ANALYSIS OF ARTEMIS PEER REVIEWS TO EUROPEAN UNION MEMBER STATES

2017-2020

IAEA

Integrated Review Service for Radioactive Waste and Spent Fuel Management, Decommissioning and Remediation

ARTEMIS

Contents

with funding from the European Commission

I. Executive Summary

This report provides an analysis of the IAEA integrated peer review service missions for radioactive waste and spent fuel management, decommissioning and remediation programmes (ARTEMIS) conducted from 2017 to 2020. During this period, the Agency conducted 11 ARTEMIS missions, of which eight addressed entire national systems for radioactive waste and spent fuel management, for all the recognized waste stream and activities.

In this report, the trends and issues highlighted during the eight ARTEMIS missions which had the same scope are disseminated to IAEA and Member States with the objective of improving the management of radioactive waste and spent fuel. The findings raised during the eight ARTEMIS missions have been analysed according to their status, as defined by ARTEMIS Guidelines:

> Recommendations: These are raised "*when aspects relative to the IAEA Safety Requirements and additional supporting documents agreed as basis for review such as International Conventions, Codes of Conduct are missing, incomplete, or inadequately implemented*."
>
> Suggestions: These "*identify opportunities for improvement not directly related to inadequate conformance with IAEA Safety Requirements, but which should be shared with the host country*."
>
> Good practices: These are "*identified in recognition of an outstanding arrangement, programme or performance superior to those generally observed elsewhere.*".

As stipulated in the ARTEMIS Guidelines, findings of ARTEMIS missions are based on IAEA Safety Standards and supporting international documents, such as IAEA Nuclear Energy Series or other international documents complementing the safety standards.

This report provides a two-step analysis:

- the distribution of findings between the categories of Recommendations, Suggestions and Good Practices, and their technical content by topic, in order to draw conclusions concerning the range and trends of the mission findings.
- a quantitative analysis of the basis used for findings in the ARTEMIS missions to indicate the role and importance of the IAEA Safety Requirements and other documents in the ARTEMIS review process in general and in the various specific ARTEMIS topics.

Among the seven topics covered by ARTEMIS missions covering the entire national system for radioactive waste and spent fuel management, the topics which resulted in the most findings are:

- Strategy
- Policy and framework

Recommendations were systematically raised in relation to the need for timely and effective implementation of national policy, and the identification of gaps/shortcomings in national policy and strategy to cover spent fuel and all types of radioactive waste from generation to disposal. The analysis

also highlighted that the significance of gaps in the availability of regulations varied depending on the regulatory approach.

The following documents were referred to most often as the basis for ARTEMIS recommendations and suggestions:

- GSR Part 1 on Governmental, Legal and Regulatory Framework for Safety (47 occurrences)
- GSR Part 5 on Predisposal Management of Radioactive Waste (42 occurrences)
- SSR-5 on Disposal of Radioactive Waste (27 occurrences).

For Good Practices, the documents most often referred to were:

- GSR Part 1 on Governmental, Legal and Regulatory Framework for Safety (16 occurrences)
- GSR Part 5 on Predisposal Management of Radioactive Waste (5 occurrences).

The safety principles and IAEA safety requirements referred to most frequently in recommendations and suggestions were:

- GSR Part 1 Requirement 10 Provision for the decommissioning of facilities and the management of radioactive waste and of spent fuel (19 occurrences)
- GSR Part 5 Requirement 6 Interdependences (11 occurrences)
- SSR-5 Requirement 1 Government responsibilities (11 occurrences)
- GSR Part 5 Requirement 2 National policy and strategy on radioactive waste management (10 occurrences).

For Good Practices, no specific safety principles and IAEA safety requirements were referred to more frequently than others. The following principles and requirements were referred to twice:

- SF-1 Principle 7 Protection of present and future generations
- GSR Part 1 Requirement 1 National policy and strategy for safety
- GSR Part 1 Requirement 10 Provision for the decommissioning of facilities and the management of radioactive waste and of spent fuel
- GSR Part 1 Requirement 36 Communication and consultation with interested parties
- GSR Part 5 Requirement 4 Responsibilities of the operator.

II. Introduction

II.1. Development of the ARTEMIS Service

The Agency developed the IAEA Radioactive Waste Management Integrated Review Service (ARTEMIS) under its Regular Budget Programme for 2014-15 under Project 3.4.1 on “Radioactive Waste and Spent Fuel Management.”

Based on several decades of experience in conducting peer reviews in the field of radioactive waste and spent fuel management, the service was structured to cover both technical and regulatory aspects

of radioactive waste and spent fuel management. The aim was to provide an integrated approach with sufficient flexibility to adapt the scope of the review and the requests and needs of Member States.

Thus, the ARTEMIS service developed by the Department of Nuclear Safety and Security and the Department of Nuclear Energy covers all aspects of radioactive waste and spent fuel management from the national legislative, regulatory and organizational framework to national policy and programme, including predisposal and disposal activities, decommissioning and remediation.

The first ARTEMIS Peer Reviews were conducted in 2017.

The ARTEMIS service is designed to allow its application to a variety of needs arising in Member States, ranging from high-level national aspects to focused, technically oriented and specific reviews. It may cover the entire national arrangements or target specific implementation aspects, with an emphasis on technology, or on safety, or both. The service may be requested for existing or planned national/institutional frameworks, systems, activities and facilities.

As such, ARTEMIS Peer Reviews may vary according to the needs of the requesting IAEA Member State. The service can support any organization involved in the management of radioactive waste and spent nuclear fuel.

ARTEMIS findings are based on IAEA Safety Standards and supporting international documents, such as the IAEA Nuclear Energy Series.

The flexibility of ARTEMIS Peer Reviews is based on a graded approach to ensure that the review (size of team, duration, etc.) corresponds to the size and scope of the national context, or the stage of development of the activity or facility being reviewed. The structure of ARTEMIS Peer Reviews, based on peer review domains (Figure 1), strengthens this flexible approach.

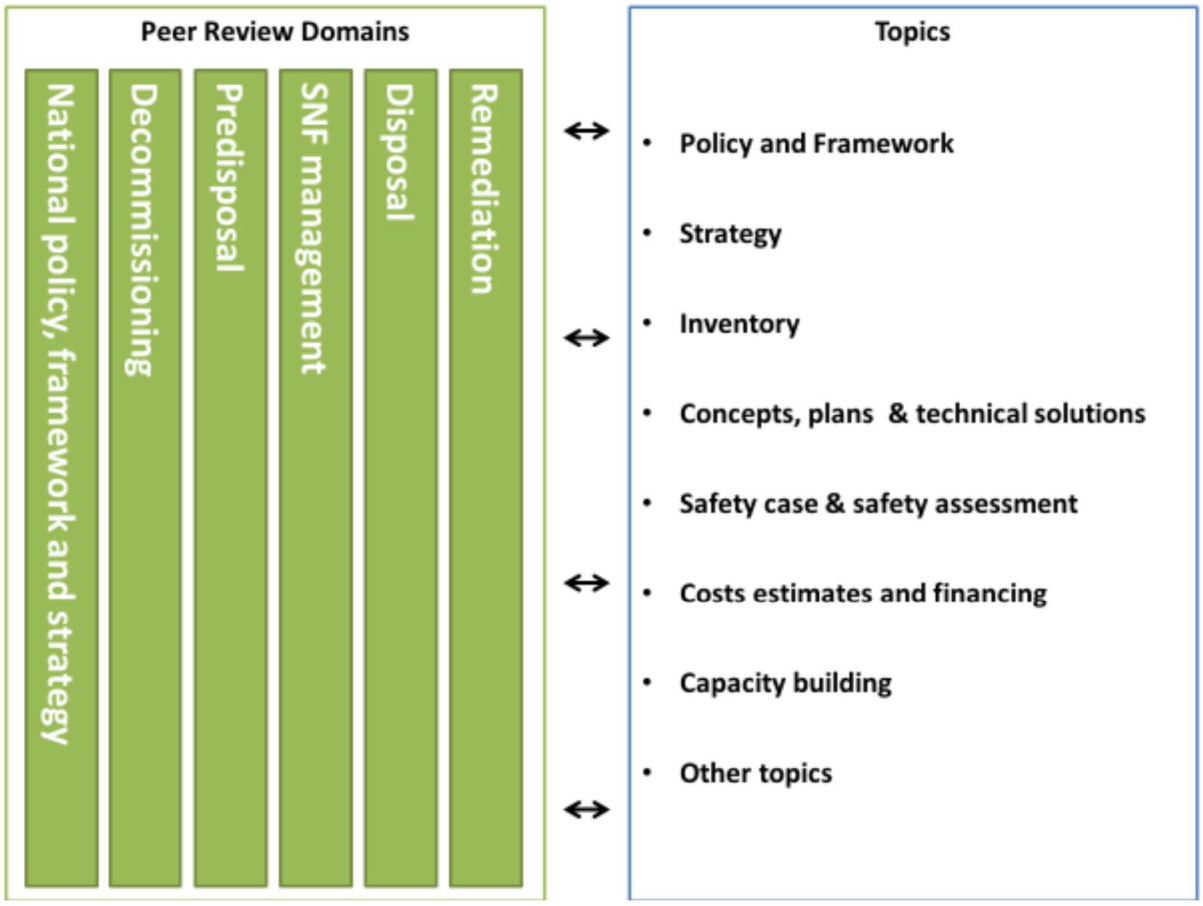


Figure 1: ARTEMIS Peer Review domains and topics

The Agency conducts ARTEMIS peer reviews on a global basis. However, the domain of national policy, framework and strategy facilitates the implementation of the Council Directive 2011/70/Euratom on establishing a Community Framework for the responsible and safe management of spent fuel and radioactive waste.

Council Directive 2011/70/Euratom (Waste Directive) places obligations on European Union (EU) Member States for periodic international peer reviews of their national framework, competent regulatory authority and/or national programme. Also, Member States shall periodically, at least every 10 years, arrange for self-assessments of their national framework, competent regulatory authority, national programme and itsimplementation.

II.2. Scope and objectives

The ARTEMIS Peer Reviews undertaken to date varied considerably in terms of size, scope and complexity. Between 2017 and 2020, 11 ARTEMIS missions have been conducted within IAEA Member States. Two missions focused on decommissioning programmes, one focused on pre-disposal management while eight missions covered the entire national system for radioactive waste and spent fuel management, for all the recognized waste streams, facilities and activities. The comparison presented in this report is limited to the same type of ARTEMIS mission and thus addresses only the

eight ARTEMIS missions which covered the entire national system for radioactive waste and spent fuel management.

The objectives of this report are to:

1. Analyse the ARTEMIS missions which covered the entire national system for radioactive waste and spent fuel management. These were conducted in EU Member States from 2017 to 2020 on the basis of the scope of the Council Directive 2011/70/Euratom.

2. Support transparency and the dissemination of information to Member States.

3. Contribute to the continuing development of the ARTEMIS service and improved management of radioactive waste management, decommissioning and remediation (RWMDR) against the Safety Standards in Member States hosting ARTEMIS missions.

4. Support the implementation of EC-IAEA cooperation in the field of nuclear safety, specifically, integrated regulatory review services in the EU.

II.3. Missions analysed

The analysis addresses eight ARTEMIS Peer Reviews implemented in European Member States between 2017 and 2020. These covered the entire national system for radioactive waste and spent fuel management and were conducted under the scope of the Council Directive 2011/70/Euratom. Figure 2 below indicates the locations of the ARTEMIS Peer Review conducted in each year, and the number of experts involved as peer reviewers for each mission. Some 46 peer reviewers took part in these missions.

2017	2018	2019	2020
Poland (5)	Bulgaria (6)	Estonia (4)	
	France (10)	Germany (8)	
	Luxembourg (2)	Latvia (4)	
	Spain[1] (7)		

Figure 2: Number of Peer Reviewers taking part in each ARTEMIS Peer Review

[1] This mission was combined with an IRRS mission.

II.4. Method of analysis

The analysis reported here was conducted in two consecutive steps.

Firstly, after a general overview of the numbers and distribution of mission findings (Recommendations, Suggestions and Good Practices), the technical content of the findings has been analysed by topic in order to draw conclusions on the range and trends of the mission findings. The areas of improvements most frequently identified during ARTEMIS missions are highlighted (Chapter IV).

Secondly, a quantitative analysis of the IAEA Safety Requirements referred to in the ARTEMIS missions has been conducted. This analysis reveals the role and importance of the IAEA Safety Requirements in the ARTEMIS review process in general and in the specific ARTEMIS Topics (Chapter V).

II.5 General references to IAEA Safety Standards

The ARTEMIS Peer Review Service provides independent expert opinion and advice on radioactive waste and spent nuclear fuel management, management of residues arising from uranium production, environmental remediation and decommissioning, based upon the IAEA safety standards and technical guidance, as well as international good practice.

The specific objective of the peer review is to review the existing national arrangements against applicable IAEA safety standards and international good practice, forming a point of reference for how the requirements are met. Thus, the Recommendations, Suggestions and Good Practices identified during a mission are based on IAEA Safety Standards (safety principles and safety requirements) and technical guidance that are clearly documented in the mission report.

The following chapter provides an analysis of the references used as the basis for Recommendations, Suggestions and Good Practices during the eight ARTEMIS Peer Reviews conducted in European Member States between 2017 and 2020. These covered the entire national systems for radioactive waste and spent fuel management and were conducted under the scope of the Council Directive 2011/70/Euratom.

When the same Requirement is used more than once as a basis for the same Recommendation or the same Suggestion, it is counted as a single reference.

> *Example: In Table 1 below, GSR Part 5 Requirement 2 is used twice as a reference for a suggestion. It is counted as one single reference.*

If two Requirements serve as the basis for one single recommendation or suggestion, then they count as two References to the safety standards.

> *Example: In Table 1 below, GSR Part 1 Requirement 1 and GSR Part 5 Requirement 2 are used as references for the same suggestion so they will be counted as two references.*

When a Requirement is used as a basis for a recommendation and a suggestion as well, or for two recommendations, it counts as two separate references to the safety standards.

> *Example: In Table 2 below, GSR Part 3 Requirement 31 is used as references for two suggestions (S5 and S6) and is counted as two references.*

Table 1

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *The Government's intent to ensure long term safety through setting out the preferred options for radioactive waste and spent fuel management and reflect national priorities as the basis for decisions is presented in multiple documents at various hierarchical levels and various ministerial areas.*	
(1)	**BASIS: GSR Part 1 Requirement 1 para. 2.3 states that** *"National policy and strategy for safety shall express a long term commitment to safety. The national policy shall be promulgated as a statement of the government's intent."*
(2)	**GSR Part 5 Requirement 2 states that** *"To ensure the effective management and control of radioactive waste, the government shall ensure that a national policy and a strategy for radioactive waste management are established. [...] The national policy and strategy shall form the basis for decision making with respect to the management of radioactive waste."*
(3)	**GSR Part 5 Requirement 2 para 3.5 states that** *"The national policy on radioactive waste management has to set out the preferred options for radioactive waste management. It has to reflect national priorities [...]"*
S1	**Suggestion: The Government should consider to enhance its statement of intent regarding the safety of SF and RAW management, through compilation of all elements of the policy on RAW and SF management in a single statement, to provide a position on the preferred options and endpoints as a clear basis for establishing a National Strategy for the management of SF and RAW.**

Table 2

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *The level of detail provided in the inventory for NHGW is limited to numbers and volumes of conditioned waste packages and weights of unconditioned waste (inorganic, organic and miscellaneous waste); there is no information on quantities and volumes, conditioning factors/processes or conditioning assumptions and characteristics for waste streams.*	
(1)	**BASIS: GSR Part 3 Requirement 31, para. 3.131 (e) states that** *"Registrants and licensees, in cooperation with suppliers, as appropriate:* *Shall maintain an inventory of all radioactive waste that is generated, stored, transferred or disposed of;"*
S5	**Suggestion: To improve transparency on how waste streams are being managed, BMU should consider including additional information and description on NHGW in future revisions of the radioactive waste inventory report.**
S6	**Suggestion: BMU should consider making greater use of the radioactive waste inventory to monitor changes in the inventory over time and demonstrate waste minimization.**

III. Distribution and analysis of findings in ARTEMIS missions by Peer Review topic

III.1. General overview of the distribution of Recommendations and Suggestions of ARTEMIS Peer Review Topics

ARTEMIS missions which covered entire national systems for radioactive waste and spent fuel management addressed seven topics. Figure 3 below lists each topic and the number of references classified as Recommendations, Suggestions and Good Practices for the eight ARTEMIS Peer Reviews in the scope of this report.

