IAEA-NS-ARTEMIS
ORIGINAL: English

INTEGRATED REVIEW SERVICE FOR RADIOACTIVE WASTE AND SPENT FUEL MANAGEMENT, DECOMMISSIONING AND REMEDIATION (ARTEMIS)

MISSION

TO

THE CZECH REPUBLIC

Prague, the Czech Republic

15-25 October 2023

DEPARTMENT OF NUCLEAR SAFETY AND SECURITY
DEPARTMENT OF NUCLEAR ENERGY

IAEA

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

ARTEMIS

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

IAEA ARTEMIS

REPORT OF THE

INTEGRATED REVIEW SERVICE FOR RADIOACTIVE WASTE AND SPENT FUEL MANAGEMENT, DECOMMISSIONING AND REMEDIATION (ARTEMIS)

MISSION

TO

THE CZECH REPUBLIC

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

IAEA ARTEMIS

REPORT OF THE

INTEGRATED REVIEW SERVICE FOR RADIOACTIVE WASTE AND SPENT FUEL MANAGEMENT, DECOMMISSIONING AND REMEDIATION (ARTEMIS) MISSION

TO

THE CZECH REPUBLIC

Mission dates: *15-25 October 2023*
Location: *Prague, the Czech Republic*
Organized by: *IAEA*

ARTEMIS REVIEW TEAM	
Ms Sylvie Voinis	ARTEMIS Team Leader (France)
Mr Szabolcs Czifrus	Reviewer (Hungary)
Ms Ramona Popescu	Reviewer (Romania)
Mr Miroslav Drahoš	Reviewer (Slovakia)
Mr Simon Carroll	Reviewer (Sweden)
Ms Denise Varley	Reviewer (United Kingdom)
Mr Vladan Ljubenov	IAEA Team Coordinator
Ms Karina Lange	IAEA Deputy Team Coordinator
Ms Kristina Nussbaum	IAEA Admin. Assistant

IAEA-2023

The number of recommendations, suggestions and good practices is in no way a measure of the status of the national infrastructure for nuclear and radiation safety. Comparisons of such numbers between ARTEMIS reports from different countries should not be attempted.

CONTENTS

EXECUTIVE SUMMARY

At the request of Ministry of Industry and Trade of the Czech Republic on 31st October 2018, the International Atomic Energy Agency (IAEA) organized an Integrated Review Service for Radioactive Waste and Spent Fuel Management, Decommissioning and Remediation (ARTEMIS) review to fulfil the Czech Republic's obligations under Article 14.3 of the Council Directive 2011/70/Euratom of 19 July 2011 establishing a Community Framework for the Responsible and Safe Management of Spent Fuel and Radioactive Waste (the Waste Directive).

The objective of the ARTEMIS Peer Review Service is to provide independent expert opinion and advice on radioactive waste (RW) and spent nuclear fuel (SF) management, decommissioning and remediation, based upon the IAEA safety standards and technical guidance, as well as international good practice.

The ARTEMIS Review Team was comprised of six senior international experts in the field of radioactive waste management and decommissioning from France, Hungary, Romania, Slovak Republic, Sweden and United Kingdom. IAEA staff provided coordination and administrative support.

The review addressed the following topics, consistent with the elements of the Waste Directive:

- National policy and framework;
- National strategy;
- National inventory;
- Concepts, plans and technical solutions;
- Safety case and safety assessment of activities and facilities;
- Cost estimates and financing; and
- Capacity building.

This ARTEMIS mission is organized back-to-back to an Integrated Regulatory Review Service (IRRS) review mission conducted from 14 to 27 May 2023. The conduct of the ARTEMIS mission and the preparation of the associated mission report have been carried out in due consideration of the IRRS mission.

The Preparatory meeting was held in March 2023. The Advance Reference Material (ARM) was provided to the IAEA in August 2023 and in September 2023, a list of questions was sent to the Czech Republic's counterparts for additional information and clarifications.

The mission took place from 15th to 25th October in Prague. The ARTEMIS Review Team evaluated the national programme and the national framework of the Czech Republic for executing the country's obligations for safe and sustainable radioactive waste and spent fuel management, with the objective of providing the national authorities with recommendations and suggestions for improvement and, where appropriate, identifying good practice. The mission was performed according to the programme provided in Appendix B.

During the ARTEMIS mission, presentations by the Czech Republic's organizations involved in radioactive waste management, spent fuel management and decommissioning activities (the Ministry of Industry and Trade, the Czech Radioactive Waste Repository Authority (SÚRAO), the State Office for Nuclear Safety (SÚJB), the operator of the NPPs (ČEZ), the research centre (ÚJV Řež)), were provided, followed by extensive discussions to answer the questions of the

ARTEMIS Review Team. During the mission, there was a visit to the Richard Disposal Facility, which was organized on 18 October. The visit included presentations about the facility, as well as a technical tour to the waste package testing site and to the underground caverns, where containers with low level waste are disposed of and intermediate level waste is stored, awaiting future disposal.

The ARTEMIS Review Team notes the strong commitment of the Government of the Czech Republic to ensure the safe implementation of radioactive waste and spent fuel management activities in the country as an essential part of the expected plans for the nuclear energy growth, in accordance with the legal and regulatory system, international conventions and IAEA safety standards.

The ARTEMIS Review Team acknowledges SÚRAO is in the siting phase of the deep geological repository (DGR) programme for the disposal of spent fuel and radioactive waste and carries out R&D to support this programme, in part at their Bukov Underground Research Facility. The team commends the strong commitment of all involved Czech Republic organizations to ensure the safe management of radioactive waste. The team was also particularly encouraged by the very open and constructive approach of the counterparts on all matters addressed in the mission.

The ARTEMIS Review Team concludes that many aspects relevant to the safe management of radioactive waste and spent fuel in the Czech Republic are in place. However, the ARTEMIS Review Team notes some important aspects, which should be evaluated and strengthened. They made a number of recommendations and suggestions, of which the most significant ones are addressed to:

The Government:

- to consider undertaking a review of the potential impact of radioactive waste and spent fuel from additional nuclear power reactors which could be included in a future State Energy Policy;
- to consider undertaking an in-depth review of the potential impacts on the financing arrangements of an expanded scope and extended duration of nuclear power programme.

The Czech Radioactive Waste Repository Authority (SÚRAO):

- to consider further enhancing plans and resources for engagement with interested parties, in particular with potential host communities to ensure sustained and effective engagement beyond the site selection phase of the DGR;
- to update the existing plans and schedules for the development of the DGR, taking into account the Complementary Delegated Act (Taxonomy).

The ARTEMIS Review Team commended Czech Republic for establishing mechanisms for verifying the alignment of individual strategies with the Policy, as well as ensuring alignment between the strategies. This was recognized as a good practice.

In summary, the ARTEMIS Review Team considers that Czech Republic has established a good basis for the safe and responsible management of radioactive waste and spent fuel, for which further improvements can be successfully implemented.

The ARTEMIS Review Team welcomes the information provided by counterparts that there is a Government Resolution[1] which, inter alia, instructs the MPO to submit to the Government,

[1] Resolution of the Government of the Czech Republic of 11 January 2023 No. 24.

by 31 December 2024, a proposal for the updated draft of the national Policy taking into account the results of the ARTEMIS review.

The ARTEMIS Review Team is of the opinion that, by considering the outcomes of the present review, the Czech Republic will be in a good position to continue meeting high standards of safety for radioactive waste and spent fuel management in the country.

In this regard, the ARTEMIS Review Team suggests that a follow-up mission in around 4-5 years from now could bring value to the Czech Republic's efforts to further improve its waste management.

I. INTRODUCTION

On 31st October 2018, the Czech Republic requested the IAEA to organize an Integrated Review Service for Radioactive Waste and Spent Nuclear Fuel Management, Decommissioning and Remediation Programmes (ARTEMIS). On 7th July 2021, the Ministry of Industry and Trade proposed the IAEA to organize back-to-back Integrated Regulatory Review Service (IRRS) and ARTEMIS missions, with the IRRS mission in May 2023 and the ARTEMIS mission in second half of 2023. Czech Republic's request for the ARTEMIS review is to satisfy its obligations under Article 14(3) of the Council Directive 2011/70/Euratom of 19 July 2011 establishing a Community Framework for the Responsible and Safe Management of Spent Fuel and Radioactive Waste (hereinafter the *EU Waste Directive*).

