Fundamentals, Safety Requirements and Safety Guides**.

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IAEA SAFETY STANDARDS SERIES No. WS-R-5

DECOMMISSIONING OF
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SAFETY REQUIREMENTS

INTERNATIONAL ATOMIC ENERGY AGENCY
VIENNA, 2006

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email: sales.publications@iaea.org
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Printed by the IAEA in Austria
October 2006
STI/PUB/1274

IAEA Library Cataloguing in Publication Data

Decommissioning of facilities using radioactive material : safety requirements. — Vienna : International Atomic Energy Agency, 2006.

p. ; 24 cm. — (IAEA safety standards series, ISSN 1020-525X ; no. WS-R-5)

STI/PUB/1274

ISBN 92-0-110906-7

Includes bibliographical references.

1. Nuclear facilities — Decommissioning — Safety measures — Standards. I. International Atomic Energy Agency. II. Series.

IAEAL

06-00456

FOREWORD

**by Mohamed ElBaradei
Director General**

The IAEA's Statute authorizes the Agency to establish safety standards to protect health and minimize danger to life and property — standards which the IAEA must use in its own operations, and which a State can apply by means of its regulatory provisions for nuclear and radiation safety. A comprehensive body of safety standards under regular review, together with the IAEA's assistance in their application, has become a key element in a global safety regime.

In the mid-1990s, a major overhaul of the IAEA's safety standards programme was initiated, with a revised oversight committee structure and a systematic approach to updating the entire corpus of standards. The new standards that have resulted are of a high calibre and reflect best practices in Member States. With the assistance of the Commission on Safety Standards, the IAEA is working to promote the global acceptance and use of its safety standards.

Safety standards are only effective, however, if they are properly applied in practice. The IAEA's safety services — which range in scope from engineering safety, operational safety, and radiation, transport and waste safety to regulatory matters and safety culture in organizations — assist Member States in applying the standards and appraise their effectiveness. These safety services enable valuable insights to be shared and I continue to urge all Member States to make use of them.

Regulating nuclear and radiation safety is a national responsibility, and many Member States have decided to adopt the IAEA's safety standards for use in their national regulations. For the Contracting Parties to the various international safety conventions, IAEA standards provide a consistent, reliable means of ensuring the effective fulfilment of obligations under the conventions. The standards are also applied by designers, manufacturers and operators around the world to enhance nuclear and radiation safety in power generation, medicine, industry, agriculture, research and education.

The IAEA takes seriously the enduring challenge for users and regulators everywhere: that of ensuring a high level of safety in the use of nuclear materials and radiation sources around the world. Their continuing utilization for the benefit of humankind must be managed in a safe manner, and the IAEA safety standards are designed to facilitate the achievement of that goal.

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1. INTRODUCTION

BACKGROUND

1.1. The term ‘decommissioning’ refers to the administrative and technical actions taken to allow the removal of some or all of the regulatory requirements from a facility (except for a repository, for which the term ‘closed’ and not ‘decommissioned’ is used). A facility, as used in this Safety Requirements publication, means a building and its associated land and equipment in which radioactive material is produced, processed, used, handled or stored on such a scale that consideration of safety is required. Decommissioning is increasingly becoming a major issue, since hundreds of facilities will end their operational lifetimes over the next 50 years.

1.2. Decommissioning activities are performed with an optimized approach to achieving a progressive and systematic reduction in radiological hazards, and are undertaken on the basis of planning and assessment to ensure the safety of workers and the public and protection of the environment, both during and after decommissioning operations.

1.3. A facility is considered decommissioned when an approved end state¹ has been reached. Subject to national legal and regulatory requirements, this end state encompasses partial or full decontamination and/or dismantlement, with or without restrictions on further use.

1.4. Decommissioning can be divided into preparatory and implementation phases, both of which are discussed in this publication. Preparations for decommissioning include the development of a decommissioning strategy, initial decommissioning planning and radiological characterization of the facility. Implementation of decommissioning includes preparation of a final decommissioning plan and its submission to the regulatory body for authorization or approval, management of the project and implementation of the plan, management of the waste and demonstration that the site meets the end state criteria defined in the plan.