The topics which raised the most findings are:

- Strategy
- Policy and framework

The topic of Inventory and Safety case and safety assessment resulted in the lowest number of findings. Safety case and safety assessment is the only ARTEMIS topic for which no suggestions were identified.

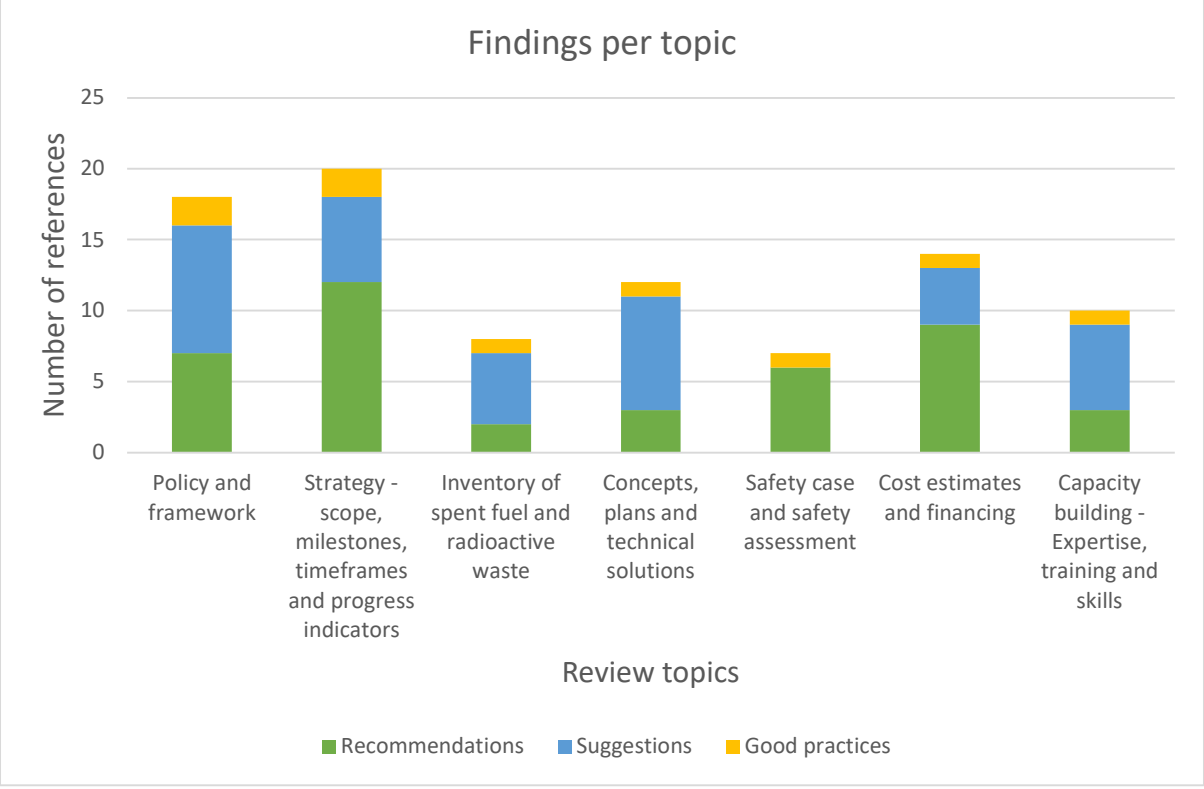


Figure 3: References to Recommendations, Suggestions and Good Practices for ARTEMIS Peer Review topics

The following chapter analyses the findings made by the ARTEMIS reviewers for each topic in order to identify general trends. For ease of reference, a short summary is provided for each finding (Recommendation, Suggestion and Good Practice) analysed. However, these shorter versions of the findings do not replace the findings as recorded in official reports which are all publicly available using the following link: Peer Review and Advisory Services Calendar | IAEA.

III.2. Topic 1: Policy and framework

This topic covers national policy, governmental, legal and regulatory framework, as well as responsibilities for radioactive waste and spent fuel management, decommissioning and remediation. Each sub-topic is analysed separately.

III.2.1. Topic 1.1: National policy

Findings concerning national policy were identified in five of the eight ARTEMIS Peer Reviews in the scope of the analysis, with a total of 2 Recommendations, 6 Suggestions and 2 Good Practices raised during the missions. Figure 4 shows the findings raised on the basis of the IAEA requirements.

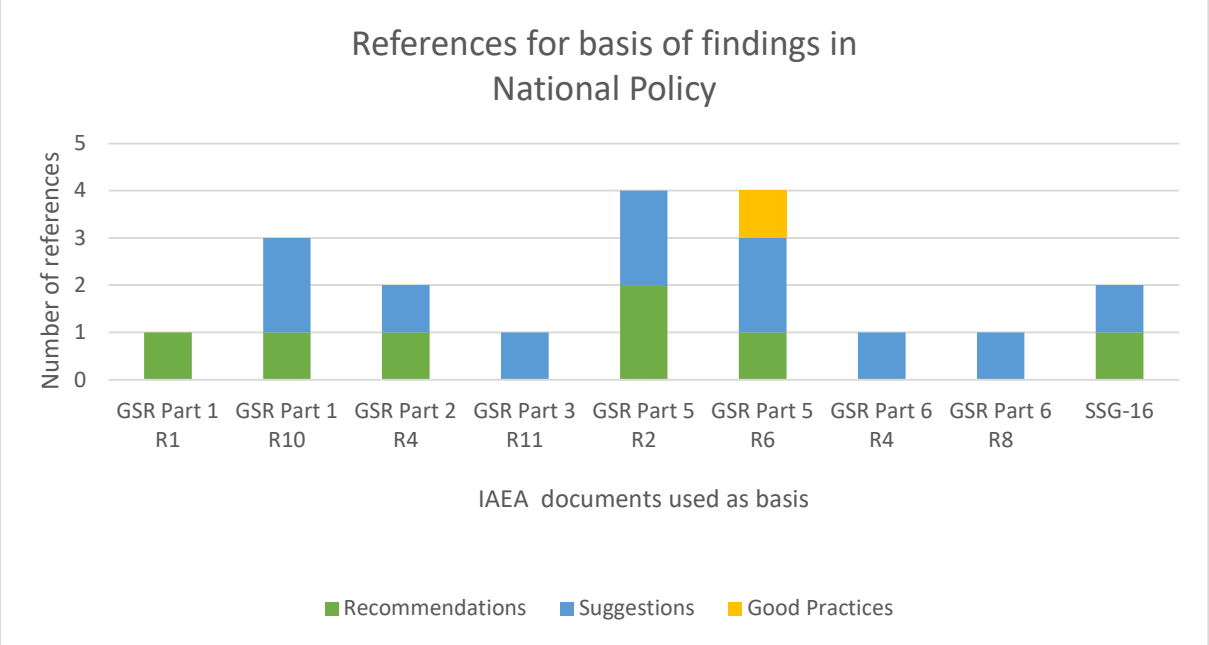


Figure 4: References for Findings used by experts under the National Policy topic

REVIEW OF FINDINGS

Bulgaria Suggestion: Policy and strategy are distributed in various documents and there is a need to consolidate and provide the position on preferred options and clear endpoints as a basis for strategy.

- GSR Part 1 Requirement 1 National policy and strategy for safety
- GSR Part 5 Requirement 2 National policy and strategy on radioactive waste management

Estonia No findings: One observation expressed some concern over policy being set only at ministerial not governmental level.

France Suggestion: French policy has set a principle to decommission in the "shortest possible time". This is challenging because of the large number of facilities and the need to have disposal capacity available when needed. The application of this principle is the subject of ongoing evaluation and discussion between the safety authority ASN and the facility owners. In order to facilitate and harmonise case by case discussions, there is a need for government to translate this principle into obligations for operators or facility owners in the national policy.

- GSR Part 1 Requirement 10 Provision for the decommissioning of facilities and the management of radioactive waste and of spent fuel
- GSR Part 5 Requirement 2 National policy and strategy on radioactive waste management
- GSR Part 6 Requirement 4 Responsibilities of the government for decommissioning
- GSR Part 6 Requirement 8 Selecting a decommissioning strategy

France Suggestion: France has considerable experience in the management of short-lived low level waste, from generation to disposal, from a large number of facilities. This involves extensive transport of the waste and large amounts will be generated during future decommissioning. Consideration should be given to all safe and feasible options in the optimisation of the management of short-lived low level waste.

- GSR Part 3 Requirement 11 Optimization of protection and safety
- GSR Part 5 Requirement 6 Interdependences

France Good Practice: There are large numbers of facilities, waste types and amounts of radioactive waste. There are various mechanisms in place to ensure coherence and to take account of interdependences in their management. The system is very structured and systematic, taking into consideration all factors and stakeholders.

- GSR Part 5 Requirement 6 Interdependences

Germany Recommendation and Suggestion: The national programme sets long term milestones, and regular monitoring of progress is necessary to ensure effective delivery and that targets are being met. A regular monitoring programme is recommended and the establishment of interim targets is suggested as indicators of progress.

- GSR Part 2 Requirement 4 Goals, strategies, plans and objectives
- GSR Part 1 Requirement 10 Provision for the decommissioning of facilities and the management of radioactive waste and of spent fuel
- SSG-16 Paragraph 16 Information to public
- GSR Part 5 Requirement 6 Interdependences

Latvia Suggestion: Latvia has Intermediate Level Waste (ILW), which is not suitable for disposal in the near surface disposal facilities currently in operation. It is suggested that the government details the preferred management option for ILW in the national policy.

- GSR Part 5 Requirement 2 National policy and strategy on radioactive waste management

Luxembourg No findings: The policy in Luxembourg is to return sources to manufacturers and the country has an arrangement with Belgium to manage small amounts of radioactive waste that may arise.

Poland No findings: There is no separate document setting out national policy on radioactive waste and spent fuel management, but a finding was not raised.

Spain Recommendation: The General Radioactive Waste Plan (GRWP) was last revised by government in 2006. The operator ENRESA has produced a number of updates since then, but they have not been formally approved by government. It is recommended that the government updates the GRWP with some urgency.

- GSR Part 5 Requirement 2 National policy and strategy on radioactive waste management

ANALYSIS OF FINDINGS

The findings of the missions noted above can be divided into two main themes, namely those of an administrative/legal nature and those of a technical nature.

The administrative/legal aspects primarily relate to presentation of the national policy and strategy in a single consolidated document, rather than being dispersed in various documents, the need for formal updates and approval of policy/strategy by government, the need to monitor the implementation of policy/strategy on a regular basis, as opposed to longer term review, and making documents on disposal publicly available. These issues in general relate to the timely and effective implementation of national policy.

The technical issues identified relate to the approaches to managing specific categories of waste such as the very low-level waste arising from decommissioning a large number of facilities or Intermediate Level Waste. In such cases, suggestions are aimed at encouraging the government to define a clear management policy.

One good practice was identified, namely the French national programme which encompasses a wide range of waste types from a broad range of facilities and activities, and which involves substantial quantities of waste. The programme is comprehensive from generation to disposal and was found to be well structured, systematic and involves all interested parties.

III.2.2. Topic 1.2: Legal, regulatory and organisational framework

Findings on legal, regulatory and organisational framework were identified in five of the eight ARTEMIS Peer Reviews in the scope of the analysis. A total of 5 recommendations, 4 suggestions and 1 good practice were raised on Legal, regulatory and organisational framework by the experts during the missions. Eleven different requirements from three IAEA safety standards were cited. Figure 5 below shows the IAEA requirements used as the basis for these findings.

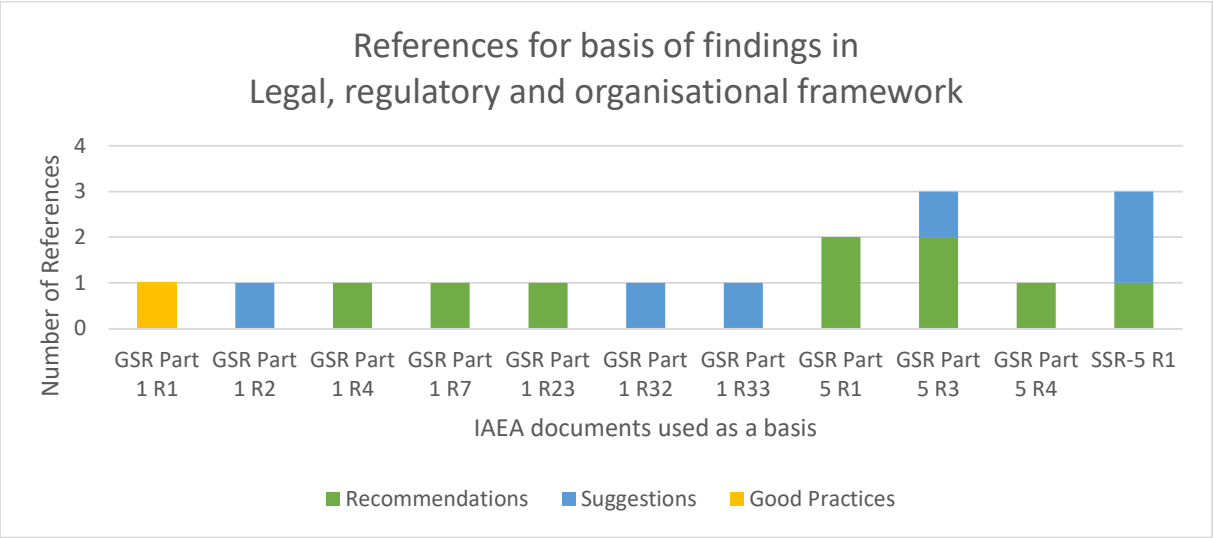


Figure 5: References for Findings used by experts for the Legal, regulatory and organisational framework ARTEMIS topic

REVIEW OF FINDINGS

Bulgaria No findings: The framework was considered to be well developed and to provide a robust infrastructure for the safe management of radioactive waste and spent fuel, including mechanisms for development of a strategy for radioactive waste and spent fuel.

Estonia Recommendation: The controlling legislation assigns responsibilities to a number of ministries, but the review mission did not see clear evidence of active cooperation between them. It was recommended that measures be put in place to ensure that all responsible government ministries take an active role to ensure effective delivery of their responsibilities.