The ARTEMIS review mission was carried out between 15-25 October 2023 following the IRRS mission which took place from 16-27 May 2023. The ARTEMIS review was led by the IAEA by the Department of Nuclear Safety and Security supported by the Department of Nuclear Energy.

The review was performed by a team of six senior international experts in the field of decommissioning and RW and SF management, from multiple IAEA Member States, with IAEA staff providing coordination and administrative support. Subsequent to a preparatory meeting in March 2023, and the receipt and review of Advanced Reference Material in August 2023, in October 2023 the ARTEMIS Review Team evaluated the Czech Republic's RW and SF management programme.

II. OBJECTIVE AND SCOPE

The ARTEMIS review provided an independent, international evaluation of Czech Republic's RW and SF management programme.

The ARTEMIS review was performed against the relevant IAEA Safety Standards and proven international practice and experiences with the combined expertise of the international peer review team selected by the IAEA.

Management of residues from the NORM industries and management of waste from remediation activities were excluded from the scope of the ARTEMIS review. The regulatory aspects related to both topics were discussed as part of the IRRS review mission.

The outcomes from the 2023 IRRS mission to the Czech Republic were taken into account as appropriate to avoid unnecessary duplication in line with the Supplementary Guidelines on the Preparation and Conduct of IRRS-ARTEMIS back-to-back Missions, applicable for situations when an IRRS mission is conducted before an ARTEMIS mission. These Supplementary Guidelines were not a substitute for the ARTEMIS Guidelines but supplemented them with the specific provisions that needed to be taken into account while conducting IRRS-ARTEMIS back-to-back missions.

III. BASIS FOR THE REVIEW

A) PREPARATORY WORK AND IAEA REVIEW TEAM

A preparatory meeting for the ARTEMIS Review, was conducted on the 7th of March 2023 online. The preparatory meeting was carried out by the appointed Team Leader Ms Sylvie Voinis, the IAEA coordinator and deputy coordinator Mr Vladan Ljubenov and Ms Karina Lange respectively, and the team of National Counterparts led by Ms Martina Máčelová from the Radioactive Waste Repository Authority (SÚRAO), with participation of representatives of the Ministry of Industry and Trade, and State Office for Nuclear Safety (SÚJB).

The meeting participants had discussions regarding:

- the Terms of Reference for the ARTEMIS review; and
- the relevant detailed aspects for organization and conduct of the review.

IAEA staff presented the ARTEMIS principles, process and methodology. This was followed by a discussion on the work plan for the implementation of the ARTEMIS review in the Czech Republic in October 2023.

Ms Martina Máčelová, and Mr Tomáš Rosendorf were appointed as the National Counterparts for the ARTEMIS mission and designated IAEA points of contact.

The Czech Republic provided IAEA with the ARM for the review on 15 August 2023.

B) REFERENCES FOR THE REVIEW

The review was made in accordance with Version 2.0 of the guidelines for the ARTEMIS review service. The Czech responses to the ARTEMIS self-assessment questionnaire were used as a key basis for the review, together with the rest of the ARM and materials presented during the review mission and the associated discussions. In accordance with the Statute of the IAEA, the ARTEMIS review was made against the IAEA Safety Standards. Other IAEA publications were considered where relevant. The complete list of IAEA publications for this review is provided in Appendix E.

C) CONDUCT OF THE REVIEW

The initial Review Team meeting took place on Sunday, 15 October 2023 in Prague, directed by the ARTEMIS Team Leader Ms Sylvie Voinis, the ARTEMIS Team Coordinator Mr Vladan Ljubenov and the Deputy Team Coordinator, Ms Karina Lange.

The ARTEMIS entrance meeting was held on Monday, 16 October 2023, with the participation of the Radioactive Waste Repository Authority SÚRAO (the waste management organization in Czech Republic), the Ministry of Industry and Trade and State Office for Nuclear Safety (SÚJB). On behalf of counterparts the representatives of SÚRAO, SÚJB and ČEZ company were represented by its senior management and staff. Opening remarks were made by Mr Tomáš Ehler (Deputy Director General, the Ministry of Industry and Trade), Mr Lukáš Vondrovic (Director, SÚRAO) and Ms Sylvie Voinis, ARTEMIS Team Leader. During the ARTEMIS mission, a review was conducted for all review topics within the agreed scope with the objective of providing Czech authorities with recommendations and suggestions for improvement and, where appropriate, identifying good practice.

The ARTEMIS Review Team performed its review according to the mission programme given in Appendix B.

The ARTEMIS Exit Meeting was held on Wednesday, 25 October 2023. Opening remarks were made by Mr Tomáš Ehler (Deputy Director General, the Ministry of Industry and Trade) and Mr Lukáš Vondrovic (Director, SÚRAO) and Mr Štěpán Kochánek (Director of Section of Nuclear Safety, SÚJB). A presentation of the results of the Review Mission was given by the ARTEMIS Team Leader Ms Sylvie Voinis. Closing remarks were made by Ms Anna Clark, Section Head, Waste and Environmental Safety Section, Division of Radiation, Transport and Waste Safety, Department of Nuclear Safety and Security.

An IAEA press release was issued.

1. NATIONAL POLICY AND FRAMEWORK FOR RADIOACTIVE WASTE AND SPENT FUEL MANAGEMENT

1.1. NATIONAL POLICY

Czech Republic position

The national policy of the Czech Republic was established by the Atomic Act, based on the following five principles:

1) The Czech state has the ultimate responsibility for the safe management of RW and SF generated in the country.
2) Waste generators are obliged to ensure the safe management of RW arising from their activities using ionising radiation. Waste generators bear all the costs of the RW and SF management so that the costs will not burden future generations.
3) Expenses for the safe management of RW and SF are to be covered by the contributions of nuclear power plant operator and fees for RW disposal from waste generators. The state-owned Nuclear Account was established to collect these financial means.
4) The state authority is established to ensure the safe disposal of existing and future RW and SF generated in the Czech Republic.
5) The disposal of RW and SF arising from nuclear activities in foreign countries is not allowed in the Czech Republic.

A graded approach is one of the fundamental principles of the Atomic Act, and takes into account the type of facility, the type of material and RW present in the facility and the activities carried out.

Based on the requirements set out in the Atomic Act, the Ministry of Industry and Trade (MPO) is responsible for the development and updating of the Concept for RW and SF management (referred to in the ARM as the "Policy for the Management of RW and SF in the Czech Republic", hereinafter referred to as the "Policy"), including the establishment of a timeframe for its evaluation and updating. The requirements for the content and method of evaluation and updating of the Policy are further regulated in Decree No. 266/2019 Coll.

The first Policy was approved in 2002 by Government Resolution No. 487/2002 and the Policy has subsequently been updated several times to reflect the evolving trends in RW and SF management at national and international levels and the state of development of the Czech DGR. The current Policy is for the period 2015-2025. This was approved by Resolution No. 597/2019 of the Government of the Czech Republic in 2019. As part of the updates, the Policy was subjected to a strategic environmental assessment process (SEA).

The counterparts highlighted that the updated Policy will include a new accelerated timetable and associated milestones for the development of the DGR in compliance with the technical criteria of the EU taxonomic classification, which were set by Government Resolution No. 24/2023. As part of the process of updating the Policy, public consultation is planned. The draft updated Policy is expected to be published in 2024, the SEA process in 2025, and approval of the Government will follow thereafter.

The Policy sets out the principles that follow those set out in Article 12 of Council Directive No. 2011/70/Euratom, including the principles set out in article 4 of the Directive.