¹ The end state is defined as a predetermined criterion defining the point at which a specific task or process (i.e. decommissioning) is to be considered completed. The actual end state is tailored to address the safety and environmental needs in each situation.

1.5. Over the years, several methods have been used for describing the operating organization's² decommissioning strategies. In the past, one of those methods included a system of referring to various decommissioning options as Stage 1, Stage 2 or Stage 3. This nomenclature has not been used in the publications of the IAEA since the late 1990s. Approaches being implemented or considered by Member States include immediate dismantling, deferred dismantling and entombment. Other options or slight modifications of these strategies are possible. These strategies are, in principle, applicable to all facilities; however, their application to some facilities may not be appropriate owing to political concerns, safety or environmental requirements, technical considerations, local conditions or financial considerations. The following is a short description of each of these decommissioning strategies:

- *Immediate dismantling* is the strategy by which the equipment, structures and parts of a facility containing radioactive contaminants are removed or decontaminated to a level that permits the facility to be released for unrestricted use, or with restrictions imposed by the regulatory body. In this case decommissioning implementation activities begin shortly after the permanent cessation of operations. This strategy implies prompt completion of the decommissioning project and involves the removal of all radioactive material from the facility to another new or existing licensed facility and its processing for either long term storage or disposal.
- *Deferred dismantling* (sometimes called safe storage, safe store or safe enclosure) is the strategy in which parts of a facility containing radioactive contaminants are either processed or placed in such a condition that they can be safely stored and maintained until they can subsequently be decontaminated and/or dismantled to levels that permit the facility to be released for unrestricted use or with restrictions imposed by the regulatory body.
- *Entombment* is the strategy by which radioactive contaminants are encased in a structurally long lived material until radioactivity decays to a level permitting the unrestricted release of the facility, or release with restrictions imposed by the regulatory body.

² The operating organization is defined as any organization or person applying for authorization or authorized and/or responsible for nuclear, radiation, radioactive waste or transport safety when undertaking activities or in relation to any facilities or sources of ionizing radiation.

1.6. Deferred dismantling and entombment strategies also allow for the processing of some radioactive material and its removal from the facility, even though these activities may be delayed or only partially implemented.

1.7. This publication supersedes the parts of Ref. [1] that are concerned with decommissioning requirements.

OBJECTIVE

1.8. The objective of this publication is to establish the basic safety requirements that must be satisfied during the planning and implementation of decommissioning for the termination of practices and for the release of facilities from regulatory control.

SCOPE

1.9. This publication deals with all phases of decommissioning and also establishes requirements for the period after the permanent planned shutdown of a facility at the end of its operational lifetime. However, most of the provisions contained in this safety standard can also be applied to decommissioning after an abnormal event that has resulted in serious damage to or the contamination of a building, or simply after a premature shutdown. This publication applies to all types of facility, including nuclear power plants, research reactors, fuel cycle facilities, manufacturing plants, medical facilities, research and university laboratories and other research facilities. It does not apply to mill tailings, waste disposal sites or waste repositories. The closure of these facilities is discussed in other IAEA publications [2, 3].

1.10. The definition of decommissioning (para. 1.1) makes it clear that decommissioning is concerned with buildings, including their associated land and equipment. There may be areas of land that have become contaminated incidentally to the normal operation of the facility, which would not constitute an accident or abnormal event. The cleanup of these areas would also be included as part of decommissioning. This publication does not address the remediation of large areas that have become contaminated as a result of an accident, past activities, discharges that have not been properly controlled, or contamination resulting from past events (e.g. nuclear weapon testing). The requirements for the remediation of these large areas are established in another IAEA publication [3].

1.11. The management and disposition of new and spent nuclear fuel and waste generated during operations are not normally considered part of decommissioning activities, but are addressed as part of operations.