- GSR Part 1 Requirement 7 Coordination of different authorities with responsibilities for safety within the regulatory framework for safety

Estonia Recommendation: No clear system was evident for the licensing of disposal facilities. It was recommended that government puts such a system in place.

- SSR-5 Requirement 1 Government responsibilities

Estonia Suggestion: Despite examples of public involvement in decision making processes being presented, such public involvement was not evident in the siting activities for disposal facilities. It was suggested that a communication strategy be set up to address this shortcoming.

- SSR-5 Requirement 1 Government responsibilities

France Good Practice: The legally binding character of, and continuing government commitment to, the key actions identified in the National Programme for the management of spent fuel and radioactive waste ensures progress towards the objectives of the National Policy.

- GSR Part 1 Requirement 1 National policy and strategy for safety

France Suggestion: The set of regulations necessary for waste safety are not yet complete, with respect to the storage and disposal of waste, although it was noted they were under development. It was recommended that development of the regulations should be finalised in a timely manner.

- GSR Part 1 Requirement 32 Regulations and guides
- GSR Part 1 Requirement 33 Review of regulations and guides
- GSR Part 5 Requirement 3 Responsibilities of the regulatory body

Germany No findings: The ARTEMIS mission referred to the Suggestion made in the IRRS mission concerning clarification of the role of actors in the regulatory framework for implementation of the Site Selection Act for the disposal of spent fuel and high level radioactive waste.

Latvia No findings: Clear mechanisms are established for drafting, assessing and adopting legislative measures and policies related to radioactive waste management. The legal and regulatory framework for management of radioactive waste covers the stages from waste generation up to storage or disposal as designated in the strategy.

Luxembourg Recommendation: The legal and regulatory framework for predisposal and decommissioning is not fully developed. It was recommended that this should be carried out using IAEA standards.

- GSR Part 5 Requirement 3 Responsibilities of the regulatory body
- GSR Part 5 Requirement 1 Legal and regulatory framework
- GSR Part 5 Requirement 4 Responsibilities of the operator

Luxembourg Recommendation: The Department of Radiation Protection has responsibilities for waste management as well as regulation. It was recommended that the Ministry of Health establishes a mechanism to ensure effective independence of the regulatory function.

- GSR Part 1 Requirement 4 Independence of the regulatory body
- GSR Part 5 Requirement 1 Legal and regulatory framework

Luxembourg Recommendation: Some waste management activities are undertaken by foreign companies in local premises, but these are not regulated. It is recommended that arrangements be put in place to exercise appropriate regulatory control.

- GSR Part 1 Requirement 23 Regulator management system
- GSR Part 5 Requirement 3 Responsibilities of the regulatory body

Luxembourg Suggestion: A process is underway to develop a safety case for the centralised waste storage facility. However, there is no regulatory basis or guidance, so it is suggested this is developed.

- GSR Part 1 Requirement 23 Management system of the regulatory body
- GSR Part 5 Requirement 3 Responsibilities of the regulatory body

Poland Suggestion: Public participation in decision making for disposal is not transparent so it is suggested information should be made public.

- GSR Part 1 Requirement 2 Establishment of a framework for safety
- SSR-5 Requirement 1 Government responsibilities

Spain No Findings: It is considered that Spain has an established legal and regulatory framework for national nuclear and radiation activities.

ANALYSIS OF FINDINGS

The findings in this section largely address shortcomings in legislation and issues related to regulatory processes.

Three reports include findings relating to the incompleteness of regulations covering various aspects of waste management, the management of disused sources and in one instance overall predisposal management of waste, as well as decommissioning. The significance of gaps depends on the size, complexity and hazard potential of the facilities present and the activities undertaken in the country.

Focussing on regulatory processes, findings have also identified some gaps in the regulatory framework, as for example the absence of a licensing process for disposal or shortcomings in public involvement.

Another major aspect of findings raised under this topic relate to the regulatory independence and coherence of the regulatory process where a number of authorities is involved and regulatory control of decommissioning. The importance of a regulatory process which is independent of conflicts of interest has been shown to be a serious safety concern which needs to be addressed. Linked to the independence of the regulatory process is the need for regulatory provisions to assign clear responsibilities among the different actors involved in the preparation, revision and implementation of national policy. There is a need for coherence and completeness to ensure safety is not overlooked, particularly if undertaken by a number of authorities. Equally the involvement of interested parties

has been shown to be a major factor in the successful implementation of facilities development and is a contributory factor to building confidence in the safety of facilities and activities.

The good practice identified in the Legal, regulatory and organisational framework ARTEMIS topic is linked to the long-term commitment to safety by the government. It highlights the role of the government in the identifications of key actions in the National Programme and its efforts to ensure their legally binding character.

III.3. Topic 2: National strategy for radioactive waste and spent fuel management

Findings on National strategy have been raised in each of the eight ARTEMIS Peer Reviews in the scope of the analysis. A total of 14 recommendations, 6 suggestions and 2 good practices were raised on National strategy by the experts during the missions. Figure 6 below provides the IAEA requirements used as the basis for these findings.

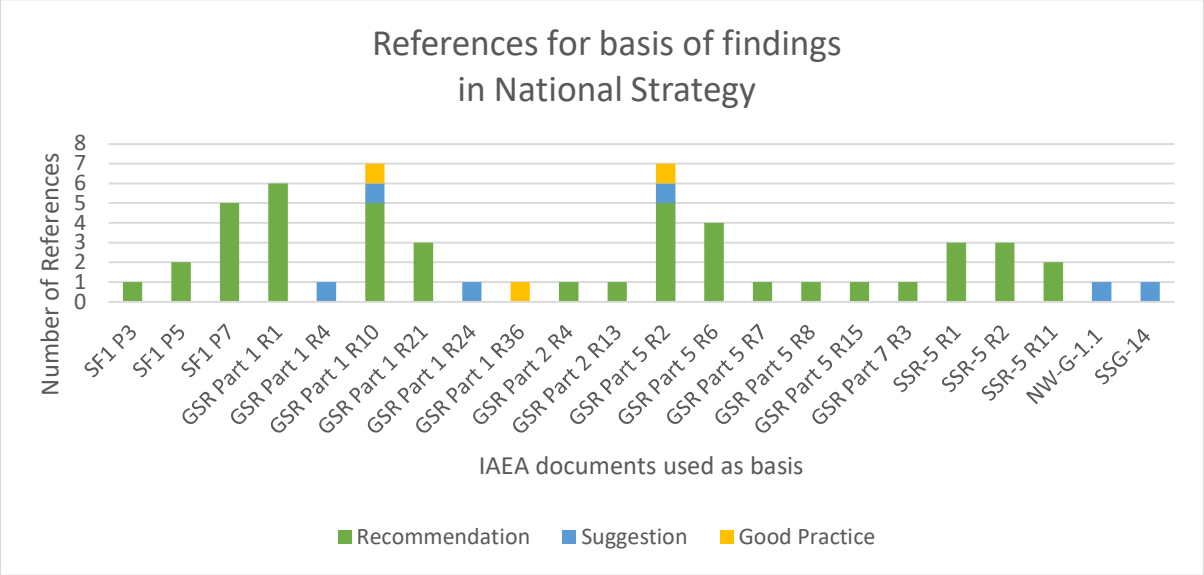


Figure 6: References for Findings used by experts under National Strategy ARTEMIS topic

REVIEW OF FINDINGS

Bulgaria Recommendation: The strategy contains all elements but is lacking in detail, so it is recommended that more detail is added on timeframes and to specifically address geological disposal.

- GSR Part 1 Requirement 1 National policy and strategy for safety
- GSR Part 5 Requirement 2 National policy and strategy on radioactive waste management

Bulgaria Recommendation: The national strategy is set out until 2030 but does not include long term milestones and schedules. It is recommended that the national strategy considers policy planning assumptions, strategic preferences and contingencies for the entire programme lifecycle, and the

definition of interim targets that support achievement of the policy end states and goals set out in the strategy.

- SF-1 Principle 7 Protection of present and future generations
- GSR Part 1 Requirement 1 National policy and strategy for safety
- GSR Part 1 Requirement 10 Provision for decommissioning and waste management
- GSR Part 5 Requirement 2 National policy and strategy on radioactive waste

Estonia Recommendation: The Government should update and enhance the National Programme to include the comprehensive list of activities and their interdependences prior to final closure of the facility and any necessary post-closure activities.

- SSR-5 Requirement 11 Step by step development and evaluation of disposal facilities
- GSR Part 5 Requirement 6 Interdependences

Estonia Recommendation: The national programme provides a detailed list of activities up to 2050, but there are some significant omissions, including post closure planning, lack of interdependences and management system aspects. Delays in implementation of some activities were also noted. It was recommended that the programme be updated and enhanced. It was also recommended that a comprehensive management system be put in place, involving all responsible ministries and which includes processes for decision making and corrective actions in case of deviations.

- SSR-5 Requirement 11 Step by step development and evaluation of disposal facilities
- GSR Part 5 Requirement 7 Management systems

France Suggestion: The National Plan is drafted by a pluralistic working group co-chaired by the national regulator (ASN). The working group also monitors progress in implementation of the National Plan. To avoid any concern with the level of independence of the regulator, it was suggested the role of ASN be formalized to ensure its independence, with particular focus on its assessment of the work produced in support of the National Plan.

- GSR Part 1 Requirement 4 Independence of the regulatory body
- NW-G-1.1 section 7.1 Creating a national policy statement

Germany Suggestion: Concern was expressed about possible changes of interpretation of site selection criteria over time. It was suggested the approach to applying the site selection criteria should be published.

- SSG-14 Appendix 1 Siting of Geological Disposal Facilities

Germany Suggestion: As site selection criteria for heat generating and non-heat generating waste could differ it was suggested these differences should be considered in the site selection process to ensure suitability for both waste types.

- GSR Part 5 Requirement 2 National policy and strategy on radioactive waste management

Germany Suggestion: Consideration has been given to conditions that may lead to waste not being recovered from the Asse mine. It was suggested that the Federal Company for Radioactive Waste Disposal (BGE) should consider publishing the safety-based conditions that would lead them to recommend that retrieval of waste from Asse II mine be discontinued.

- SSG-23 paragraph 4.99 Management systems

Latvia Recommendation: The government should ensure that the strategy reflects the preferred long term management options stated in the policy, including interim targets and end states. The strategy should take into account the interdependences between related actions and their associated risks, considering uncertainties in knowledge.

- SF-1 Principle 5 Optimization of protection
- GSR Part 1 Requirement 1 National policy and strategy for safety
- GSR Part 1 Requirement 10 Provision for decommissioning and waste management
- GSR Part 5 Requirement 2 National policy and strategy on radioactive waste management
- GSR Part 5 Requirement 6 Interdependences

Latvia Recommendation: The government should evaluate existing provisions to ensure the timely implementation of the strategy, including effective means of preventing and mitigating omissions, deviations, failures, and delays.

- SF-1 Principle 3 Optimization of protection
- GSR Part 2 Requirement 4 Goals, strategies, plans and objectives
- GSR Part 2 Requirement 13 Measurement, assessment and improvement of the management system

Luxembourg Recommendation: The Government should establish and regularly update the national policy and strategy to include provisions for the management of radioactive waste generated by potential emergency situations or other new identified waste streams.

- GSR Part 5 Requirement 15 Documentation of the safety case and supporting safety assessment
- GSR Part 5 Requirement 8 Radioactive waste generation and control
- GSR Part 7 Requirement 3 Responsibilities of international organizations in emergency preparedness and response

Poland Recommendation: The national plan lists research activities to be undertaken, but there is no plan to implement the research. It was recommended that Government should ensure that a programme is established.

- GSR Part 1 Requirement 1 National policy and strategy for safety
- GSR Part 1 Requirement 10 Provision for the decommissioning of facilities and the management of radioactive waste and of spent fuel

Spain Suggestion: The available disposal capacity for low and intermediate level waste of the El Cabril facility is limited. The facility is currently 76% full so an extension of the current disposal capacity will be required in the near term. ENRESA (the waste management organisation) should consider completing the licence extension application in a timely manner to ensure the continued availability of disposal capacity. This objective should be included in the update to the General Radioactive Waste Plan.

- GSR Part 1 Requirement 24 Demonstration of safety for the authorization of facilities and activities

Spain Recommendation: The development of a centralised spent fuel storage facility (CSF) has been delayed. It is recommended that the Government seeks advice from the competent authority, to ensure that the delay in the implementation of the CSF does not negatively impact the safe management of spent fuel and high-level radioactive waste.

- GSR Part 5 Requirement 6 Interdependence

Spain Recommendation: There is lack of progress in developing geological disposal. It is recommended that the Government complements the existing regulatory framework by developing regulations and an implementation plan for establishing the deep geological disposal facility, including clarification of roles and responsibilities for each stage of implementation.

Furthermore, it is recommended that the competent authorities should develop a plan for regulatory engagement, licensing submissions and regulatory hold points in consultation with ENRESA and other appropriate stakeholders. ENRESA should proactively complete establishment of the technical basis of the geological disposal programme, particularly the site selection process, and define the major milestones with proposed deadlines.

- SF-1 Principle 7 Protection of present and future generations
- SSR-5 Requirement 1 Government responsibilities
- SSR-5 Requirement 2 Responsibilities of regulator
- GSR Part 1 Requirement 21 Liaison between regulator and authorised parties

France Good Practice: The French approach to developing and implementing the National Plan which provides a comprehensive scope including all radioactive materials and waste types, alternative scenarios and management routes. The preparation, implementation and follow-up of the plan is well organized and main stakeholders are committed to the plan. The plan is continuously improved on an efficient basis.

- GSR Part 1 Requirement 10 Government to make provision for decommissioning
- GSR Part 5 Requirement 2 National policy and strategy

Germany Good Practice: The use of the National Civil Society Board as a mediating and independent body to support the site selection process.

- GSR Part 1 Requirement 36 Communication and consultation with interested parties

ANALYSIS OF FINDINGS

The findings concerning national waste management strategies largely address shortcomings in national plans with several national programmes being found to be incomplete or lacking specific details. There was an absence of milestones and timeframes, which makes monitoring of progress difficult. There is also a need for plans to be formally updated in a timely manner.

Several discrete issues were identified. One was emphasis of the need for regulatory independence when development of the national plan involved the regulatory authority. Another was the need for interfaces to be considered when different parts of the plan were the responsibilities of different authorities. The need for coherent research programmes was identified as an issue.

The need for progress with facilities and activities was identified as an issue, including one instance where disposal capacity for low level waste was running short, another where development of a centralised spent fuel storage facility was delayed and one where no progress was being made in the development of geological disposal. Potential safety issues that could arise as a result of these delays was identified as a concern. Some technical issues were raised concerning siting criteria for geological disposal of heat and non-heat generating waste and possible changes over time in the interpretation of siting criteria, due to limited availability of interpretative guidance.

The French national waste management plan was identified as a good practice due to its comprehensive nature, which covers all types of waste and all sources of generation and management routes for all identified waste.

Use of the German National Civil Society Board as a mediating and independent body to support the site selection process was also identified as a good practice, demonstrating an open and inclusive approach.

III.4. Topic 3: Inventory of spent fuel and radioactive waste

Findings on Inventory were raised in six of the eight ARTEMIS Peer Reviews in the scope of the analysis. A total of 2 recommendations, 5 suggestions and 1 good practice were raised on Inventory by the experts during the missions. Figure 7 below presents the IAEA requirements used as the basis for these findings.