The main principles and approaches applied in both the Policy and national legislation were adopted from international experience. These include:

- Only those organisations that hold RW and SF management licences issued by the State Office for Nuclear Safety based on fulfilling the requirements set out in the Atomic Act and its implementing regulations are permitted to manage RW and SF.
- The management of RW and SF in the Czech Republic is required to respect the relevant national strategic objectives and recognized international principles and guidance (IAEA safety standards, OECD Nuclear Energy Agency recommendations, EC requirements).
- RW and SF generators bear all the costs of the management of RW and SF. The costs of the disposal of RW and SF currently generated will not burden future generations.
- RW and SF generators are required to limit the production of RW to the minimum extent and submit detailed data on the short- and long-term generation of RW and SF and other documentation that determines the amount and the method of transfer of funds to the Nuclear Account. When determining the fees to be paid into the Nuclear Account, fees for the disposal of LLW and ILW and fees for the disposal of RW and SF that do not meet the waste acceptance criteria (WAC) for disposal in operating facilities are calculated separately.
- RW and SF management licensees are legally required to maintain records of their RW and SF that cover all the SF and RW properties considered in the legislation.
- RW is processed for disposal by the relevant SÚJB licence-holders. The aim is to ensure that RW, including unused ionising radiation sources, is disposed of immediately and without undue delay.
- SÚRAO maintains and optimises the operation of existing disposal facilities and provides solutions for ensuring disposal capacity for all the generated in the Czech Republic via the peaceful use of nuclear energy and ionising radiation.
- The basic Czech management strategy for SF consists of its direct disposal in a DGR, the commissioning of which is planned for 2065 in the current Policy. However, the strategy is expected to be updated to include a commissioning date of 2050.
- Prior to commissioning the DGR, SF and RW deemed unacceptable for disposal in operating disposal facilities shall be safely stored on the premises of the generators or at SÚRAO -operated disposal facilities.
- The management of RW and SF and the development of the DGR are conducted in full accordance with the respective legal requirements and international recommendations, bearing in mind the current level of knowledge.
- Options for reducing the volume and radiotoxicity of SF will be monitored and evaluated on a continuous basis.
- The public will participate fully in the development of the DGR at all stages of the process. The DGR site selection process is based on partnerships between SÚRAO and the municipalities and communities concerned.

ARTEMIS observation

The national policy in the Czech Republic is codified mainly by the Atomic Act. The scope and basic principles are comprehensive and in line with IAEA fundamental safety principles and international practice.

There are requirements for the periodic review and updating of the Policy. The ARTEMIS Review Team notes that the process involves consultation and also formal evaluation of the revised Policy through a Strategic Environmental Assessment (SEA). The ARTEMIS Review Team further notes that the draft report of the Integrated Regulatory Review Service (IRRS) Mission to the Czech Republic from 2023 considered that the Government of the Czech

Republic has demonstrated an integrated approach, involving all relevant stakeholders on all levels (all relevant ministries and authorities, industry, research institutions, universities, regional representatives) in the preparatory activities for updating the Policy.

Concerning the planned update of the national Policy, the ARTEMIS Review Team notes that important aspects include the incorporation of the technical criteria of the Complementary Delegated Act (Taxonomy), the stated aspiration of which is to accelerate the timetable to have an operational DGR (by 15 years, to 2050), and the overall effort to keep the Policy in line with current and planned developments. However, the work on the updated Policy is ongoing, and the outcome was not available for consideration by the ARTEMIS Review Mission.

The ARTEMIS Review Team notes that the Atomic Act requires organisations involved in the management of RW and SF to develop and implement strategies and plans that are consistent with Policy. This interaction between the Policy and strategies is considered further in chapter 2, *National Strategy for Radioactive Waste and Spent Fuel Management*.

There is a clear National Policy, which is kept under review and periodically updated. Information was presented during the ARTEMIS Mission on certain considerations to be incorporated in the updated Policy (e.g. timelines for NPP operation, timelines for DGR development, implications of potential new NPP considerations), even though the updated Policy is not yet available. Given the timing, there is an opportunity to incorporate relevant recommendations and suggestions from this ARTEMIS review into the updated Policy. The ARTEMIS Review Team welcomes the information provided by the counterparts that there is a Government Resolution[2] which, inter alia, instructs the MPO to submit to the Government, by 31 December 2024, a proposal for the updated draft of the National Policy taking into account the results of the ARTEMIS review.

[2] Resolution of the Government of the Czech Republic of 11 January 2023 No. 24.

1.2. LEGAL, REGULATORY AND ORGANISATIONAL FRAMEWORK (PARTLY REFERRING TO IRRS)

Czech Republic position

The National Policy influences the activities of a wide range of institutions and companies, in particular the Government of the Czech Republic and state authorities in general, SÚJB, SÚRAO, waste generators, institutions involved in the development of RW and SF disposal methods and municipalities directly affected by radioactive waste disposal, as well as the general public. The institutional framework for RW and SF management in the Czech Republic and the competencies of the various stakeholders are described in more detail in Figure 1-1.

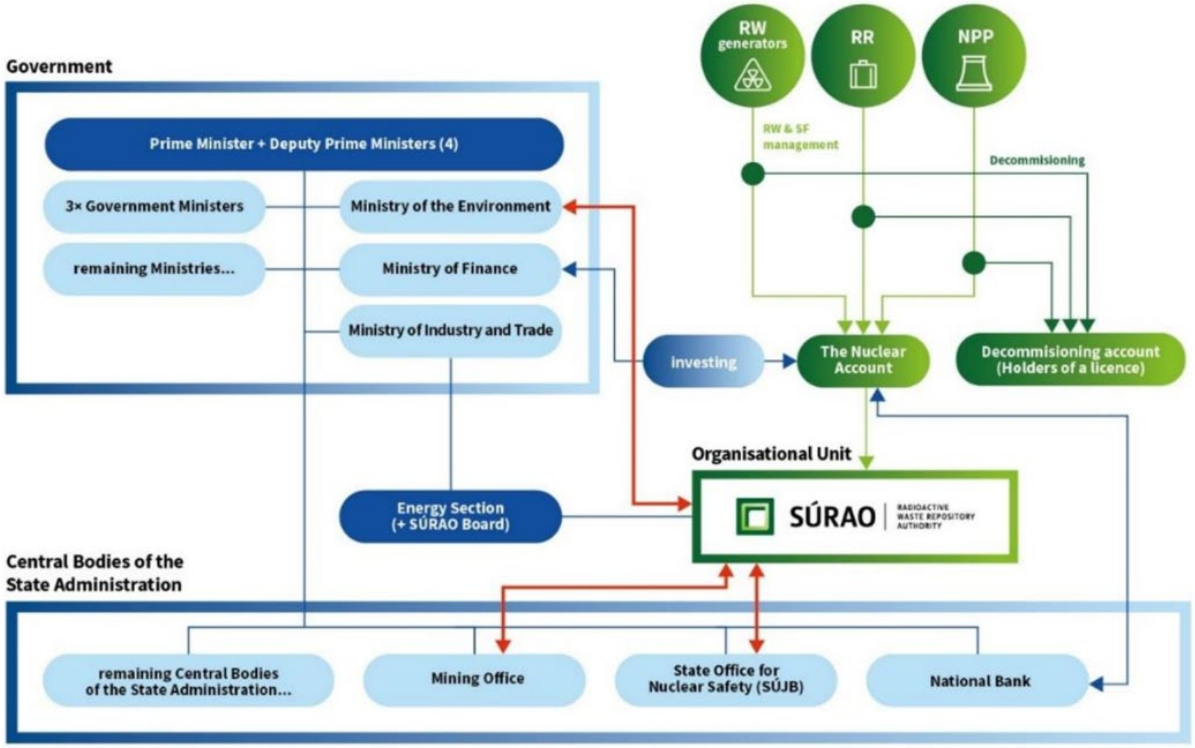


Fig. 1-1. *The institutional framework for RW and SF management in the Czech Republic*

By the approval of the Policy, the Government determines the principles, objectives and priorities to ensure the optimal approach to RW and SF management. The aims of the Government must subsequently be fulfilled by the various ministries involved, especially by the Ministry of Industry and Trade, the Ministry of the Environment and the Ministry of Finance.

Government of the Czech Republic

The role of the Government in RW and SF management is defined in the Atomic Act (section 210); the Government approves annual, three-year and long-term plans of SÚRAO. The Government approves all these documents via the recommendation of the Ministry of Industry and Trade. SÚRAO has the formal status of a state organisational unit.