1.12. This publication addresses the radiological hazards resulting from decommissioning activities. Non-radiological hazards, such as industrial hazards or hazards due to chemical waste, can also be significant during decommissioning. These issues shall be given due consideration during the planning and implementation process, in the safety assessments and environmental assessments, and in the estimation of costs and the provision of finance for the decommissioning project; however, this publication does not explicitly address these issues.

STRUCTURE

1.13. Section 2 establishes the requirements for the protection of workers, the public and the environment. The responsibilities of the major parties associated with decommissioning are discussed in Section 3. Section 4 establishes the requirements for developing a decommissioning strategy and Section 5 covers the resulting decommissioning plan. Section 6 establishes the requirements for the funding of decommissioning and Section 7 establishes the requirements for the management of decommissioning. Section 8 establishes the requirements to be followed during the conduct or implementation of decommissioning activities. Section 9 establishes the requirements for determining when decommissioning has been completed, including surveys to support the termination of decommissioning activities.

2. PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

2.1. The activities associated with the decommissioning of a facility shall be considered part of the original practice³ and the requirements of the Basic

³ A practice is defined as any human activity that introduces additional sources of exposure or exposure pathways or extends exposure to additional people or modifies the network of exposure pathways from existing sources, so as to increase the exposure or the likelihood of exposure of people or the number of people exposed [5].

Safety Standards (BSS) [4] shall be enforced during all decommissioning activities.

2.2. The dose limits for the normal exposure of workers and members of the public shall be applied. Radiation protection of any persons who are exposed as a result of decommissioning activities shall be optimized with due regard to the relevant dose constraints.

2.3. In addition to provisions for protection against normal exposures, provision shall be made during decommissioning for protection against, and mitigation of, potential exposures that may result from an incident or accident. However, if the incident is of such a nature as to warrant an intervention, other applicable IAEA safety standards shall be invoked [3].

2.4. A safety culture shall be fostered and maintained in both the operating organization and the regulatory body in order to encourage a questioning and learning attitude to safety and to discourage complacency [5]. Individuals responsible for decommissioning activities shall be trained to appropriate levels of awareness of health, safety and environmental matters.

2.5. Environmental radiation protection, consistent with that for a practice, shall be maintained during the entire decommissioning process and beyond if a facility is released with restrictions on future use. If there are no such restrictions, the site and the facility shall meet the pertinent regulatory end point criteria.

3. RESPONSIBILITIES ASSOCIATED WITH DECOMMISSIONING

GENERAL

3.1. Each Member State where organizations use, possess, store or handle radioactive material shall include provisions in its national legal framework for decommissioning. All phases of decommissioning, from the initial plan to the final release of the facility from regulatory control, shall be regulated.

3.2. Requirements for the general responsibilities in the legal and governmental infrastructure with respect to all matters concerning nuclear activities are set out in Ref. [6]. These requirements will not be repeated here, but they also apply in establishing the appropriate infrastructure.

GOVERNMENT

3.3. The government shall provide an appropriate national legal and organizational framework within which decommissioning, including management of resulting radioactive waste, can be planned and carried out safely. This shall include a clear allocation of responsibilities, provision of independent regulatory functions and requirements for funding mechanisms for decommissioning.

3.4. The responsibilities of the government include:

- Defining the national policy for decommissioning and for management of the resulting radioactive waste;
- Defining the legal, technical and financial responsibilities of organizations to be involved in decommissioning;
- Ensuring that the necessary scientific and technical expertise remains available both for the operating organization and for the support of independent regulatory and other national review functions;
- Establishing a mechanism to provide and ensure adequate financial resources for safe and timely decommissioning.

REGULATORY BODY

3.5. The regulatory body is responsible for the regulation of all phases of decommissioning, from initial planning to termination of the practice or final release of the facility from regulatory control. The regulatory body shall establish the safety standards and requirements for decommissioning, including management of the resulting radioactive waste, and shall carry out activities to ensure that the regulatory requirements are met.