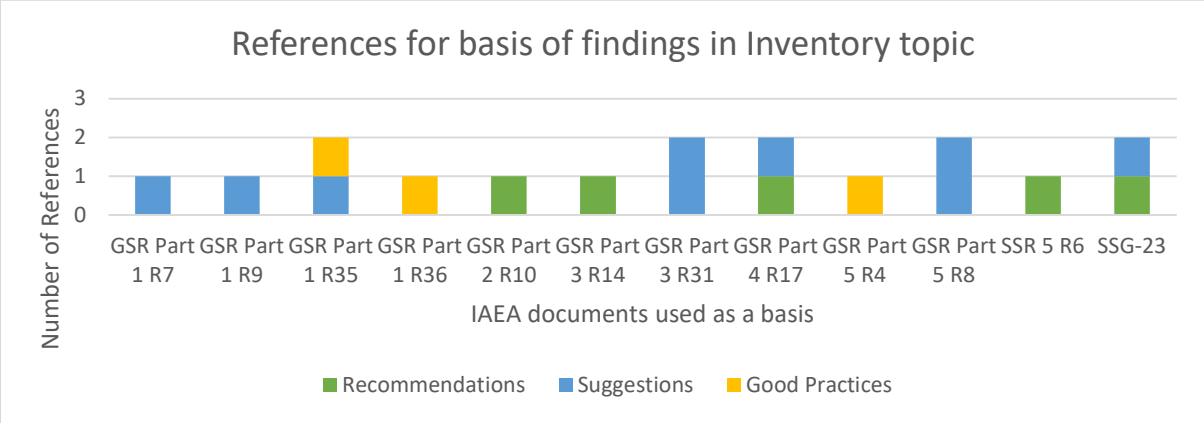


Figure 7: References for Findings used by experts under Inventory ARTEMIS topic

REVIEW OF FINDINGS

Bulgaria suggestion: Individual licensees are required to maintain inventories of radioactive waste and spent fuel, but there is no integrated national inventory maintained in a national data base. It was suggested Government should consider developing such a data base.

- GSR Part 1 Requirement 35 Safety related records
- GSR Part 1 Requirement 7 Coordination of different authorities with responsibilities for safety within the regulatory framework for safety

Estonia Suggestion: There are some uncertainties in the inventory and characteristics of waste and in future arisings. It was suggested that characterisation should be improved, and that the prediction of future arisings should ensure the inventory for disposal fully reflects any remaining uncertainties in waste volumes and properties.

- GSR Part 5 Requirement 9 Characterisation and classification at various steps

France Good Practice: The French approach to compiling, maintaining, and publishing the National Inventory and in providing a thorough record of all radioactive materials and waste types in the National Plan, complemented by the proactive effort to identify legacy inventories and sources.

- GSR Part 1 Requirement 35 Safety related records
- GSR Part 1 Requirement 36 Communication and consultation with interested parties
- GSR Part 5 Requirement 4 Responsibilities of the operator

Germany suggestions: The level of detail in the inventory of non-heat generating waste is limited. It was suggested that the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) consider including additional information and description in future revisions of the radioactive waste inventory report. It was also suggested that BMU should make greater use of the radioactive waste inventory to monitor changes in the inventory over time and demonstrate waste minimization.

- GSR Part 3 Requirement 31 Radioactive waste and discharges
- GSR Part 5 Requirement 8 Radioactive waste generation and control

Latvia Recommendation: The records for waste disposed of in vaults 1 – 6 of the "Radons" facility were established at the time of disposal based on available information, including passports for disused sealed radioactive source (DSRS). Records for all radioactive waste are kept in an archive and are included in the waste inventory. Experience from similar facilities in other countries indicates that discrepancies exist between records and verified data on waste inventories and forms, so historical data should be used with caution. The safety assessment of the "Radons" facility was conducted using unverified historical data, without consideration of uncertainties and their impact on the assessment results. There are no general requirements for evaluation of uncertainties and for sensitivity analyses with regard to safety assessments. The government should establish requirements for management of uncertainties in order to evaluate the sensitivity of the safety and radiological analysis.

GSR Part 4 Requirement 17 Uncertainty and sensitivity analysis
SSG-23 paragraph 4.39 Chemistry Programme for Water Cooled Nuclear Power Plants

Latvia suggestion: The implementer should consider further analysis of the impact of uncertainties on the results of safety assessment and radiological analysis of the inventory.

- GSR Part 4 Requirement 17 Uncertainty and sensitivity analysis
- SSG-23 paragraph 4.39 Chemistry Programme for Water Cooled Nuclear Power Plants

Luxembourg No findings: The inventory of radioactive waste in the country is detailed and is kept updated.

Poland Recommendation: ZUOP (the national waste operator) implements all steps of waste management. It was recommended it provides for external or internal independent verification of its pre-disposal management activities and disposal of radioactive waste. ZUOP is the only organization with responsibility for collecting and managing radioactive waste in Poland as well as being responsible for compiling and maintaining the radioactive waste national inventory.

- GSR Part 2 Requirement 10 Management of processes and activities
- SSR-5 Requirement 6 Interdependences
- GSR Part 3 Requirement 14 Monitoring for verification of compliance

Spain No findings: The process for compilation, update and publication of the national inventory is defined and implemented.

ANALYSIS OF FINDINGS

The findings raised on inventory related mainly to concerns over the level of detail available, the maintenance of a national integrated inventory and independent verification of quantities and characteristics. One recommendation concerned independent verification of waste characteristics prior to disposal. Two reports raised findings on the analysis of uncertainties of the inventory, how they are taken account of in the inventory and their impact on safety assessment and radiological analysis.

The good practice on national inventory was identified by the mission to France. The inventory was found to be comprehensive and was presented in an open and transparent manner, which facilitates the involvement of interested parties and provides a good basis for dialogue.

III.5. Topic 4: Concepts, plans and technical solutions for spent fuel and radioactive waste management

Findings on Concepts, plans and technical solutions were raised during six of eight ARTEMIS Peer Reviews in the scope of the analysis. A total of 3 recommendations, 8 suggestions and 1 good practice were raised. Figure 9 below shows the IAEA requirements used as a basis for these findings.

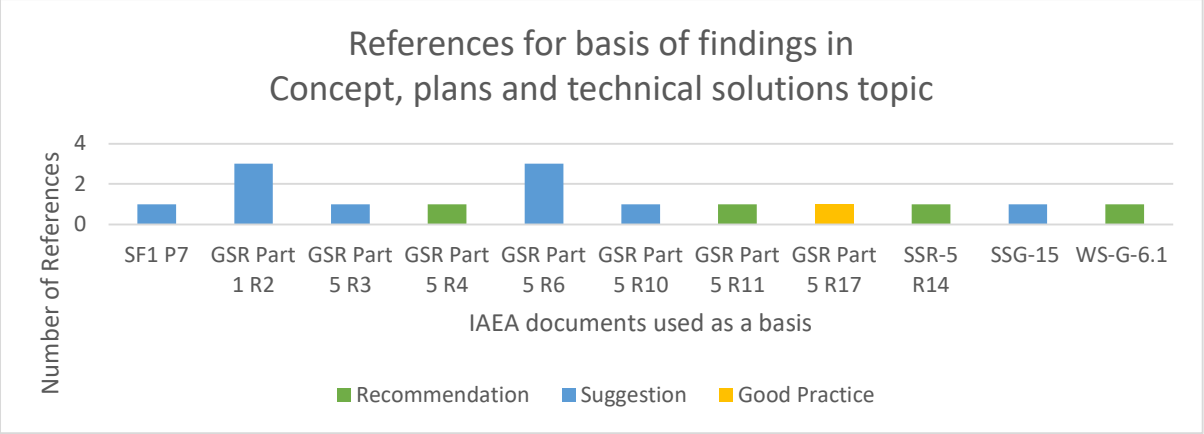


Figure 8: References for Findings used by experts under Concept, plans and technical solutions ARTEMIS topic

REVIEW OF FINDINGS

Bulgaria suggestion: The national strategy does not specify how spent sorbents and sludges resulting from the treatment of liquid waste at the Kozloduy power station will be treated and conditioned. It was suggested that the licensees should consider planning such processing as soon as reasonably possible.

- SF-1 Principle 7 Protection of present and future generations
- GSR Part 5 Requirement 10 Processing of radioactive waste
- GSR Part 1 Requirement 2 Establishment of a framework for safety

Bulgaria suggestion: According to the national strategy, a dry spent fuel storage facility is needed by 2030 to ensure sufficient storage space for spent fuel. It was suggested that the Government should consider making a decision for the facility as soon as possible in order to the meet the timescale defined in the national strategy, given the long time period for developing and licensing such a facility.

- GSR Part 1 Requirement 2 Establishment of a framework for safety

Estonia recommendation: The selected disposal options, in particular the proposed disposal silo at the depth of 30 - 50 metres, have been selected mainly on the basis of consideration of similar facilities overseas. They have not been evaluated on the basis of the suitability for the specific waste inventory and expected range of geological environments in Estonia. It was recommended that the operator should evaluate the suitability of the proposed disposal concepts to provide safe disposal of the total expected waste inventory in the geological environments at potential site(s).

- SSR-5 Requirement 14 Documentation of the safety case

France suggestion: There is a centralised facility in France dedicated to the disposal of very low-level waste (VLLW). The decommissioning programme envisaged in France will mean that very large quantities of such material will be transported over large distances with concomitant safety concerns. It was suggested that the Government should consider a broad range of options in a national decision on the optimization of VLLW management, including the potential for different approaches in different regions. Broad consultation leading up to a national decision should include local representatives of the assigned regulatory body for VLLW disposal from the various regions at the earliest possible time.

- GSR Part 5 Requirement 3 Responsibilities of the regulatory body

France suggestion: Currently, the reference national strategy for spent fuel management and nuclear materials management is based upon the assumption that all spent nuclear fuel will be reprocessed and nuclear materials recycled for use in manufacture of fuel for future nuclear power generation.

The Government should aim to identify the points in time whereby continued delay in realization of the facilities for reuse of spent fuel and nuclear materials will result in the need for decisions on predisposal capabilities and capacities for the management of spent fuel and nuclear materials. These decisions may prompt consideration of the need for a review of the reference strategy.

GSR Part 1 Requirement 2 Establishment of a framework for safety

Germany suggestion: The central reception storage facility (ZBL, Zentrales Bereitstellungslager) will be constructed to store radioactive waste with negligible heat generation (NHGW) coming from BGZ's

(the Federal Company for Radioactive Waste Storage) on-site waste storage facilities, before the waste is emplaced in the Konrad facility. The ZBL facility is scheduled to be commissioned in 2027 and could also be used to accept NHGW from all waste producers. The NHGW stored in BGZ-operated storage facilities should be transferred to ZBL from sites where the decommissioning of the Nuclear Power Plant (NPP) has been completed, to enable the entire sites to be released from regulatory control within the next decade.

The Government should consider taking benefit from the construction and operation of the ZBL by enabling this facility to accept NHGW from all waste producers and thereby increase flexibility within the National Programme for radioactive waste management.

- GSR Part 5 Requirement 6 Interdependences

Germany suggestion: After completion of Nuclear Power Plant decommissioning there will be no infrastructure that can be used to deal with damage to the body of spent fuel casks which requires unloading of the spent fuel elements for reconditioning. The Government should consider identifying a contingency plan for the repair of storage casks and the removal of spent fuel elements in the event of damage.

- SSG-15 Appendix I paragraph I.51 Consideration of inclusion of a hot cell in the design of a dry spent fuel storage facility

Germany suggestion: It was suggested that EWN (the publicly owned organisation for the decommissioning of nuclear facilities) should consider designing the new ESTRAL storage facility for spent fuel to have a storage lifetime to cover the period before the deep geological disposal facility is operational in 2050.

- GSR Part 5 Requirement 6 Interdependences

Latvia recommendations:

The government should establish requirements for long-term storage to ensure that waste is preserved in a condition suitable for its subsequent management.

The implementer should further develop specific waste acceptance criteria for the long-term storage of intermediate level waste and set out procedures to ensure that waste is preserved in a condition suitable for its subsequent management.

- GSR Part 5 Requirement 4 Responsibilities of the operator
- GSR Part 5 Requirement 11 Storage of radioactive waste
- WS-G-6.1 Storage of radioactive waste

Luxembourg No Findings: A recommendation was made in the Legal, regulatory and organisational framework topic concerning the regulatory framework for the safe predisposal management of radioactive waste and decommissioning, which is not fully in compliance with the IAEA Safety Standards.

Poland No Findings: The National Plan provides comprehensive identification of the various waste streams in Poland and proposes solutions for the long-term management of all radioactive waste and spent fuel.

Spain good practice: The overall design of the Centralized Storage Facility (CSF) has been formulated with multiple safety features and capabilities to provide lifetime flexibility: for example, the receipt and processing of casks and waste packages are decoupled. The design has been informed by engagement with the designers and operators of existing facilities and adoption of best in class for each element of the design. The process of incorporating the best in class in the design of the CSF, together with multiple capabilities for the management for spent fuel, is considered to be good practice.

- GSR Part 5 Requirement 17 Location and design of facilities

ANALYSIS OF FINDINGS

The issues identified in the findings for the Concepts, plans and technical solutions topic were quite varied, due to the broad spectrum of waste types under consideration, the size of country programmes and their histories. Three main themes are identified from the analysis:

- timeframes for facility development and the availability of storage capacity pending the development of disposal facilities.

- the need to optimise approaches to storage/disposal, for example in the management of very low-level waste.

- the need to decide on particular technical solutions, for example the treatment of sludges from NPP water treatment systems, the development of specific waste acceptance criteria for long-term storage, and the need to find solutions when the decommissioning of NPPs results in facilities for handling spent fuel storage flasks becoming unavailable.

A good practice was identified in Spain where the design of the centralised spent fuel storage facility was found to incorporate multiple capabilities, flexible timescales and was based on proven good engineering practice.

III.6. Topic 5: Safety case and safety assessment of radioactive waste and spent fuel management activities and facilities

Findings on Safety case and safety assessment of radioactive waste and spent fuel management activities and facilities were raised during four of the eight ARTEMIS Peer Reviews in the scope of the analysis. A total of 6 recommendations and 1 good practice were raised on Safety case and safety

assessment by the experts during the missions. No Suggestions were identified. Figure 9 shows the IAEA requirements used as the basis for these findings.