Ministry of Industry and Trade (MPO)

The Atomic Act (section 212) requires that the MPO prepares and updates the Policy, submits it to the Government for approval, and subsequently notifies the European Commission. The MPO established SÚRAO to manage RW in the Czech Republic and to prepare and operate disposal facilities.

The MPO submits its own and SÚRAO's strategic and legislative materials relating to the management of RW and SF to the Government when required. There is an exception with submitting national reports compiled in accordance with the Joint Convention and Article 14.1 of the Council Directive 2011/70/Euratom, which are submitted by the chairperson of SÚJB or, occasionally, by the prime minister or other authorised members of the Government.

Ministry of Finance

The Ministry of Finance is responsible for managing the Nuclear Account at the Czech National Bank. It invests unused funds in interest-bearing financial instruments, e.g. bonds (section 116 and 215 of the Atomic Act and see Chapter 7).

Ministry of the Environment

The Ministry of the Environment is the state supervision authority in all matters concerning the protection of environment (Competence Act No. 2/1969 Coll.) and responsibility in radiological protection (section 218 of the Atomic Act). Concerning RW management, the Ministry has a significant role in terms of the SEA process, the approval of construction plans via EIAs, the granting of permits for geological investigation survey work (determining the exploration area) at potential sites for the DGR and the determination of protected area status for the final DGR site.

1.2.2 Radioactive waste disposal implementor (SÚRAO)

The Atomic Act (section 113) sets out the responsibilities of SÚRAO, which has the formal status of a state organisational unit. SÚRAO was established in 1997 to manage activities related to the disposal of RW. SÚRAO is responsible primarily for the preparation, construction, commissioning, operation and closure of RW and SF disposal facilities and the monitoring of their impact on the environment. RW and SF management includes the processing of spent and irradiated fuel into a form suitable for disposal or subsequent use after it has been declared to be RW, the maintaining of records of RW received and its generators, the administration of RW disposal charges, the inspection of the facilities of licensees and the verification of their decommissioning funds and the approval of the use of financial resources from such funds, the provision of RW management services and the granting of financial contributions to municipalities affected by RW management activities. SÚRAO performs its activities based on its government-approved statute and annual, three-year and long-term activity plans. The National Policy comprises one of the strategic documents on which these plans are based.

SÚRAO operates three facilities: Dukovany (within the Dukovany NPP site; in operation since 1995; owned by the state since 2000), Richard (near the town of Litoměřice; in operation since 1964) and Bratrství (near the town of Jáchymov; the disposal of natural radionuclides only; in operation since 1974). SÚRAO is also responsible for the institutional control of already closed Hostim disposal facility (near the town of Beroun; in operation from 1959 to 1964; closed in 1997).

1.2.3 Regulatory Bodies

The State Office for Nuclear Safety (SÚJB)

SÚJB is the central state administration authority for the supervision of the use of nuclear energy and ionising radiation and for ensuring radiation protection (section 200 and subsequent of the Atomic Act).

SÚJB was established via Act No. 21/1993 Coll. of 21 December 1992 (see Annex 1). On 1 January 1993 it took over responsibility for the monitoring of nuclear safety in the Czech Republic from the ČSKAE. Its sphere of authority was supplemented by the provisions of Act No. 287/1993 Coll., on the competences of the State Office for Nuclear Safety.

In 2016, the new Atomic Act was adopted, which replaced preceding Act No. 18/1997 Coll. The new Atomic Act, which fully incorporated the regulations and directives issued by the EU (Euratom), became effective on 1 January 2017.

SÚJB has all the powers and competences necessary for the performance of its mission, i.e. the state supervision of nuclear safety, radiation protection, physical protection and the management of extraordinary radiation events. The competences of SÚJB do not overlap with or contradict those of any other state administration authority. The chairperson of SÚJB is responsible for its activities and for reporting to the prime minister and the Government.

Independent evaluations of the Czech state supervision system were performed as part of two IRRT missions (2000, 2001), an IRRS mission (2013) and follow-up IRRS missions (in 2017, 2023).

The Czech Mining Office

The Czech Mining Office, the central state mining authority, supervises mining activities and activities conducted using mining methods, the management of explosives, underground fire protection and the safe condition of underground facilities. It also administers payments for the use of mining areas and mined minerals. The Office supervises the mine safety of SÚRAO's disposal facilities Bratrství and Richard and will provide licences for the various mining procedures involved in the construction and operation of the future DGR.

1.2.4 Public Entities

Institutions involved in the development of methods for the disposal of RW and SF

Research, scientific, higher education and implementation institutions and organisations use the Policy to plan their professional capacities and to systematically prepare to fulfil any requirements that may arise from the implementation of the Policy.

Affected municipalities

SÚRAO has established two Civil Control Commissions to share information with representatives of municipalities near to disposal facilities Bratrství and Richard already in operation. The Commissions serves as platform to share results of monitoring system and to inform the population of the near vicinity about activities performed in repositories. SÚRAO is further the member of Civil Safety Commission Dukovany to share information from the Dukovany disposal facility and NPP operation.

The DGR site selection process includes the desire on the part of SÚRAO to strengthen partnerships with the municipalities concerned. The involvement of such municipalities is crucial in terms of advancing the preparation of any significant project, including DGRs. The involvement of municipalities in the DGR dialogue is and will be on a purely voluntary basis and it is offered mainly on site to local representatives. If these municipalities are not interested in the dialogue, the participation is ensured by providing information and publicly available documents.

The general public

The Policy is a source of information on the intentions and priorities of the RW and SF management process in the Czech Republic, all of which are in strict compliance with international standards and recommendations.

1.2.5 Radioactive Waste and Spent Fuel Generators

The Policy provides a framework for decision-making by RW and SF generators with concern to their business and production strategies. Several RW and SF management-related facilities are currently in operation in the Czech Republic (see Fig. 2).

The main and only actor on the field of peaceful use of nuclear energy is the energy company ČEZ, a.s., as the operator of two nuclear power plants in the Czech Republic at Temelín and Dukovany.

Research Centre Řež s. r. o. operates the LVR-15 research reactor. The other research reactors in the Czech Republic are LR-0 of the Research Centre Řež, s.r.o. and training reactors at the Czech Technical University in Prague, Faculty of Nuclear Sciences and Physical Engineering (VR-1, VR-2).

RW of institutional origin is generated in the Czech Republic from the use of radionuclides in the medicine, industry and research sectors. RW generators transfer their waste for further treatment and processing to RW management licence holders, i.e. ÚJV Řež, a.s., UJP Praha a.s., ZAM-SERVIS s.r.o., ISOTREND s.r.o. and VF, a.s.

ARTEMIS observation

The ARTEMIS Review Team notes that a comprehensive legal, regulatory and organisational framework is established, and applied. In this regard, the ARTEMIS Review Team also notes that the [draft] 2023 report of the IRRS Mission to the Czech Republic also concluded that the Atomic Act aligns with IAEA fundamental safety principles and that the governmental, legal and regulatory framework for nuclear safety, security and safeguards as well as for radiation protection is established and applied.

1.3. CONSIDERATIONS RELATED TO POTENTIAL EXPANSION OF THE NUCLEAR POWER PROGRAMME

Czech Republic position

The current State Energy Policy addresses construction of additional large nuclear power reactors on existing sites. The anticipated new State Energy Policy will include additional small or medium-sized (modular) reactors. A revision of the National Action Plan for Development of Nuclear Power for period 2015-2025 is also envisaged. The Government has established the Standing Committee for the Construction of New Nuclear Resources, which has a number of working groups to address issues such as funding, legal, technical, human resources, etc.

ARTEMIS observation

The ARTEMIS Review Team notes that the present National Policy of RW and SF management is in general tailored to existing NPP facilities and three planned large reactor units in the country. The ARTEMIS Review Team notes that information was made available during the Mission about the current update to the National Policy, which will address of a number of additional nuclear facilities.

The ARTEMIS Review Team notes that the updated National Policy does not fully consider possible additional and new types of facilities not yet specified in the State Energy Policy. Such additional and new types of facilities may introduce challenges requiring modification and adaptation of the Policy.

/RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *The National Policy considers the decommissioning and radioactive waste implications of existing and a number of planned additional nuclear facilities, but does not fully consider the decommissioning and radioactive waste implications of potential additional and new types of nuclear facilities, which are not currently foreseen in the State Energy Policy.*	
(1)	**BASIS: GSR Part 5, Requirement 2, para 3.5 states that** *"[…] the national policy […] has to be based on knowledge of the waste to be managed (e.g. knowledge of the inventory and of waste streams) now and in the future. "*
(2)	**BASIS: IAEA Nuclear Energy Series No. NW-G-1.1 states that** *"The existing policy and strategy should be reviewed and analysed in relation to:[…] new national, political or technical circumstances that might require amendment of the policy and strategy, for example:* *— New governmental arrangements and policies, e.g. revised changes in national policy on the import or export of radioactive waste;* *— The closure or opening of nuclear facilities that might create new waste streams to be managed;* *— Delays in developing waste storage/disposal facilities;* *— The opening or closure of a national waste repository, which could influence the need for storage arrangements;[…]"*
S1	**Suggestion: The Government should consider undertaking a review of the potential impact of additional and new types of nuclear facilities which could be included in a future State Energy Policy.**

2. NATIONAL STRATEGY FOR RADIOACTIVE WASTE AND SPENT FUEL MANAGEMENT

2.1. SCOPE

Czech Republic position

The Policy includes the National Programme and was initially adopted by the Czech Government on May 15, 2002 (Government Resolution No. 487/2002). It is a fundamental document which defines the RW management policy and strategy of the government and its agencies. The scope of the Policy and strategy includes all RW generated from nuclear installations and workplaces with ionizing radiation sources in healthcare, research and industry.

The Policy requires organisations that are involved in RW and SF management to develop and implement strategies and plans that are consistent with its principles, objectives and recommendations.

The objective of the national strategy is the continuous improvement of the process of responsible and safe management of RW and SF, without undue burden to future generations.

Activities relating to the safe management of RW and SF management are based on provisions of the national strategy, to implement the primary policy principles of safe operation of disposal facilities with sufficient disposal capacity and the development of the DGR.

ARTEMIS observation

The ARTEMIS Review Team notes that the Atomic Act requires organisations involved in the management of RW and SF to develop and implement strategies and plans that are consistent with the National Policy.

The Czech Republic has put in place a comprehensive framework concerning the national policy and strategy.

The ARTEMIS Review Team notes that the strategies and plans for RW management of individual licensees are required to comply with the National Policy and Strategy. Based on the discussions held with the Counterparts, the Artemis Review Team notes that the Government has established mechanisms and procedures for ensuring the alignment of the strategies and plans developed by organizations involved in the management of RW and SF with the National Policy, both individually and collectively. The process is illustrated in Figure 2-1 below. In particular, the ARTEMIS Review Team notes that SÚJB is obliged not only to compare individual strategies with the National Policy, but also to take into account strategies of other stakeholders in order to ensure their mutual coherency and prevention of any conflicts.[3] A final outcome (an approval in the form of a licence) is only reached when full compliance is ensured. The ARTEMIS Review Team considers the mechanisms and procedures for ensuring the alignment of the strategies with the National Policy, and where necessary with each other, to be an example of good practice.

[3] The general obligation is based on general principles of state administration, as included in articles 2 to 8 of the Act No. 500/2004 Coll. Code of Administration.

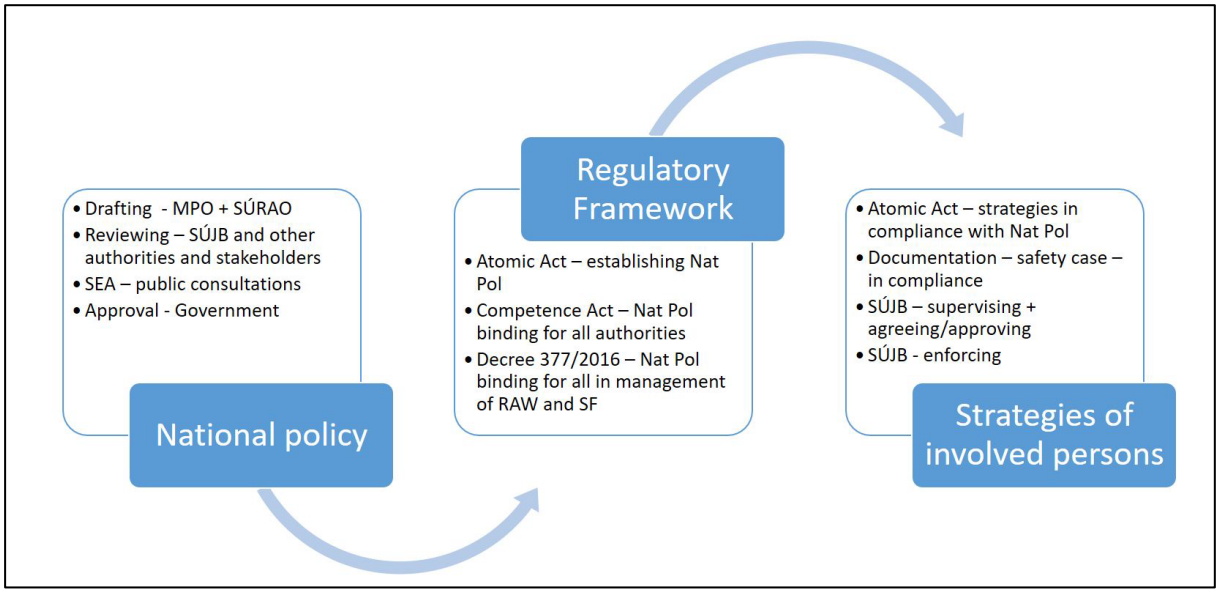


Fig. 2-1. Processes for ensuring alignment between the National Policy and strategies in the Czech Republic (from counterparts presentation to the ARTEMIS review mission). Note that there are also feedback loops back to the National Policy, not shown in the figure. In this context, the term "involved persons" refers to organizations involved in the management of radioactive waste and spent fuel.

The ARTEMIS Review Team notes also that, in practice, the strategies for management of operational and institutional RW are practically independent and that the Czech Republic emphasized that this contributes to the effective management and control of both main RW streams in the country.

2.2. MILESTONES AND TIMEFRAMES

Czech Republic position

GSR Part 1 states that the national strategy shall set out the mechanisms for implementing the National Policy. The Czech Republic's mechanisms for implementing the Policy are not set out in a separate strategy document.

The Policy was updated in 2019 according to address the EC requirement to complement so-called 'key performance indicators' (KPIs) in the implementation of the Policy and to provide cost assessment of the national programme. The Policy sets out "tools for policy implementation", including a series of objectives and milestones for the management of RW and SF for the period from 2019 to 2030. These objectives address key elements of the Policy including communication with the public, management of RW (suitable for disposal in operating disposal facilities), the management of RW and SF not suitable for disposal in operating disposal facilities and the preparation of a DGR, R&D and economic objectives. The government has assigned responsibilities for these objectives and milestones, some of which defined as time-specific, some as ongoing and some as permanent.

The national strategy sets out that disposal is the end point of RW and SF management. SÚRAO plans to implement one DGR, starting operation in 2050. This timescale is a change from the Policy adopted in 2019, which states that the DGR will be commissioned by 2065. This change is due to the technical criteria of the Complementary Delegated Act (Taxonomy).

The Policy recognizes that achievement of milestones and objectives is conditional on compliance with underlying assumptions and that there are risks such as delays to DGR site selection, possible delays in implementing additional SF storage or additional waste disposal capacity and changes in nuclear energy strategy. The Policy recognizes the need to monitor the achievement of the objectives and to take timely preventive and corrective action.

The Government stated its intention to evaluate the achievement of policy objectives by means of detailed analysis of the state of RW and SF management. As noted, it set a number of KPIs to evaluate implementation of policy objectives. These are the available disposal capacity for LLW and ILW (expressed as the ratio of capacity to waste production exceeding a value of one), the available storage capacity for ILW/HLW and SF (similarly expressed) and the timely achievement of milestones for DGR preparation. These KPIs are evaluated every three years, together with other areas of the policy. Progress is reported in annual reports published by SÚRAO or as separate documents for specific milestones.