3.6. The responsibilities of the regulatory body include:

- Establishing criteria for determining when a facility or part of a facility is permanently shut down, based on termination of the authorized activities⁴;
- Establishing safety and environmental criteria for the decommissioning of facilities, including criteria for clearance of material during decommissioning and conditions on the end state of decommissioning and on the removal of controls;
- Establishing requirements for decommissioning planning;
- Reviewing the initial decommissioning plan and reviewing and approving the final decommissioning plan before allowing decommissioning activities to be commenced;
- Implementing inspection and review of decommissioning activities and taking enforcement actions in case of non-compliance with safety requirements;
- Establishing policies and requirements for the collection and retention of records and reports relevant to decommissioning;
- Evaluating the end state of a decommissioned facility and deciding whether the conditions have been met to allow the termination of the practice and/or release from regulatory controls or whether further activities or controls are needed;
- Giving interested parties an opportunity to provide comments on the plan before it is approved.

OPERATING ORGANIZATION

3.7. The operating organization shall implement planning for decommissioning and shall carry out the decommissioning activities in compliance with national safety standards and requirements. The operating organization shall also be responsible for all aspects of safety and environmental protection during the decommissioning activities. The operating organization shall provide financial assurances and resources to cover the costs

⁴ An authorized activity is defined as an activity for which any form of authorization has been given. Authorization is the granting by a regulatory body or other governmental body of written permission for an operating organization to perform specific activities.

associated with safe decommissioning, including management of the resulting radioactive waste.

3.8. The responsibilities of the operating organization include:

- Establishing a decommissioning strategy and preparing and maintaining a decommissioning plan throughout the lifetime of the facility;
- Establishing a quality assurance programme as part of the management system [7];
- Notifying the regulatory body prior to shutting down the facility permanently or terminating the activity;
- Managing the decommissioning project and performing the decommissioning activities;
- Identifying an acceptable destination for all waste arising from decommissioning;
- Performing safety assessments and environmental impact assessments related to decommissioning;
- Preparing and implementing appropriate safety procedures, including emergency preparedness, and applying good engineering practices;
- Ensuring that properly trained, qualified and competent staff are available for the decommissioning project;
- Performing appropriate radiological surveys in support of decommissioning;
- Ensuring that end state criteria have been met by performing a final survey;
- Keeping records and submitting reports as required by the regulatory body.

4. DECOMMISSIONING STRATEGY

4.1. The operating organization shall define a decommissioning strategy on which the planning for decommissioning will be based. The strategy shall be consistent with national decommissioning and waste management policy.

4.2. The preferred decommissioning strategy shall be immediate dismantling. There may, however, be situations where immediate dismantling is not a practical strategy when all relevant factors are considered. These factors may

include: the availability of waste disposal or long term storage capacity for decommissioning waste; the availability of a trained workforce; the availability of funds; co-location of other facilities on the same site requiring decommissioning; technical feasibility; and optimization of the radiation protection of workers, the public and the environment. If the deferred dismantling or entombment strategy is chosen, the operating organization shall provide a justification for the selection. The operating organization shall also demonstrate that, for the selected strategy, the facility will be maintained in a safe configuration at all times and will be adequately decommissioned in the future and that no undue burdens will be imposed on future generations.

4.3. The decommissioning strategy shall take into account that, until authorization has been given to implement the final decommissioning plan, the facility shall be considered an operating facility. All applicable requirements for the facility shall then remain in place unless the regulatory body has agreed to their reduction on the basis of a reduction of the hazards (e.g. the removal of nuclear material from the facility).

4.4. The decommissioning strategy shall include provisions to ensure that, if final shutdown occurs before a final decommissioning plan is prepared, adequate arrangements are provided to ensure the safety of the facility until a satisfactory decommissioning plan can be prepared and implemented.

4.5. If the shutdown of a facility is sudden (e.g. as a consequence of a severe accident), the facility shall be brought to a safe configuration before an approved decommissioning plan is implemented. The decommissioning strategy shall be reviewed on the basis of the situation that caused the sudden shutdown to determine whether revision is required.

4.6. Appropriate means shall be available to manage waste of all categories in a timely manner, with account taken of the overall decommissioning management strategy. Disposal is the preferred option for waste that is generated during decommissioning activities, but if disposal capacity is not available waste shall be stored safely in accordance with applicable requirements [2].