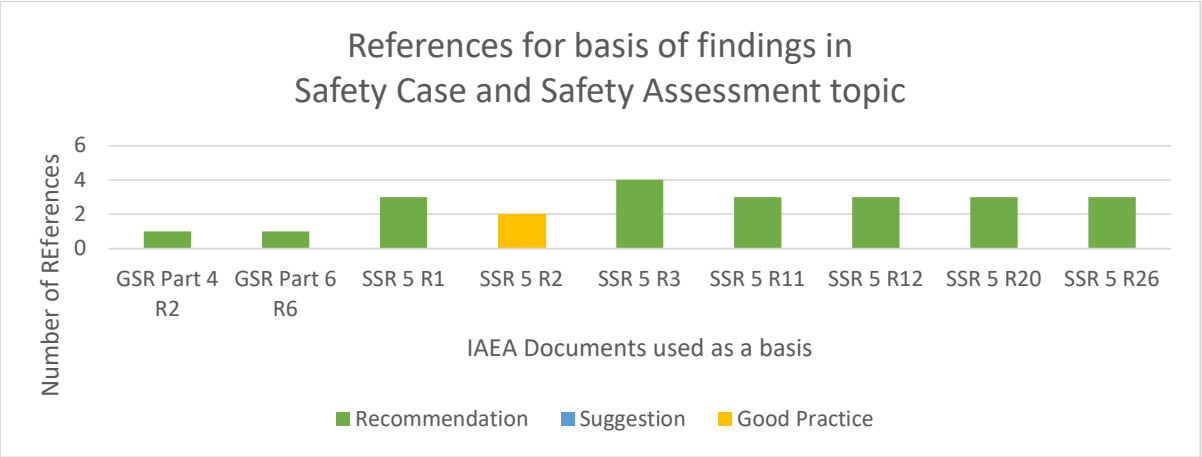


Figure 9: References for Findings used by experts under Safety Case and Safety Assessment ARTEMIS topic

REVIEW OF FINDINGS

Bulgaria No finding: The demonstration of safety is an essential part of the licensing process for each step of the lifecycle of facilities and activities related to radioactive waste and spent fuel in the country. The process for the demonstration of safety is considered to be well established in Bulgarian legislation.

Estonia recommendations: Whilst there is demonstration of a good understanding of the safety issues relevant to current activities at Paldiski and a clear demonstration of regular safety assessments for these activities, there is no safety documentation for the planned disposal facilities nor any specific requirements for such documentation to be produced prior to the licence application. There is thus no basis to establish Waste Acceptance Criteria (WAC) for the planned silo type disposal facility which have consequently not been produced. The established WAC for the planned near surface type disposal facility at Paldiski rely on generic considerations based on experience from comparable facilities in other countries.

It was thus recommended that the Government should establish detailed requirements and guidance for safety documentation for disposal facilities, which should include the assessment of long-term safety after facility has been closed. The implementer should develop a preliminary safety case with supporting safety assessments for all proposed disposal facilities and should update the preliminary WAC based on these and the licence conditions.

- SSR-5 Requirement 1 Government responsibilities
- SSR-5 Requirement 3 Responsibilities of the operator
- SSR-5 Requirement 12 Preparation, approval and use of the safety case and safety assessment for a disposal facility

France Good Practice: Developing preliminary safety cases or evaluations for facilities fosters sound planning and decision making, not only for the planned waste arisings scenarios but also for scenarios resulting from a change in the national strategy.

- SSR-5 Requirement 2 Responsibilities of the regulator

Germany No finding: Safety cases and safety assessment in Germany are consistent with IAEA Safety Standards and the process for the demonstration of safety is considered to be well established.

Latvia recommendation: It was recommended that the implementer should ensure that the safety of ongoing activities at the non-operational Salaspils research reactor is assessed, including care and maintenance of the facility and predisposal waste management activities in updated safety assessment.

- GSR Part 4 Requirement 2 Scope of the safety assessment
- GSR Part 6 Requirement 6 Responsibilities of the licensee for decommissioning

Luxembourg No Finding: A safety case and safety assessment for the Local de collecte de déchets radioactifs (LCDR) storage facility was established for Luxembourg by a foreign radiation protection expert to be part of the licensing process for the collection and storage local centre (LCDR). There were no recommendations or suggestions, but the review referred to the findings raised on the legal and regulatory framework, which needed to be developed.

Poland recommendation: The current licence for the existing surface disposal facility in Różan is based on safety documentation from 2002 and the most recent safety documentation dates from a Phare 2004 project. Regulatory requirements have changed and there are no comprehensive waste acceptance criteria for the facility. It was therefore recommended that the national waste operator ZUOP prepare an up-to-date safety case for the Różan Facility, including a safety assessment and waste acceptance criteria, and submit these to the regulator for review**.**

- SSR-5 Requirement 11 Step by step development
- SSR-5 Requirement 20 Waste acceptance criteria
- SSR-5 Requirement 26 Existing disposal facilities

Poland recommendation: ZUOP has no formal plan for conducting R&D to support development of the safety case and implementation of a planned near surface facility. It was recommended that ZUOP should establish its own programme of prioritised R&D for the current and planned surface disposal facilities, based on a safety case and safety assessment.

- SSR-5 Requirement 3 Responsibilities of the operator

Spain No finding: The regulatory processes for developing and assessing a safety case are considered to be well developed. There is a clear allocation of responsibilities.

ANALYSIS OF FINDINGS

Three themes have been identified from the findings of the Safety case and safety assessment topic. The first was the absence of a safety case and the need to develop a site-specific safety case, together with the need for out-of-date assessments to be brought in line with current international safety requirements. The second theme was the need for research and development programmes to support the development of disposal facilities and their safety cases. The third was the need to develop waste acceptance criteria based on facility/site specific safety cases or justified by such safety cases. In each instance recommendations were made for the development of safety cases and site/facility specific waste acceptance criteria by the facility operators and for both aspects to be submitted for regulatory review and approval.

A particular good practice was identified in France where preliminary safety cases were developed based on planned scenarios of future waste arisings, together with alternative scenarios should national strategies change and impact on inventories, which provides a good basis for future planning.

III.7. Topic 6: Cost estimates and financing of radioactive waste and spent fuel management

Findings on the Cost estimates and financing of radioactive waste and spent fuel management topic were raised during seven of the eight ARTEMIS Peer Reviews in the scope of the analysis. A total of 9 recommendations, 4 suggestions and 1 good practice were raised. Figure 10 below shows the IAEA requirements used as a basis for these findings.

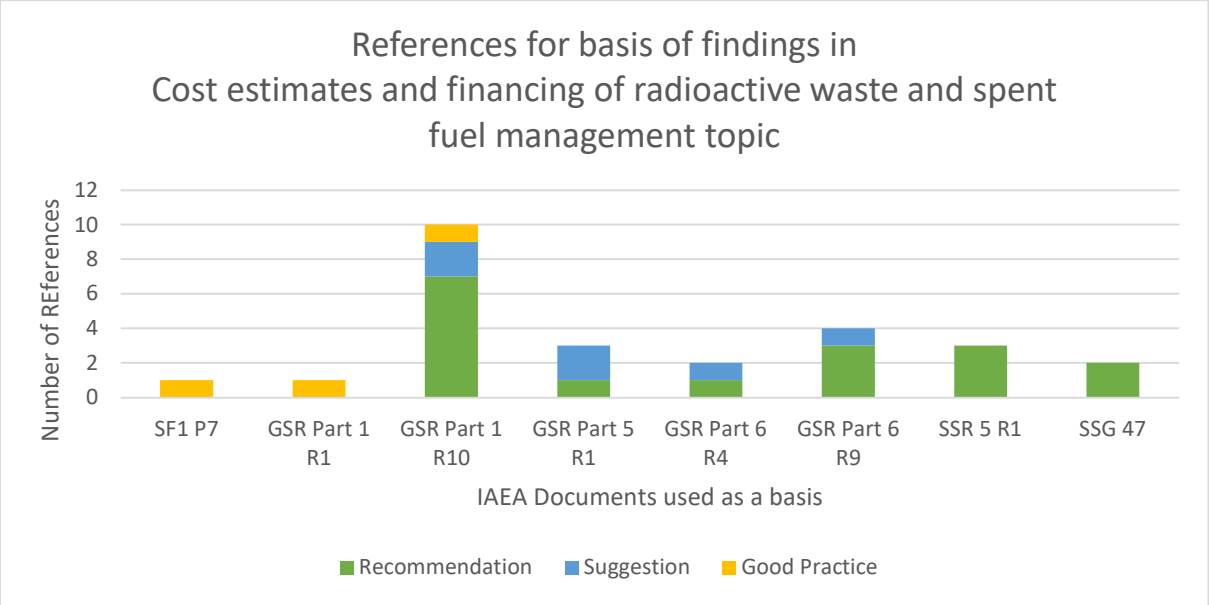


Figure 10: References for Findings used by experts under Cost estimates and financing ARTEMIS topic.

REVIEW OF FINDINGS

Bulgaria recommendation: The radioactive waste fund covering the waste management activities does not include the cost of a geological disposal facility. It was recommended that the Government ensure that financial provisions for geological disposal are made.

- GSR Part 1 Requirement 10 Provision for decommissioning and waste management

Estonia recommendations: The Government should update the cost assessment to include all stages of waste management, including required post-closure activities, and to reflect the uncertainties in the programme. The costs of waste management related to post-closure were calculated as part of the 2015 study but are not currently included in the National Programme.

- SSR-5 Requirement 1 Government responsibilities

The government approves the budget for 3 or 4 years, which does not cover long-term activities. The Government should ensure that appropriate mechanisms are in place to ensure the timely availability of adequate funding to deliver the National Programme up to and including any required post-closure activities.

- SSR-5 Requirement 1 Government responsibilities

France Good practice: The requirement for the creation of tangible assets to cover decommissioning and radioactive waste management liabilities, rather than holding them as general assets of the operator, and giving these assets legal protection. Operators of basic nuclear installations are obliged to secure sufficient assets to meet prudent estimates of their obligations, following the principle of “polluter Pays” and “intergenerational equity”.

- SF-1 Principle 7 Protection of present and future generations
- GSR Part 1 Requirement 1 Government responsibilities
- GSR Part 1 Requirement 10 Provision for decommissioning and waste management

France Suggestion: There is no mechanism for small waste producers to fully transfer their liabilities to the French National Radioactive Waste Management Agency (Andra), or any other entity, for disposed waste under the “polluter pays” principle. Consideration should be given to creating a mechanism to permit small producers to transfer title and liability to Andra, or some other persistent entity, for waste disposal at an appropriate time after acceptance for disposal.

- GSR Part 5 Requirement 1 Government responsibilities

France Suggestion: The requirement to make provisions for nuclear liabilities applies only to basic nuclear installations and installations classified on environmental protection grounds (ICPEs) as handling radioactive materials. For other users of radioactive materials reliance is placed entirely upon the general fiduciary duties of the companies responsible. The Government should consider the level of financial risk to the state arising from entities outside the requirements for segregated assets and guarantees. In the light of this, it should consider whether relying solely on the fiduciary duties of the

companies is sufficient or whether there should be additional obligations. In any event, consideration should be given to providing clarity on this potential exposure of the state in the National Plan for the purpose of transparency and completeness.

- GSR Part 1 Requirement 10 Provision for decommissioning and waste management

France Suggestion: The Ministry (DGEC, the General Directorate for Energy and Climate Change) should consider whether it would be helpful to establish its own systematic view of prudency as it applies to decommissioning and radioactive waste management and establish this as a requirement, where necessary, on operators to establish an appropriate level of risk to the state. A general statement on the level of risk should be presented in the National Plan.

- GSR Part 5 Requirement 1 Government responsibilities

Germany recommendation and suggestion: The 2015 Cost Report, part of Germany's National Programme, does not reflect current progress in the implementation of the National Programme and does not include a complete overall cost assessment (e.g. retrieval of the Asse II mine waste, ZBL). It was thus recommended that BMU update the cost assessment for the national waste management programme in the Cost Report, based on a consistent approach across all activities and inclusion of the cost of waste retrieval from the Asse II mine. It was also suggested that BMU should consider updating the Cost Report more frequently than every 10 years and provide additional information on assumptions and cost breakdowns.

- GSR Part 1 Requirement 10 Provision for decommissioning and waste management
- GSR Part 6 Requirement 9 Financing of decommissioning
- GSR Part 6 Requirement 4 Responsibilities of government for decommissioning

Germany recommendation: Risk and uncertainty analyses are not undertaken as part of the cost assessment for all public sector components of the radioactive waste and spent fuel management programme. It was recommended that the Government analyse risk and uncertainty when updating the cost assessment for all public sector components of the radioactive waste and spent fuel management programme.

- GSR Part 1 Requirement 10 Provision for decommissioning and waste management
- GSR Part 6 Requirement 9 Financing of decommissioning
- SSG-47 paragraphs 6.5 and 6.8 Financing of decommissioning

Latvia recommendation: There is no estimate of the total cost for achieving the goal of safe management of all classes of existing and future radioactive waste. The government should ensure that adequate cost estimates are made available in a timely manner, in order to facilitate appropriate financing to achieve the goal of safe management of all classes of existing and future radioactive waste**.**

- GSR Part 1 Requirement 10 Provision for decommissioning and waste management
- GSR Part 6 Requirement 9 Financing of decommissioning

Luxembourg No finding: The estimation of the relative costs for waste management was considered to be well-established and the funding mechanism well-identified. The waste producer is responsible for the cost of the safe management of waste including its disposal. The country covers the costs for management of waste for which no holder can be identified (orphan sources and legacy waste).

Poland recommendations: The current cost estimates for radioactive waste generated by research, industry and medicine (institutional waste) have been projected to 2025 but the radioactive waste management activities extend beyond this date. It was recommended that the national waste operator (ZUOP) should develop a comprehensive estimate of the lifetime cost of the management of institutional waste including disposal. The Government should also undertake a review of the lifetime cost estimate and ensure that funding to cover the required activities is made available to ZUOP in a timely manner.

- GSR Part 1 Requirement 10 Provision for decommissioning and waste management

Spain recommendation: The Spanish Radioactive Waste Management Agency (ENRESA) performs an annual cost assessment of the national plan (GRWP), which is submitted to Ministry for the Ecological Transition each year in accordance with the regulation. In past years the tax rates prescribed in the regulation have been below the appropriate values that would cover the costs for the realization of the National Waste Management Programme, based on ENRESA estimations. In addition, the regulation has not been amended since 2010. Consequently, the annual revenues to the Fund are less than ENRESA's cost assessment. Possible evolution of nuclear energy policy could affect the robustness of the funding mechanism. Because of these factors it was recommended that the Government should routinely review the funding mechanism, including the need to update tax rates, to ensure adequate and timely financing of NPP decommissioning, Centralized Storage Facility development, Deep Geological Disposal facility programme development and implementation of other radioactive waste and spent fuel management activities.

- GSR Part 1 Requirement 10 Provision for decommissioning and waste management
- GSR Part 5 Requirement 1 Government to set appropriate financial arrangements for waste management
- SSR-5 Requirement 1 Government responsibilities

ANALYSIS OF FINDINGS

The findings identified on cost estimates and financing of radioactive waste and spent fuel management programmes related to four main themes. The first relates to the lack of comprehensiveness in cost estimation. In some countries some waste management activities or some categories of waste were not included in the cost estimates and funding arrangements.

A second theme was the period covered by cost estimation where estimates were in some cases for limited periods into the future, so it was recommended that lifetime cost estimation should be undertaken.

The third theme was the methodology used for cost estimation including estimation of inflation in costs, how to account for uncertainties and the impact of changes in national strategy on cost estimates.

The last theme related to the need for more frequent reviews and updates of cost estimates.

III.8. Topic 7: Capacity building for radioactive waste and spent fuel management – expertise, training and skills

Findings on Capacity building for radioactive waste and spent fuel management were raised during seven of the eight ARTEMIS Peer Reviews in the scope of the analysis. A total of 3 recommendations, 6 suggestions and 1 good practice were raised on Capacity building. Figure 11 shows the IAEA requirements used as the basis for these findings.