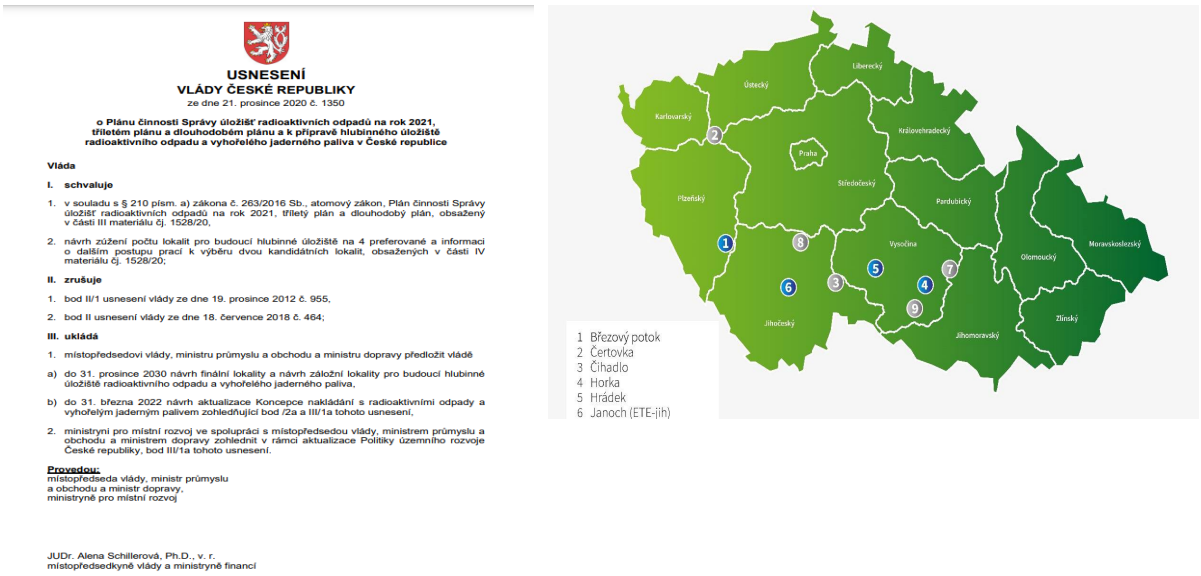
In addition to the objectives, milestones and KPIs set out in the policy, waste generators are required under section 111 of the Atomic Act to draw up a strategy which implements principles included in the concept (which means policy) for RW and SF management. A graded approach is applied in the development of these strategies, depending on the quantities and characteristics of the waste generated, which are reviewed by SÚJB. Waste generators holding licences for RW management also submit annual reports on compliance with the limits and conditions for safe management of RW.

One of the objectives of the national strategy is the communication of information on the long-term solution for the management of RW and SF to all affected entities and the broader public in an understandable manner, while enabling the public to participate effectively in the implementation of the policy objectives. The principle of transparency in dealing with the public shall be applied, which includes the opportunity for the public to comment on the chosen solution and actively influence it.

The strategy states that “The public will be involved in preparing RW and SF disposal facilities and will be allowed to participate in implementing the individual stages of preparation. The site selection for the DGR will be based on a partnership between SÚRAO and the municipalities concerned”.

The Government approved SÚRAO’s proposal for investigation of four sites by Government Resolution No. 1350/2020 in December 2020, to be followed by submission of a proposal for a final site and a back up site by 2030.

Figure 2-2. shows the Governmental resolution on investigation of four potential DGR sites and a map of their locations.



USNESENÍ
VLÁDY ČESKÉ REPUBLIKY
ze dne 21. prosince 2020 č. 1350

o Plánu činnosti Správy úložišť radioaktivních odpadů na rok 2021, tříletém plánu a dlouhodobém plánu a k přípravě hlubinného úložiště radioaktivního odpadu a vyhořelého jaderného paliva v České republice

Vláda

I. schvaluje

1. v souladu s § 210 písm. a) zákona č. 263/2016 Sb., atomový zákon, Plán činnosti Správy úložišť radioaktivních odpadů na rok 2021, tříletý plán a dlouhodobý plán, obsažený v části III materiálu čj. 1528/20,

2. návrh zúžení počtu lokalit pro budoucí hlubinné úložiště na 4 preferované a informaci o dalším postupu prací k výběru dvou kandidátních lokalit, obsažených v části IV materiálu čj. 1528/20;

II. zrušuje

1. bod II/1 usnesení vlády ze dne 19. prosince 2012 č. 955,

2. bod II usnesení vlády ze dne 18. července 2018 č. 464;

III. ukládá

1. místopředsedovi vlády, ministru průmyslu a obchodu a ministru dopravy předložit vládě

a) do 31. prosince 2030 návrh finální lokality a návrh záložní lokality pro budoucí hlubinné úložiště radioaktivního odpadu a vyhořelého jaderného paliva,

b) do 31. března 2022 návrh aktualizace Koncepce nakládání s radioaktivními odpady a vyhořelým jaderným palivem zohledňující bod /2a a III/1a tohoto usnesení,

2. ministryni pro místní rozvoj ve spolupráci s místopředsedou vlády, ministrem průmyslu a obchodu a ministrem dopravy zohlednit v rámci aktualizace Politiky územního rozvoje České republiky, bod III/1a tohoto usnesení.

Provedou:
místopředseda vlády, ministr průmyslu a obchodu a ministr dopravy, ministryně pro místní rozvoj

JUDr. Alena Schillerová, Ph.D., v. r.
místopředsedkyně vlády a ministryně financí

Ústecký
Liberecký
Karlovarský
Královéhradecký
Praha
Středočeský
Plzeňský
Pardubický
Vysočina
Olomoucký
Moravskoslezský
Jihočeský
Jihomoravský
Zlínský

1 Březový potok
2 Čertovka
3 Čihadlo
4 Horka
5 Hrádek
6 Janoch (ETE-jih)

Fig. 2-2. *Governmental resolution on investigation of four potential DGR sites and a map of their locations*

The national strategy also identifies the implementation of the research and development (R&D) programme for the DGR. The national strategy states that the R&D programme will take into account the requirements of Article 12 of EC Directive 2011/70/Euratom, which recommends the R&D activities necessary for the implementation of National Policy. The steps for developing this programme are presented in the national strategy.

ARTEMIS observation

The ARTEMIS Review Team notes that SÚRAO is undertaking significant activities related to public engagement and transparency such as: annual reports, SÚRAO website, reports on Czech television and radio (scientific editorial), lectures (to schools/universities), information centres, exhibitions, SÚRAO summer school, and in various types of social media.

The creation of an appropriate institutional and legal framework that reflects the importance and uniqueness of the DGR project is of paramount importance for the various stages related to its development. The ARTEMIS Review Team considers that establishing a legal framework with a specified role for the municipalities in the repository siting process is a prerequisite, to create a tool to interact between SÚRAO, MPO and the municipalities concerned in order to reach a consensual solution.

The ARTEMIS Review Team also appreciates that representatives from the Czech Republic are involved in international activities to exchange experience on effective dialogue between all stakeholders in decision-making processes, such as those at the IAEA, OECD Nuclear Energy Agency (Forum on Stakeholder Confidence – FSC), Euratom Programme for Research and Development, European Nuclear Forum's Information and Transparency Working Group, etc.

The ARTEMIS Review Team appreciates the high level of effort required to ensure continuous engagement with stakeholders, such as: the creation/participation of local/regional working groups and involvement of members of the municipalities concerned.

SÚRAO has established an Expert Advisory Board with a wide range of experts, the aim of which is to discuss and evaluate all key documents that will serve as a basis for selection of the final DGR site.

Such activities will continue throughout all the phases of the life cycle of the DGR and will need the allocation of adequate resources, both financial and human.

The ARTEMIS Review Team notes that whilst a timeline exists for the development of the DGR , there is no detailed schedule with associated milestones in the national strategy, taking account the provisions of the Complementary Delegated Act (Taxonomy). Moreover, the ARTEMIS Review Team emphasizes that the time needed for the licensing process at each step of the programme (siting, design, construction, commissioning, etc.) has to be taken into account in the timeframe of the development of the DGR. Also, possible delays should be anticipated of the DGR, in order to comply with the Taxonomy technical criteria.