4.7. The concept of clearance [4] shall be applicable for material resulting from decommissioning activities that is released from regulatory control.

4.8. For sites that house more than one facility, a global decommissioning programme shall be developed for the entire site to ensure that

interdependences are taken into account in the planning for individual facilities.

5. DECOMMISSIONING PLAN

5.1. The operating organization shall prepare and maintain a decommissioning plan throughout the lifetime of the facility, unless otherwise approved by the regulatory body, in order to show that the decommissioning can be accomplished safely to meet the defined end state.

5.2. The decommissioning plan shall be supported by an appropriate safety assessment covering the planned decommissioning activities and abnormal events that may occur during decommissioning. The assessment shall address occupational exposures and potential releases of radioactive substances with resulting exposure of the public.

5.3. A graded approach shall be applied to the development of the decommissioning plan. The type of information and the level of detail in the plan shall be commensurate with the type and status of the facility and the hazards associated with the decommissioning of the facility.

5.4. For new facilities, consideration of decommissioning shall begin early in the design stage and shall continue through to the termination of the practice or the final release of the facility from regulatory control. The regulatory body shall ensure that operators take into account eventual decommissioning activities in the design, construction and operation of the facility, including features to facilitate decommissioning, the maintenance of records of the facility, and consideration of physical and procedural methods to prevent the spread of contamination.

5.5. For existing facilities where a decommissioning plan does not yet exist, a suitable plan for decommissioning shall be prepared as soon as possible, once the regulatory body has provided requirements and guidance, and shall be periodically updated.

5.6. The operating organization shall prepare and submit an initial decommissioning plan together with the application for authorization to

operate the facility. This initial decommissioning plan is necessary to ensure that sufficient funds will be available for decommissioning, to facilitate early planning for minimization of the need for decontamination, and to provide for early acquisition and maintenance of records important for decommissioning.

5.7. This initial plan shall be reviewed and updated periodically, at least every five years or as prescribed by the regulatory body, or when specific circumstances warrant, such as if changes in an operational process lead to significant changes to the plan. Revisions or amendments shall also be made as necessary in the light of operational experience gained, new or revised safety requirements or technological developments. If an incident or accident occurs, the decommissioning plan shall be reviewed as soon as possible and modified as necessary.

5.8. A baseline survey of the site, including obtaining information on radiological conditions, shall be performed prior to construction and updated prior to commissioning of a new facility. This information will be used to determine background conditions during the end state survey. For those practices for which such a baseline survey has not been done in the past, data from analogous, undisturbed areas with similar characteristics shall be used instead of pre-operational baseline data.

5.9. Provision shall be made, as far as possible, to ensure that key staff are retained and that institutional knowledge about the facility is maintained and is accessible. Appropriate records and reports that are relevant to decommissioning (e.g. records on the use of the facility, events and incidents, radionuclide inventories, dose rates and contamination levels) shall be retained during the lifetime of the facility. In this way the design and modifications of the facility and its operating history will be identified and factored into the decommissioning plan.

5.10. Prior to the implementation phase of decommissioning activities, a final decommissioning plan shall be prepared and submitted to the regulatory body for approval. This plan shall define how the project will be managed, including: the site management plan, the roles and responsibilities of the organizations involved, safety and radiation protection measures, quality assurance, a waste management plan, documentation and record keeping requirements, a safety assessment and an environmental assessment and their criteria, surveillance measures during the implementation phase, physical protection measures as required, and any other requirements established by the regulatory body.

5.11. During the preparation of the final decommissioning plan, the extent and type of radioactive material (irradiated and contaminated structures and components) at the facility shall be determined by means of a detailed characterization survey and on the basis of records collected during the operational period. If nuclear material or operational waste remains at the facility, this radioactive material shall be included in the characterization survey.

5.12. The methodology and criteria that the operating organization will use to demonstrate that the proposed end state has been achieved shall be stated in the decommissioning plan.