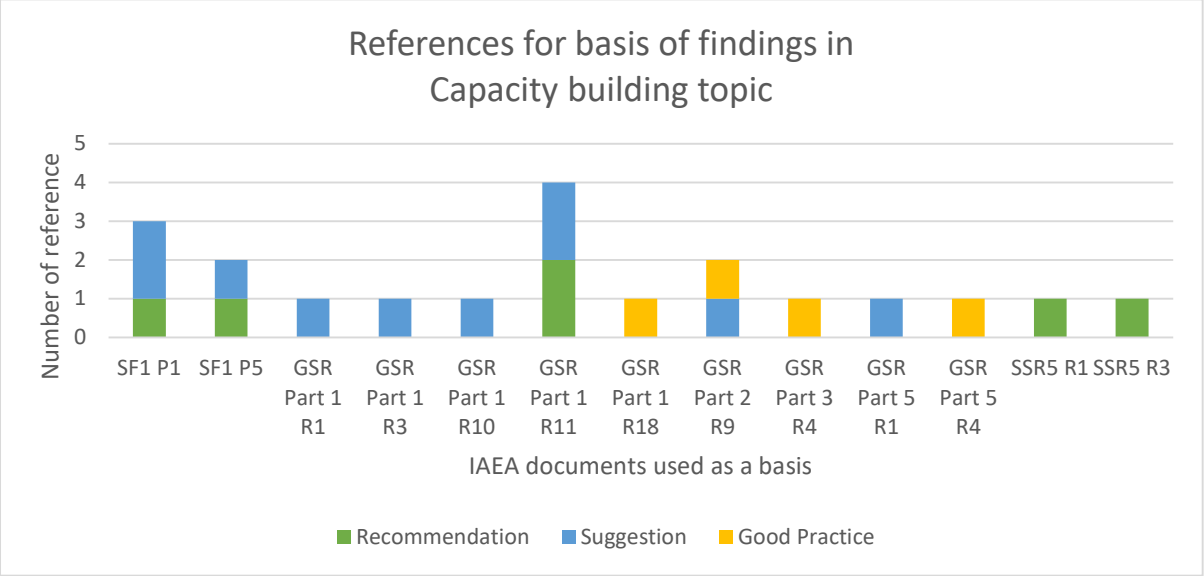


Figure 11: References for Findings used by experts under the Capacity building ARTEMIS topic.

REVIEW OF FINDINGS

Bulgaria suggestion: While the regulatory and operational infrastructure for capacity building is well developed and comprehensive in Bulgaria, the regulation on budgetary constraints for the State Enterprise "Radioactive Waste" (SE RAW, the national operator having prime responsibility for the safe management of radioactive waste) does not allow for identification and accommodation of human resource requirements in response to actions foreseen in the national strategy while these actions are not finally approved. It was suggested that the government should consider providing the means to allow SE RAW to explore and develop needs in competence and research for those actions foreseen in the national strategy which are not finally approved.

- SF-1 Principle 1 Prime responsibility for safety with operator
- GSR Part 1 Requirement 11 Competence for safety

Estonia recommendation: There is no long-term resourcing plan for the National Programme. Consequently, there are no estimates of the number of people required to deliver the programme nor the skills which these people must have. It was recommended that the Government should develop a national resourcing plan for delivery of the National Programme and ensure it is supported by appropriate training activities to provide the necessary knowledge and skills.

- SSR-5 Requirement 1 Government responsibilities
- GSR Part 1 Requirement 11 Competence for safety

Estonia suggestion: R&D needs are documented as part of individual technical activities within the National Programme. This makes it difficult to obtain a complete picture of the R&D needs for the National Programme and therefore to ensure that the necessary human and financial resources will be available. The Government should compile a single comprehensive list of all the R&D needs for the implementation of the National Programme and establish effective mechanisms for provision of the necessary human and financial resources for delivery.

- GSR Part 1 Requirement 1 National policy and strategy for safety

France good practice: Efforts made by actors involved in radioactive waste management programmes to establish, develop and maintain the necessary and required competence and skills of staff was emphasised, including the management of staff skills based on a formalised curriculum of technical training courses for each category of employee.

- GSR Part 1 Requirement 18 Staffing and competence of the regulatory body
- GSR Part 2 Requirement 9 Provision of resources
- GSR Part 3 Requirement 4 Responsibilities of the regulatory body
- GSR Part 5 Requirement 4 Responsibilities of the operator

Germany suggestion: The various organizations involved in radioactive and spent fuel management independently pursue research programmes. The Government should consider improving the coordination of research, development and demonstration activities for the management of spent fuel and radioactive waste, to ensure they are commensurate with the needs of waste management operators and regulators.

- GSR Part 1 Requirement 10 Provision for the decommissioning and waste management

Latvia no findings. Latvia has defined and implemented a comprehensive human resources policy to identify and develop human resources and capacities to provide solutions in proportion to the needs identified. The implementation of the strategy also envisages outsourcing of important tasks to

implement the significant amount of work foreseen at the “Radons” facility and the Salaspils research reactor in the short and medium-term.

Luxembourg suggestion: Due to the need to address findings made by past peer review missions in the country, including the ARTEMIS mission, the workload of personnel involved in the national programme for radioactive waste management might increase and the need to increase the number of staff should be considered.

- GSR Part 1 Requirement 3 Establishment of a regulatory body
- GSR Part 5 Requirement 1 Legal and regulatory framework

Poland recommendation and suggestion: It was recommended that ZUOP should update its human resource plan to provide further detail on the specific expertise needed and the recruitment timeframe, and in particular to prioritize the recruitment of the additional specialists needed for the safety demonstration of the current and future facilities at Rożan and Świerk, as well as of the planned new repository.

Whilst the government and the national waste operator ZUOP have developed human resources framework plans, these plans do not provide clear identification of priority recruitment needs related to management of radioactive waste and spent nuclear fuel. It was suggested that the Government should consider further developing its human resource framework plan for the effective implementation of the National Plan and to ensure that the specific needs for the management of radioactive waste and spent nuclear fuel are explicitly identified and prioritised.

- SF-1 Principle 5 Optimisation of protection
- SF-1 Principle 1 Responsibility for safety
- GSR Part 1 Requirement 11 Competence for safety

Spain suggestion: ENRESA is bounded by public sector employment requirements which restrict its flexibility in recruitment. ENRESA also faces the challenge of ensuring knowledge continuity due to retirements. The strategy and processes for knowledge transfer should be further developed to address this challenge in a comprehensive manner. It was also suggested that ENRESA should consider ensuring that the strategy and mechanisms are put in place to avoid the loss of knowledge of and expertise in radioactive waste and spent fuel management.

- GSR Part 2 Requirement 9 Provision of resources

Spain recommendation: It was suggested that ENRESA should re-evaluate the adequacy of R&D funding needed to support the step-by-step development of the Deep Geological Disposal programme.

- SSR-5 Requirement 3 Responsibilities of the operator

ANALYSIS OF FINDINGS

The main themes identified in the findings on Capacity building for radioactive waste and spent fuel management in respect of expertise, training and skills were how to address budgetary limitations and the lack of assessment of human resource needs. It was emphasised that recruitment limitations imposed by lack of flexibility in public service employment regulations could give rise to difficulties in knowledge management programmes as personnel retired.

Recommendations and suggestions were made concerning the need for effective assessment of human resource and to have the budgetary resources available to recruit and train suitable personnel.

A number of findings noted that R&D programmes supporting spent fuel and radioactive waste management were often distributed across several organisations. In the absence of an integrated overview, difficulties arose in predicting future human resource requirements necessary for such programmes. The integrated consideration of R&D needs and activities was thus suggested.

It was also suggested that flexibility should be considered in ensuring effective knowledge management. A good practice was noted in France, where the main organisations responsible for the radioactive materials and waste management use a formalised curriculum of technical training courses for each category of employee to establish, develop and maintain the necessary and required competence and skills of staff.

IV. Occurrences of IAEA Safety Standards and supporting international documents in the ARTEMIS missions' findings

According to the ARTEMIS guidelines, "*the bases for ARTEMIS review service are the IAEA Safety Standards and supporting international documents. In some cases, the review can be supported by other IAEA documents, such as e.g. IAEA Nuclear Energy Series or other international documents in complement to the safety standards*". ARTEMIS guidelines specify that "*near the Safety Standards Series and Nuclear Energy Series, the following documents can be included into the review basis:*
- Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management;
- For the reviews under obligations of art. 14(3) of the EC 2011/70/EURATOM Directive establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste, the given Directive is included in the basis for the reviews together with the safety standards". However, this type of document was never used as the basis for findings.

Figure 12 shows the number of occurrences of each IAEA Safety Standards and supporting international IAEA documents which are referred to as a basis in an ARTEMIS mission finding in the scope of the analysis.

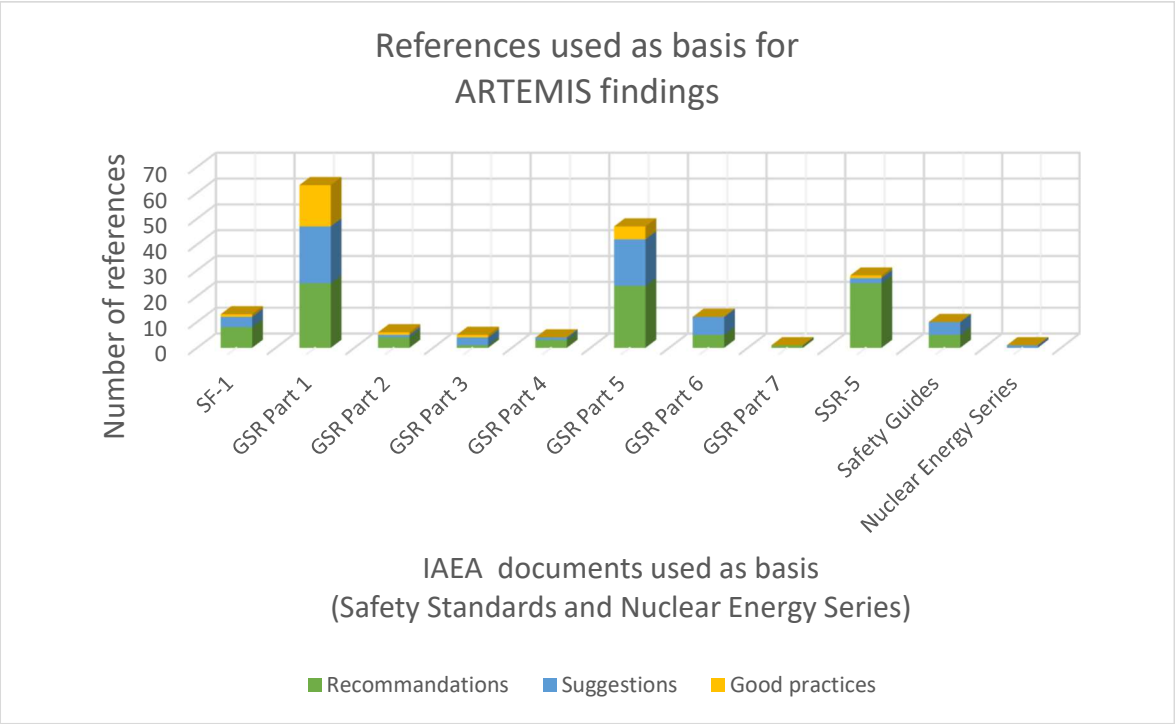


Figure 12: Refences to IAEA Documents as basis for findings (Recommendations, Suggestions, Good Practices)

The most referenced documents used as the basis for ARTEMIS recommendations and suggestions are the following Safety Requirements:

- GSR Part 1 on Governmental, Legal and Regulatory Framework for Safety (47 occurrences)
- GSR Part 5 on Predisposal Management of Radioactive Waste (42 occurrences)

- SSR-5 on Disposal of Radioactive Waste (27 occurrences)

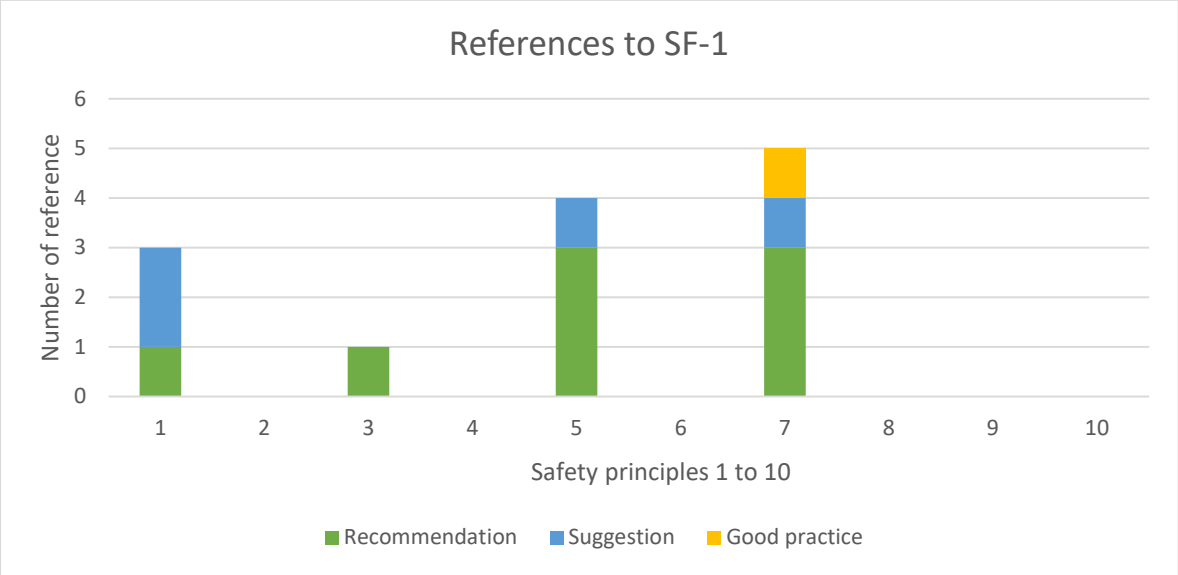
For Good Practices, the Safety Requirements with most references are:

- GSR Part 1 on Governmental, Legal and Regulatory Framework for Safety (16 occurrences)
- GSR Part 5 on Predisposal Management of Radioactive Waste (5 occurrences)

Specific references from IAEA Safety Guides can be used as the basis for ARTEMIS findings, but they are used at a secondary level in comparison with the Safety Requirements. Only 5 Safety Guides have been used as references, with a total of 10 occurrences. Of the IAEA Nuclear Energy Series and other IAEA international documents, only one NE Series document has been used as a basis in one suggestion in the missions in the scope of the analysis.

The following figures provide a quantitative analysis of the basis used for findings in the ARTEMIS missions to indicate the role and importance of the IAEA Safety Requirements and other documents in the ARTEMIS review process in general and in the specific ARTEMIS topics.