The ARTEMIS Review Team considers that the SÚRAO medium-term R&D plan for the period 2020-2030 includes plans and approach for DGR, but there is a need for further consideration of specific R&D topics. The national policy identifies a number of R&D objectives but does not specify the plans to ensure that the required R&D is undertaken in the required timeframe and that the necessary resources (both human and financial) will be available.

The ARTEMIS Review Team considers that a programme with prioritization of tasks in connection with the national objectives to be achieved and a schedule for implementation of the DGR would facilitate the timely execution of R&D needs. Such a detailed schedule can be used also to plan what resources would be required and when. The reassessment of the schedule allows all parties (SÚRAO, SÚJB) to be able to fully discharge their duties and responsibilities in the development of the DGR having in mind the provisions of the Complementary Delegated Act (Taxonomy).

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *The Atomic Act requires organizations involved in the management of radioactive waste and spent fuel to develop and implement strategies and plans that are consistent with the Policy. The ARTEMIS Review Team notes that there are mechanisms to review the alignment of individual strategies with the Policy and with each other.*	
(1)	**BASIS: GSR Part 1 (Rev. 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. The strategy shall set out the mechanisms for implementing the national policy."*
(2)	**BASIS: GSR Part 5 para. 3.6. states that** *"The national strategy for radioactive waste management has to outline arrangements for ensuring the implementation of the national policy. It has to provide for the coordination of responsibilities […]."*
(3)	**BASIS: 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 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. The policy and strategy shall be compatible with the fundamental safety principles and with international instruments, conventions and codes that have been ratified by the State. The national policy and strategy shall form the basis for decision making with respect to the management of radioactive waste."*
GP1	**Good Practice: The Government has established mechanisms for ensuring alignment of the strategies and plans developed by organizations involved in the management of radioactive waste and spent fuel with the National Policy, both individually and collectively.**

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *There are ongoing activities and plans for further development of engagement with potential host communities during selection of the site for the proposed DGR and for the partnership programme between all stakeholders in the various phases of the DGR. There will be a need for additional resources and activities beyond the site selection phase.*	
(1)	**BASIS: GSR Part 5 Requirement 1 states that** *"The government shall provide for an appropriate national legal and regulatory framework within which radioactive waste management activities can be planned and safely carried out. This shall include the clear and unequivocal allocation of responsibilities, the securing of financial and other resources, and the provision of independent regulatory functions. Protection shall also be provided beyond national borders as appropriate and necessary for neighbouring States that may be affected."*
(2)	**BASIS GSR Part 5 Para. 3.4 states that** *"Matters that have to be considered by the government include: […] Defining and putting in place the overall process for the development, operation and closure or decommissioning of facilities, including the legal requirements at each step, the decision making process and the process for the involvement of interested parties […]."*
(3)	**BASIS: SSR-5 Requirement 11 states that** *"Disposal facilities for radioactive waste shall be developed, operated and closed in a series of steps. Each of these steps shall be supported, as necessary, by iterative evaluations of the site, of the options for design, construction, operation and management, and of the performance and safety of the disposal system."*
(4)	**BASIS: SSR-5 Requirement 11, para. 4.3 states that** *"Confidence has to be developed and refined by means of iterative design and safety studies as the project progresses […]. The process has to provide for:* *the collection, analysis and interpretation of the relevant scientific and technical data; the development of designs and operational plans; and the development of the safety case for safety in the operational stage and after closure. The step by step process provides access for all interested parties to the safety basis for the disposal facility. This facilitates the relevant decision making processes that enable the operator to proceed to the next significant step in the development of the facility, and on to its operation and, finally, its closure."*
(4)	**BASIS: SSG-23 Para 4.91. states that** *"Early involvement of interested parties should be ensured as part of the process of building confidence in the safety of the disposal facility. A key consideration is that interested party involvement should take place within an open and transparent framework for consultation, with clearly defined rules of procedure."*
S2	**Suggestion: SÚRAO should consider further enhancing plans and resources for engagement with interested parties, and in particular, with potential host communities to ensure they are properly engaged beyond the site selection phase of the DGR.**

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *The programme for achieving the milestones for the DGR is not sufficiently detailed, including the R&D plan.*	
(1)	**BASIS: SSR-5 Requirement 11, para 4.2 states that** *"A step by step approach to the development of a disposal facility for radioactive waste refers to the steps that are imposed by the regulatory body and by political decision making processes […]. For the operator, it provides a framework in which sufficient confidence in the technical feasibility and safety of the disposal facility can be built at each step in its development."*
R1	**Recommendation: SÚRAO should update the existing plans and schedules for the development of the DGR, taking into account the Complementary Delegated Act (Taxonomy).**

3. INVENTORY OF SPENT FUEL AND RADIOACTIVE WASTE

Czech Republic position

According to the Atomic Act, RW is defined as "*materials that contain or are contaminated with radioactive substances that have no further use and which do not fulfil the conditions for the clearance of radioactive materials directly from the workplace*".

The national RW and SF inventory of the Czech Republic consists of several sets of data recorded during collection, sorting, processing, treatment, storage, transportation and disposal of waste.

The RW classification system is determined by Decree No. 377/2016 Coll. The classification scheme is given in Table 3-1.

Classification	**Definition**	**Specific requirements**	**Storage/ disposal Facility**
	Material under clearance levels, not considered as radioactive waste	Clearing from workplace under section 76 of the Atomic Act	
Temporary waste	Very short-lived waste; radionuclides levels below clearance levels	Storage until waste radioactivity is lower than clearance levels; clearance from the workplace	Storage in generator´s facility (under licence)
Very low-level waste Low-level waste	Waste from operation and decommissioning of NPP and other nuclear installation	Disposal facility (Dukovany)	Very low-level waste Low-level waste
Very low-level waste Low-level waste	Waste from institutional sphere	Disposal facility (Richard and Bratrství)	Very low-level waste Low-level waste
Intermediate-Level waste	Waste from institutional sphere	Minimum depth tens of metres beneath the surface	Disposal facility (Richard and Bratrství)
High-level waste	Waste not meeting the WAC for operated disposal facilities, spent fuel after declaring as waste HLW from decommissioning of NPP and other nuclear installations	At a depth of several hundreds of metres beneath the surface	Deep geological repository

Table 3-1. National radioactive waste classification scheme

Figure 3-1. shows an overview of current radioactive waste and spent fuel management streams in the Czech Republic.