5.13. Interested parties shall be provided with an opportunity to review the final decommissioning plan and to provide comments on the plan to the regulatory body prior to its approval.

5.14. If the deferred dismantling strategy has been selected, it shall be demonstrated in the decommissioning plan that such an option will be implemented safely and will require minimum active safety systems, radiological monitoring and human intervention and that future requirements for information, technology and funds have been taken into consideration. The potential aging and deterioration of any safety related equipment and systems shall also be considered.

6. FUNDING

6.1. National legislation shall set out the responsibilities with respect to financial provisions for decommissioning. These provisions shall include establishing a mechanism to provide and ensure adequate financial resources for safe and timely decommissioning.

6.2. Adequate financial resources to cover the costs associated with safe decommissioning, including the management of the resulting waste, shall be available when needed, even in the event of premature shutdown of the facility. Financial assurances to provide for the required resources shall be in place before authorization to operate the facility is given.

6.3. The amount of financial assurance obtained shall be consistent with a facility specific cost estimate and shall be changed if the cost estimate increases or decreases. The cost estimate shall be reviewed as part of the periodic review of the decommissioning plan.

6.4. If financial assurance for the decommissioning of an existing facility has not yet been obtained, suitable funding provision shall be put in place as soon as possible. Provisions for financial assurance shall be required prior to license renewal or extension.

6.5. If the decommissioned facility is released with restrictions on its future use, financial assurance that is adequate to ensure that all necessary controls remain effective shall be obtained before authorization is terminated.

7. DECOMMISSIONING MANAGEMENT

7.1. An organization for the management and implementation of decommissioning shall be established as part of the operating organization, with the responsibility for ensuring that decommissioning will be conducted safely. The decommissioning management's reporting hierarchy and lines of authority shall be such that they do not create conflicts between organizations that could compromise safety during decommissioning.

7.2. The ultimate responsibility for safety shall remain with the operating organization, although it is permissible to delegate the performance of specific tasks to a subcontractor. The decommissioning management shall ensure that the work of contractors is appropriately controlled so that it is conducted safely. If the operating organization changes during the lifetime of the facility, procedures shall be put in place to ensure the transfer of responsibility for the safety of the facility and for the control of radioactive material.

7.3. The skills needed for decommissioning shall be evaluated and the minimum requirements for qualifications of staff in each position shall be established. It shall be ensured that an individual responsible for performing an activity during the decommissioning process has the necessary skills, expertise and training to complete the decommissioning process safely.

7.4. All individuals shall have the responsibility and authority to bring any safety concerns to the decommissioning management. The decommissioning management shall also ensure that appropriate authority for stopping work is provided.

7.5. Decommissioning tasks shall be controlled through the use of written procedures. These procedures shall be subject to review and approval by the appropriate organizations responsible for ensuring safety and practicability. A methodology for issuing, modifying and terminating work procedures shall be established.

7.6. Relevant documents and records shall be prepared by the operating organization, shall be kept for an agreed time and shall be maintained to a specified quality by appropriate parties before, during and after decommissioning.

7.7. A comprehensive quality assurance programme under the operating organization's management system [7] shall be applied to all phases of decommissioning. The programme shall include the maintenance and archiving of documents and records relating to decommissioning, and the performance of all work activities and operations for decommissioning. Features important to safe decommissioning, and therefore requiring consideration in the quality assurance programme, shall be identified by the operating organization and specified in the initial decommissioning plan.

7.8. The management of the decommissioning project shall be tailored to the project's complexity and size and to the potential hazards associated with it.

8. CONDUCT OF DECOMMISSIONING

8.1. The operating organization shall implement the decommissioning and related waste management activities in compliance with the national safety standards and requirements. The operating organization shall be responsible for all aspects of safety and environmental protection during the decommissioning activities.

8.2. The operating organization shall inform the regulatory body prior to shutting down the facility permanently. If a facility is shut down and no longer

used for its intended purpose, a final decommissioning plan⁵ shall be submitted for approval within two years of the cessation of the authorized activities, unless an alternative schedule for the submission of the final decommissioning plan is specifically authorized by the regulatory body. The operating organization shall not implement the decommissioning plan until the regulatory body has approved it. Any amendments to this plan shall also be submitted to the regulatory body for approval. The operating organization shall ensure that the facility is maintained in a safe configuration until the approval of the decommissioning plan.