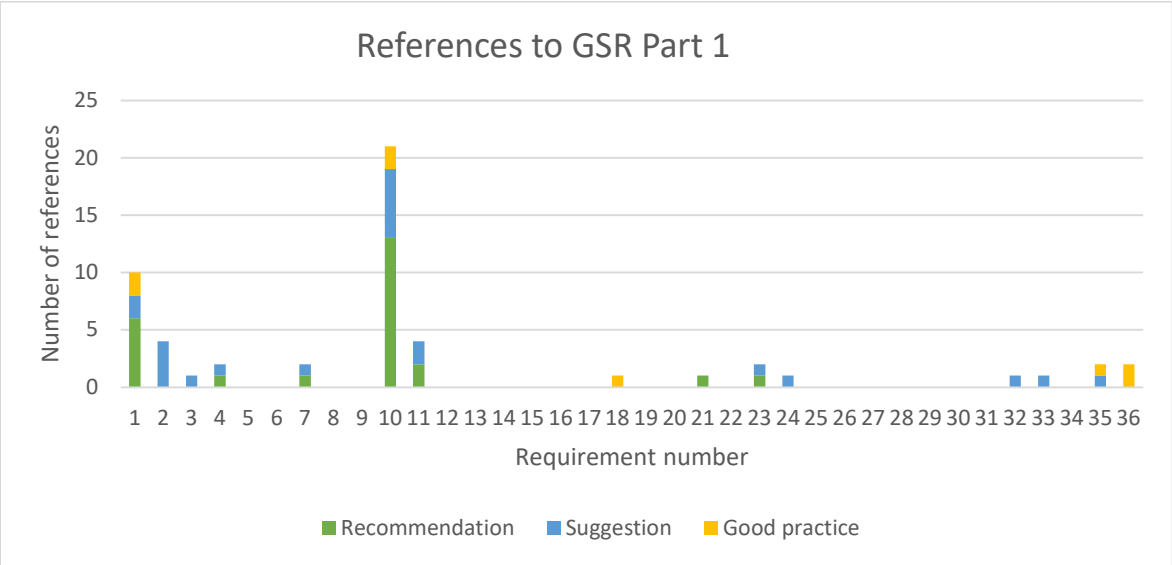
IV.1. References to the 10 Fundamental Safety Principles (SF-1)



Among the fundamental safety objective and ten associated safety principles stated in the IAEA Safety Fundamentals (SF-1), safety principles were referred to 13 times as the basis for recommendations and suggestions. They were referred to once for good practices. The most referred safety principles are presented below in descending frequency of occurrence:

- SF-1 Principle 7: Protection of present and future generations (5 occurrences)
- SF-1 Principle 5: Optimization of protection (4 occurrences)
- SF-1 Principle 1: Responsibility for safety (3 occurrences)
- SF-1 Principle 3: Leadership and management for safety (1 occurrence)

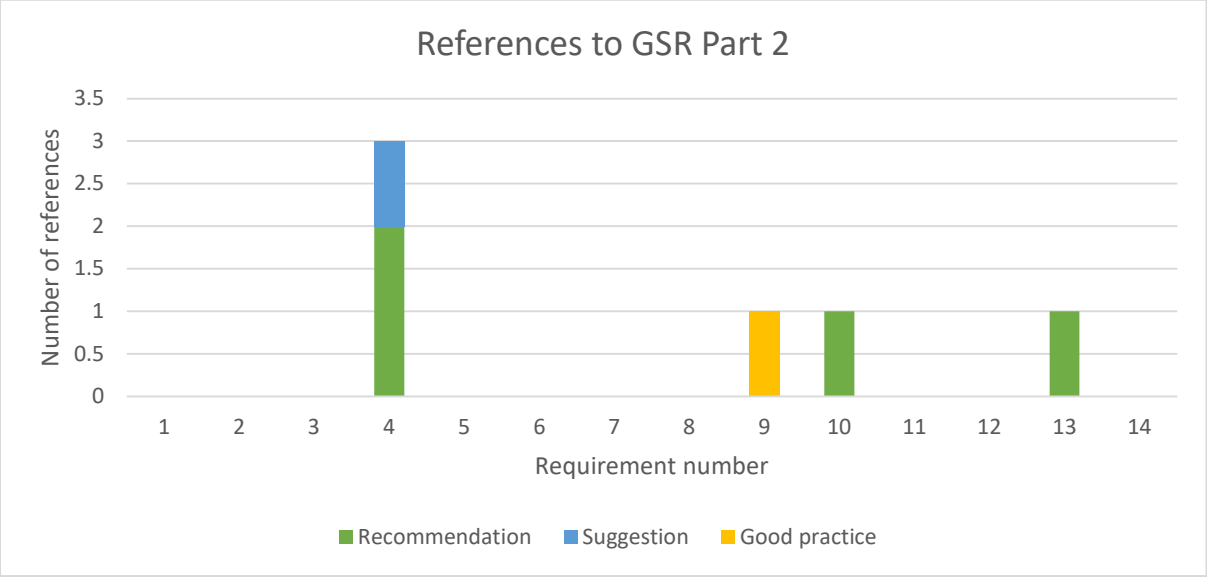
IV.2. References to GSR Part 1: Governmental, Legal and Regulatory Infrastructure for Safety



GSR Part 1 Requirements were referred to 47 times as the basis for recommendations and suggestions. They were referred to 16 times for good practices.

The requirement of GSR Part 1 with most references is Requirement 10 (Provision for the decommissioning of facilities and the management of radioactive waste and of spent fuel) with 21 occurrences, followed by Requirement 1 (National policy and strategy for safety) with 10 occurrences.

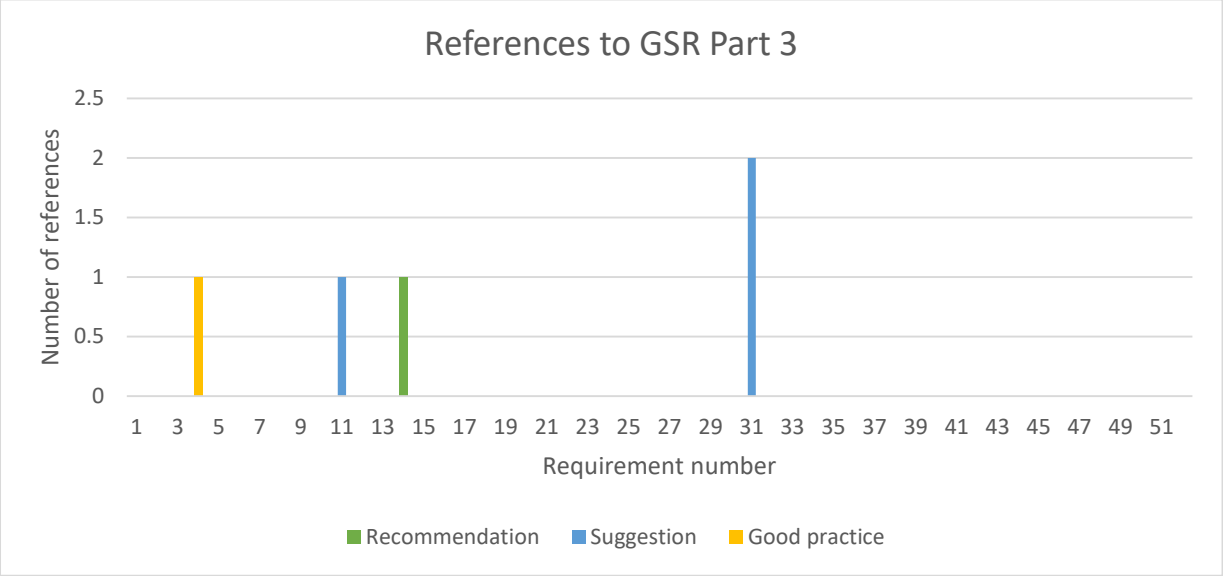
IV.3. References to GSR Part 2: Leadership and Management for Safety



GSR Part 2 Requirements were referred to 5 times as the basis for recommendations and suggestions. They were referred to once for good practices.

The Requirement of GSR Part 2 with most references is Requirement 4 (Goals, strategies, plans and objectives) with 3 occurrences.

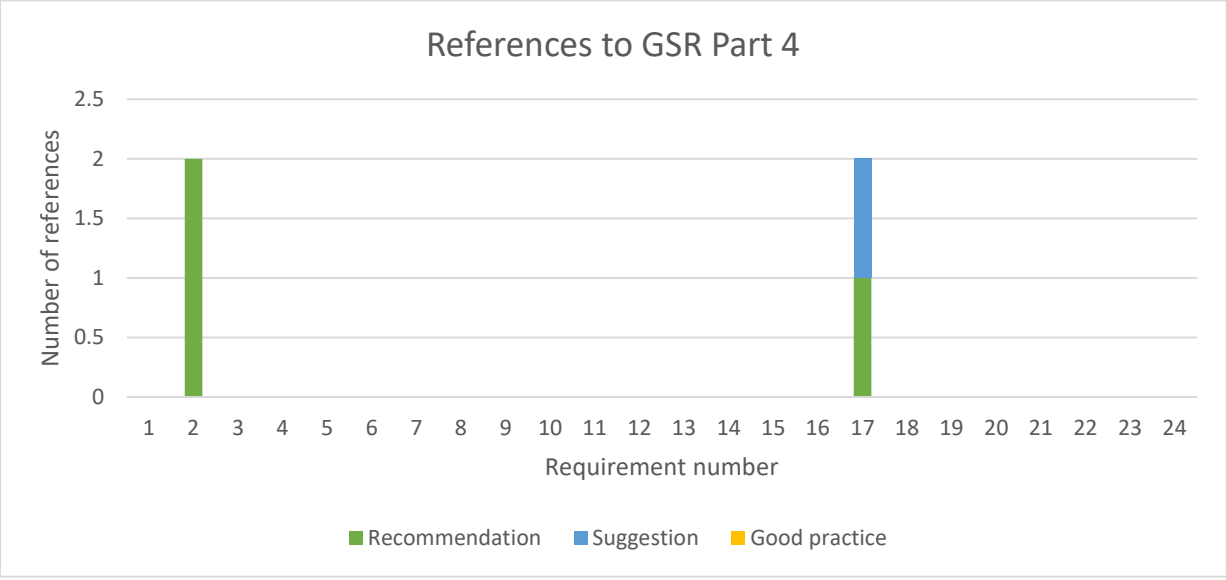
IV.4. References to GSR Part 3: Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards



GSR Part 3 Requirements were referred to 4 times as basis for recommendations and suggestions. They were referred to once for good practices.

The Requirement of GSR Part 3 with most references is Requirement 31 (Radioactive waste and discharges) with 2 occurrences.

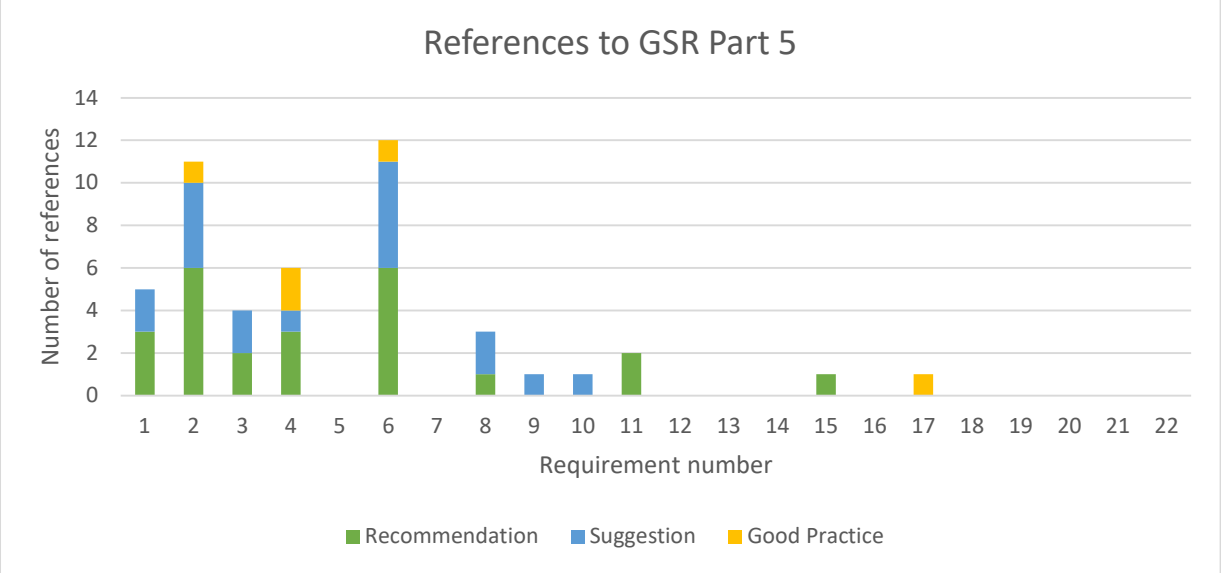
IV.5. References to GSR Part 4: Safety Assessment for Facilities and Activities



GSR Part 4 Requirements were referred to 4 times as the basis for recommendations and suggestions. They were not used for any good practices.

The Requirements of GSR Part 4 with most references are Requirement 2 (Scope of the safety assessment) and 17 (Uncertainty and sensitivity analysis) with 2 occurrences each.

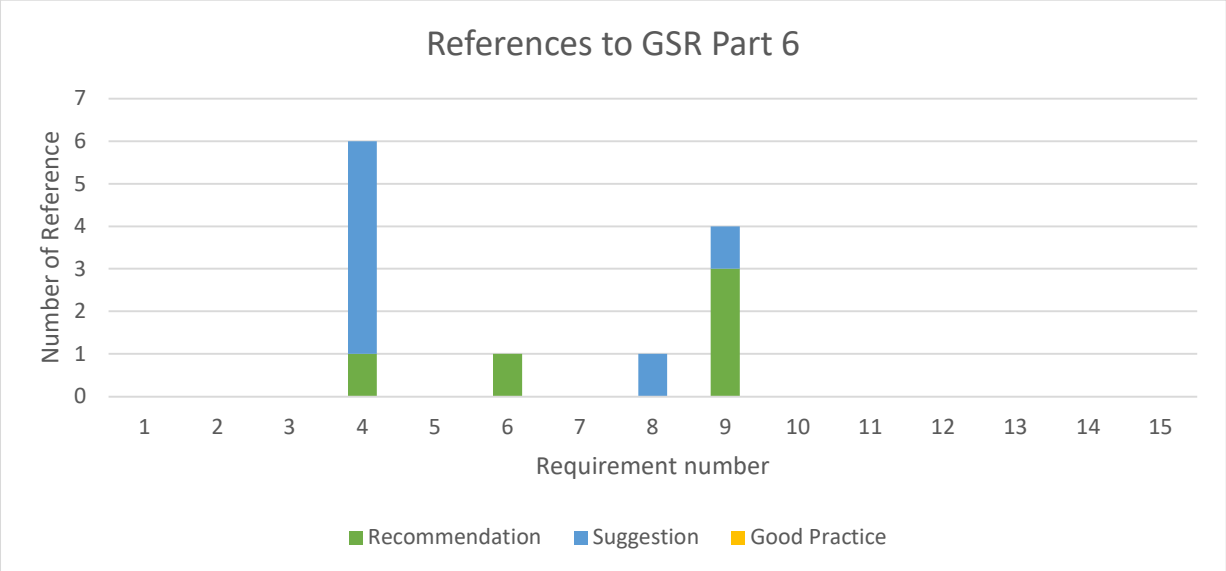
IV.6. References to GSR Part 5: Predisposal Management of Radioactive Waste



GSR Part 5 Requirements were referred to 42 times as the basis for recommendations and suggestions. They were used 5 times for good practices.

The Requirement of GSR Part 5 with most references is Requirement 6 (Interdependences) with 12 occurrences, followed by Requirement 2 (National policy and strategy on radioactive waste management) with 11 occurrences.