8.3. In the case of deferred dismantling, the operating organization shall ensure that the facility has been placed, and will be maintained, in a safe configuration and will be appropriately decommissioned in the future. An adequate maintenance and surveillance programme, which shall be subject to the approval of the regulatory body, shall be developed to ensure safety during the period of deferment.

8.4. In order to provide an adequate level of safety, the operating organization shall, inter alia, prepare and implement appropriate safety procedures; apply good engineering practice; ensure that staff are properly trained and qualified and are competent; and keep and submit records and reports as required by the regulatory body.

8.5. Decontamination and dismantling techniques shall be chosen such that the protection of workers, the public and the environment is optimized and the generation of waste is minimized. Decommissioning activities such as decontamination, cutting and handling of large equipment and the progressive dismantling or removal of safety systems have the potential for creating new hazards. The impacts on safety of these activities shall be assessed and managed so that these hazards are mitigated and are kept within acceptable limits and constraints.

8.6. Prior to using any new or untried methods for decommissioning, it shall be demonstrated that the use of such methods is justified and is addressed

⁵ The final decommissioning plan is that version of the decommissioning plan submitted for approval to the regulatory body prior to implementation of the plan. During implementation of this final plan revisions or amendments may subsequently be needed as the activity progresses.

within the optimization analysis supporting the decommissioning plan. Such analyses shall be subject to review and approval by the regulatory body.

8.7. Emergency planning arrangements, commensurate with the hazards, shall be established and maintained and incidents significant to safety shall be reported to the regulatory body in a timely manner. Additional requirements for preparedness and response to emergencies are established in another IAEA publication [8].

8.8. A proper waste management path shall be established for all waste streams arising from decommissioning activities. If a final decision on disposal has not been made for particular waste types, the operating organization shall arrange for the safe storage of the waste until its final disposition is completed. If operational waste or nuclear fuel remains at the site after permanent shutdown of a facility, then such material shall be removed and transported to an authorized facility in compliance with applicable regulations, or else the approved decommissioning plan shall address the management of these materials.

8.9. The regulatory body shall make arrangements for and shall implement inspection and review of the decommissioning activities to ensure that they are being carried out in accordance with the decommissioning plan and with other requirements for which the regulatory body has oversight responsibility. Whenever safety requirements and conditions for authorization are not met, the regulatory body shall take appropriate enforcement actions.

9. COMPLETION OF DECOMMISSIONING

9.1. On completion of decommissioning it shall be demonstrated that the end state criteria as defined in the decommissioning plan and any additional regulatory requirements have been met. The operating organization shall only be relieved of further responsibility for the facility after approval by the regulatory body.

9.2. The facility shall not be released from regulatory control, nor shall authorization be terminated until the operating organization has demonstrated that the end state in the decommissioning plan has been reached and that any

additional regulatory requirements have been met. The regulatory body shall evaluate the end state of the site by performing a thorough inspection of the remainder of the facility after decommissioning activities have been completed to ensure that the end point criteria have been met.

9.3. A final decommissioning report shall be prepared that documents, in particular, the end state of the facility or site, and this report shall be submitted to the regulatory body for review.

9.4. A system shall be established to ensure that all records are maintained in accordance with the records retention requirements of the quality assurance system and the regulatory requirements.

9.5. If waste is stored on the site, a revised or new, separate authorization, including requirements for decommissioning, shall be issued for the facility.

9.6. If a facility cannot be released for unrestricted use, appropriate controls shall be maintained to ensure the protection of human health and the environment. These controls shall be specified and shall be subject to approval by the regulatory body. Clear responsibility shall be assigned for implementing and maintaining these controls. The regulatory body shall ensure that a programme has been established to apply the remaining regulatory requirements and to monitor compliance with them.

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ISSN 1020-525X**