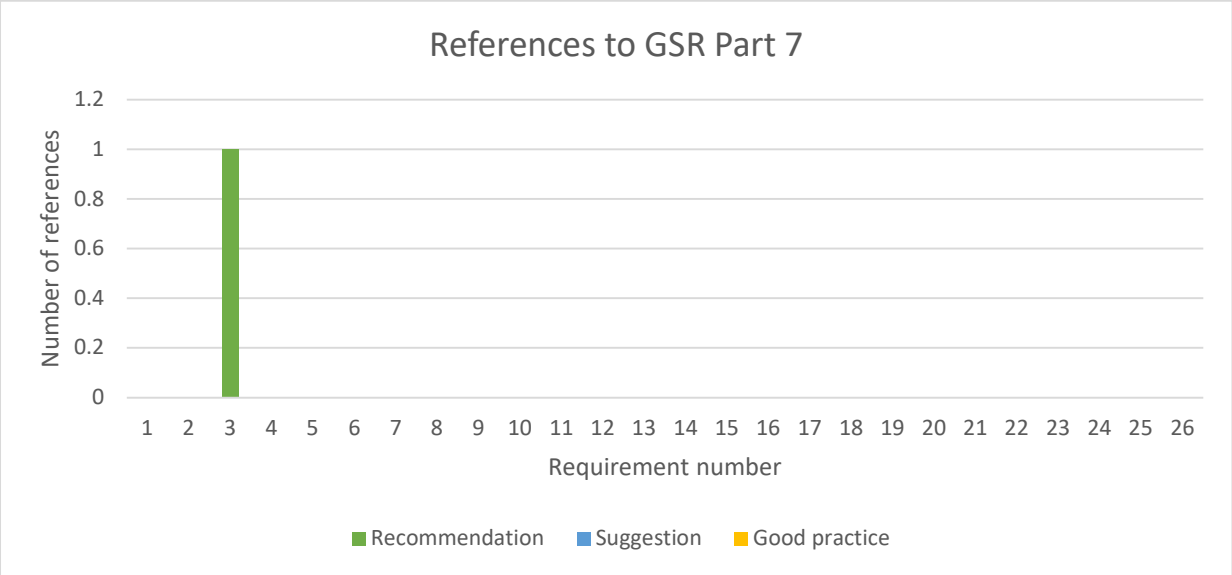
IV.7. References to GSR Part 6: Decommissioning of Facilities



GSR Part 6 Requirements were referred to 12 times as the basis for recommendations and suggestions. They were not used for good practices.

The Requirement of GSR Part 6 with most references is Requirement 4 (Responsibilities of the government for decommissioning) with 6 occurrences, followed by Requirement 9 (Financing of decommissioning) with 4 occurrences.

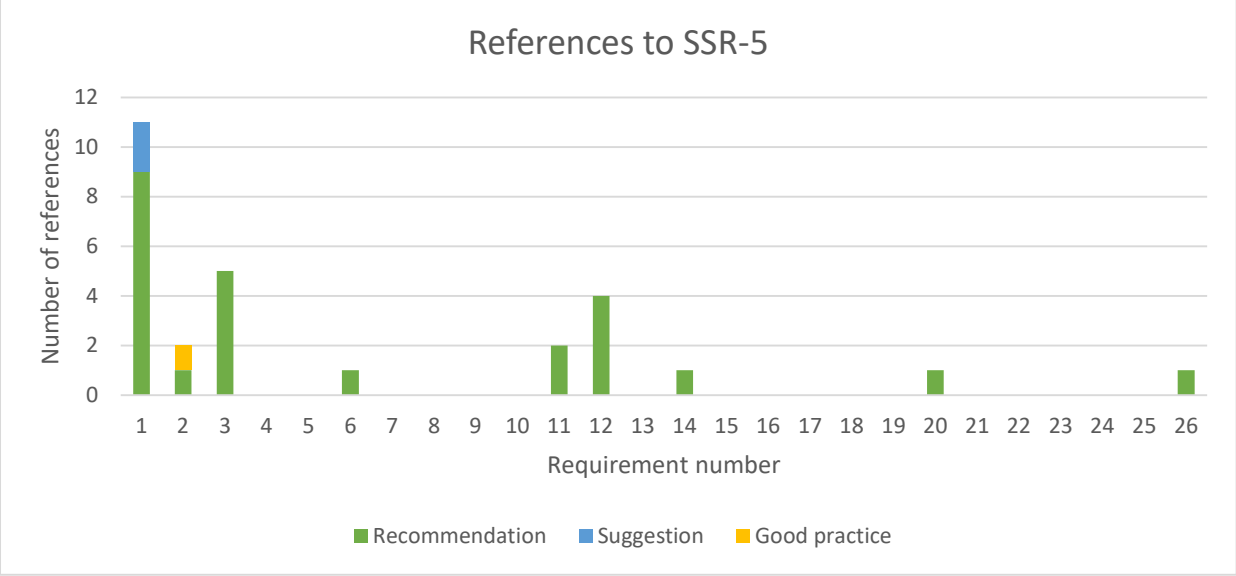
IV.8. References to GSR Part 7: Preparedness and Response for a Nuclear or Radiological Emergency



GSR Part 7 Requirements were referred to only once as the basis for a recommendation. They were not used for suggestions and good practices.

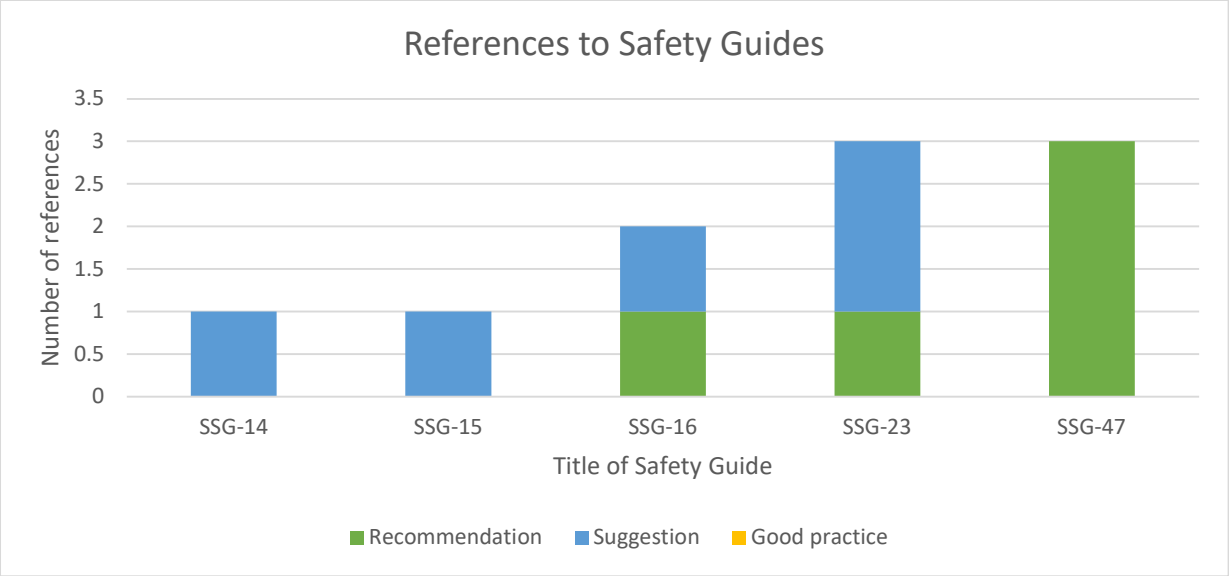
The only Requirement of GSR Part 7 referred to is Requirement 3 (Responsibilities of international organizations in emergency preparedness and response) with 1 occurrence.

IV.9. References to SSR-5: Disposal of Radioactive Waste



SSR-5 Requirements were referred to 27 times as the basis for recommendations and suggestions. They were used once for good practices. The requirement of SSR-5 with most references is Requirement 1 (Government responsibilities) with 11 occurrences, followed by Requirement 3 (Responsibilities of the operator) with 5 occurrences.

IV.10. References to IAEA Safety Guides

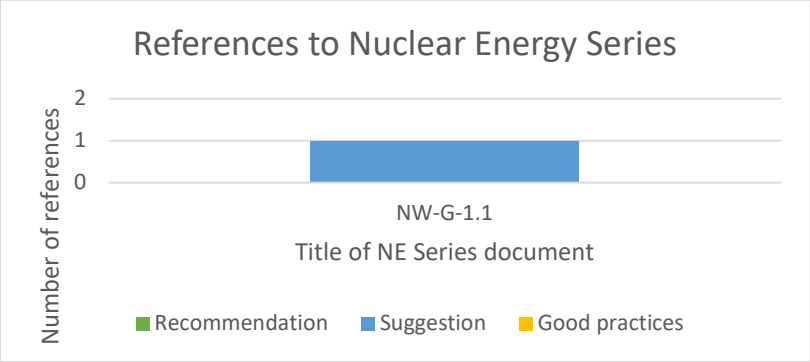


The following IAEA Safety guides were referred to as the basis for recommendations and suggestions:

- SSG-14: Specific Safety Guide on Geological Disposal Facilities for Radioactive Waste (1 occurrence)
- SSG-15: Specific Safety Guide on Storage of Spent Nuclear Fuel (1 occurrence)
- SSG-16: Specific Safety Guide on Establishing the Safety Infrastructure for a Nuclear Power Programme (2 occurrences)
- SSG-23: Specific Safety Guide on The Safety Case and Safety Assessment for the Disposal of Radioactive Waste (3 occurrences)
- SSG-47: Specific Safety Guide on Decommissioning of Nuclear Power Plants, Research Reactors and Other Nuclear Fuel Cycle Facilities (3 occurrences)

They were not used for good practices.

IV.11. References to IAEA Nuclear Energy Series



IAEA Nuclear Energy Series document NW-G-1.1 entitled Policies and Strategies for Radioactive Waste Management was referred to once as a basis for one suggestion. No other IAEA Nuclear Energy Series documents were used for recommendations or good practices.

ANALYSIS

Taking account of all findings (recommendations, suggestions and good practices), the references used most frequently were, in descending order of occurrence, GSR Part 1 Requirement 10, GSR Part 5 Requirement 6 followed by GSR Part 5 Requirement 2 and SSR-5 Requirement 1.

- GSR Part 1 Requirement 10 Provision for the decommissioning of facilities and the management of radioactive waste and of spent fuel (21 occurrences)
- GSR Part 5 Requirement 6 Interdependences (12 occurrences)
- GSR Part 5 Requirement 2 National policy and strategy on radioactive waste management (11 occurrences)
- SSR-5 Requirement 1 Government responsibilities (11 occurrences)

For recommendations and suggestions excluding good practices, the safety principles and IAEA safety requirements with most references are the following:

- GSR Part 1 Requirement 10 Provision for the decommissioning of facilities and the management of radioactive waste and of spent fuel (19 occurrences)
- GSR Part 5 Requirement 6 Interdependences (11 occurrences)
- SSR-5 Requirement 1 Government responsibilities (11 occurrences)
- GSR Part 5 Requirement 2 National policy and strategy on radioactive waste management (10 occurrences)

For Good Practices, no safety principles and IAEA safety requirements can be clearly identified as the most referenced. The following references each occur twice:

- SF-1 Principle 7 Protection of present and future generations
- GSR Part 1 Requirement 1 National policy and strategy for safety

- GSR Part 1 Requirement 10 Provision for the decommissioning of facilities and the management of radioactive waste and of spent fuel
- GSR Part 1 Requirement 36 Communication and consultation with interested parties
- GSR Part 5 Requirement 4 Responsibilities of the operator.

V. Conclusions

Every IAEA ARTEMIS mission conducted from 2017 to 2020 covering the entire national system for radioactive waste and spent fuel management, for all the recognized waste streams and activities, made findings on the National Strategy topic. Only one mission did not raise any findings on Cost estimates and financing of radioactive waste and spent fuel management. For other ARTEMIS topics, at least four countries received findings in each topic area. This demonstrates the relevance of ARTEMIS topics as they are currently defined in the Guidelines and Self-Assessment questionnaire for ARTEMIS reviews covering the entire national system for radioactive waste and spent fuel management.

Among the seven ARTEMIS topics, the ones which raised the most findings are national strategy for radioactive waste management and policy and framework. In these topics, the most frequent findings related to the following themes:

- shortcomings in national plans
- incompleteness of national programmes or lack of specific details
- the need to integrate national policy and strategy in a single consolidated document
- shortcomings in legislation
- the regulatory process (e.g. absence of a licensing process for disposal, shortcomings in public involvement, regulatory independence).

The topics of Inventory and Safety case and safety assessment resulted in the lowest number of findings. Safety case and safety assessment is the only ARTEMIS topic where no suggestions were identified.

The safety principles and IAEA safety requirements referred to most frequently in recommendations and suggestions were:

- GSR Part 1 Requirement 10 Provision for the decommissioning of facilities and the management of radioactive waste and of spent fuel (19 occurrences)
- GSR Part 5 Requirement 6 Interdependences (11 occurrences)
- SSR-5 Requirement 1 Government responsibilities (11 occurrences)
- GSR Part 5 Requirement 2 National policy and strategy on radioactive waste management (10 occurrences).

The significance of GSR Part 1 Requirement 10, on Provision for decommissioning of facilities and the management of radioactive waste and spent fuel, in recommendations and suggestions from ARTEMIS missions reflects the challenges faced by Member States to take reasonable steps in their national policies and programmes to avoid any undue burden on future generations for the management of spent fuel and radioactive waste. These Member States, irrespective of the size of their waste management programme, have also to cope with the expected increase in volumes of radioactive waste arising from the operation and decommissioning of nuclear facilities and activities using radioisotopes in science, industry and medicine.

In view of this and the expected increase in volumes of radioactive waste from decommissioning activities, the development and implementation of predisposal processes to reduce waste volumes is becoming increasingly important. GSR Part 5 Requirement 6 on Interdependences stipulates that "*Owing to the interdependences among the various steps in the predisposal management of radioactive waste, all activities from the generation of radioactive waste up to its disposal, including its processing, are to be seen as parts of a larger entity, and the management elements of each step have to be selected so as to be compatible with those of the other steps. This has to be achieved principally through governmental and regulatory requirements and approaches* ". This requirement is given as the second most frequent basis for recommendations and suggestions in this review.

Member States who received an ARTEMIS mission have established national policies. However, progress can be made on the comprehensiveness of their policies to ensure they systematically address all types of radioactive waste and spent fuel and all stages of their management. Thus, GSR Part 5 Requirement 2 on National policy and strategy on radioactive waste management is the fourth most frequently referred to requirement in ARTEMIS recommendations and suggestions: "*To ensure the effective management and control of radioactive waste, the government shall ensure that a national policy and a strategy for radioactive waste management are established. The policy and strategy shall be appropriate for the nature and the amount of the radioactive waste in the State, shall indicate the regulatory control required, and shall consider relevant societal factors*".

At the same time the safe long-term management of spent fuel and radioactive waste is a key challenge for these Member States. For this reason, SSR-5 Requirement 1 on disposal is used as often as GSR Part 5 Requirement 6 as a basis for recommendations and suggestions. Even though a number of design options for disposal facilities have been developed and various types of disposal facility have been constructed in many States and are in operation, the ARTEMIS missions analysed in this report emphasise that important challenges remain for governments to take appropriate decisions on long-term solutions for management of radioactive waste and spent fuel, to define them in national policies and to set "*clearly defined legal, technical and financial responsibilities for organizations that are to be involved in the development of facilities for radioactive waste management, including disposal facilities of all types*".