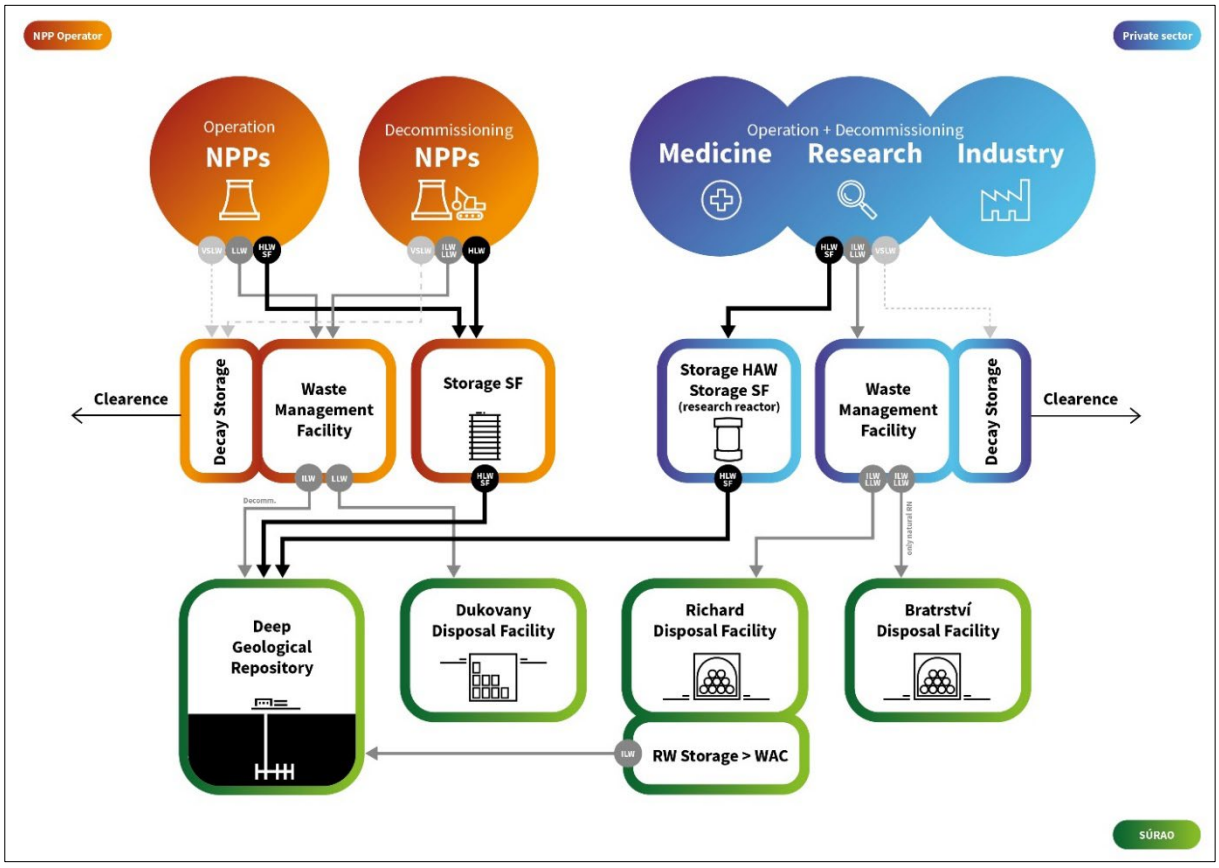


Fig. 3-1. Overview of current radioactive waste and spent fuel management streams in the Czech Republic

As licensees, all waste generators are required to keep records of the RW and SF originating from their activities and transmit the data to SÚJB via annual reports. SÚJB has the responsibility to maintain the full national RW inventory and communicate the information it contains to international organizations such as the IAEA.

The management of the information recorded in the National Inventory is as followed:

- SÚJB manages the database containing information on ionising radiation sources;
- SÚRAO manages the database of RW and SF to be disposed.

For the operating disposal facilities, the document which includes the scope of RW records accompanying RW is produced according to section 10 of the Decree No. 377/2016 Coll. Estimates of the quantities of future RW and SF produced are regularly updated in the safety reports of existing disposal sites and the preparation of a DGR.

For RW destined for disposal in the DGR:

- The SF inventory is summarised in the SF database. The database contains details on parameters that are important for the SF source term calculations necessary for the safety assessment. Those parameters comprise the final mass and activity of the key radionuclides, the geometric and material parameters of the fuel assembly, the fuel type, enrichment, burnup, and operational parameters.

- The RW that does not meet the WAC for operating disposal facilities are expected to be disposed in the DGR. The inventory and properties (physical, mechanical, chemical, and radiological) of all the types of this RW, including changes to the inventory and the properties after the closure of the disposal facility are summarised in the HLW and ILW database.

Quantifying the number of waste packages to be disposed of in the DGR is difficult due to the diversity of the RW and their radiological characteristics. This diversity may create the need for several different types of waste packages.

Solid RW is collected at the NPPs in an organised manner. Preliminary characterisation of solid RW is based on the counting rate measured close to the surface of the container. The counts are used for making decisions on whether the waste package is suitable for release from control (clearance). Detailed characterization is also done by the NPP, including nuclide specific and surface contamination measurements. The nuclide specific measurements provide information on the gamma emitters and normally scaling factors are used to determine the activity values of difficult-to-measure nuclides.

The estimation of future sources of SF and RW is based on the planned operation of current nuclear facilities, current developments in industry, healthcare and research sectors, and the planned construction of three new nuclear power units.

The inventory of planned new nuclear facilities is determined conservatively and flexibly, working with the possibility of adapting the national inventory to take into account an increased number of nuclear units. Updates of the inventory for operating NPPs involve the comparison of the initial estimated inventory with the actual inventory created via the operation of NPPs. Any differences are analysed and used to more accurately estimate the future inventory. SÚRAO cooperates closely with the operator of NPPs in this respect.

The future estimation of LLW and ILW amounts is communicated from waste generators to SÚRAO yearly, based on their business activities.

In accordance with the Atomic Act, SF is not considered RW until it is declared waste by the waste generator or SÚJB. SF management is subject to the same requirements as RW management and the generators are obliged to manage it in a way that further treatment is not foreclosed.

ARTEMIS observation

The ARTEMIS Review Team notes that the national inventory is based on data provided by RW generators, such as NPPs and different institutions; and includes the records of RW and SF in existing storage or disposal facilities.

The ARTEMIS Review Team notes the distinct roles of the main organisations. SÚRAO compiles the inventory of existing stored and disposed RW located in facilities and the inventory of SF. Data on future waste arisings are provided in a separate report, and are incorporated into the National Policy. SÚJB compiles the national inventory of RW and also forwards it to international organizations (e.g. IAEA). Both SÚRAO and SÚJB are provided with data on RW by the waste generators.

The ARTEMIS Review Team is of the opinion that establishing a single national inventory database could offer certain advantages over the present arrangements. Such a national database would offer a single official source of information for data on all past, present and expected future RW and SF production to support decision making related to their management.

The ARTEMIS Review Team notes that both SÚJB and SÚRAO have responsibilities in relation to quality control on characterization, treatment and processing of RW. SÚJB carries out inspections of waste generators' workplaces in terms of legislative requirements (operational limits & conditions (OLC), WAC). SÚRAO regularly visits generators' workplaces and checks compliance with the WAC.

The ARTEMIS Review Team was informed that Waste characterization reports are sent to one of the waste disposal facilities for preliminary checking whether WAC of the given disposal/storage facility are met. Such characterization reports also contain declaration from the waste generator that no toxic material is found in the waste package. When a waste package enters one of the waste disposal facilities, the waste package is checked again for surface contamination and dose rate (all packages), and nuclide specific measurements using gamma spectrometry are performed (selected packages). The ARTEMIS Review Team notes that this assurance/compliance process is in accordance with international practice.

In addition to being a waste generator, ÚJV Řež also carries out extensive research activities in the field of RW treatment and disposal. Having substantial experience in waste handling, ÚJV Řež also provides engineering support to operating nuclear facilities, including NPPs, in the field of waste management. The ARTEMIS Review Team notes that the experience and support of ÚJV has positive influence on the waste management processes going on in the country.

The ARTEMIS Review Team was informed that ÚJV Řež has 30 to 100 m^3/y of historic or legacy RW. This consists of old laboratories, hot cells, pipes, etc. Old Pu-Be and Am-Be sources are also processed at ÚJV Řež using cementation. A strategy exists for eliminating this historic or legacy waste, according to which management plans are developed and updated yearly.

Regarding the disposal of RW and SF, the ARTEMIS Review Team notes that the national inventory distinguishes between the disposal of RW in operated facilities and the RW and SF that is to be disposed of later in the DGR.

According to current planning, the latter type of RW is expected in the amounts of 4500 m^3. This volume estimate includes packages with ILW or HLW that originate in smaller amounts as operational waste from the operating nuclear power plants, planned new reactor units, research organizations, medical and industrial facilities, and from decommissioning. Correspondingly, this is the planned capacity of the DGR for non-spent fuel type of waste. Some ILW from decommissioning of the NPPs, consisting of activated materials, will need to be disposed of in the DGR. The ARTEMIS Review Team notes that the estimated quantities may be higher than estimates for similar nuclear reactor types in other national countries. Accordingly, it could be useful for the NPP licensees to re-evaluate the expected quantities of RW on the basis of updated modelling of the activation of materials.

The ARTEMIS Review Team notes that the SF inventory is summarised in the SF database for safety assessment purposes. The database contains details on parameters that are important for the SF source term calculations necessary for the safety assessment. Those parameters comprise the final mass and activity of the key radionuclides, the geometric and material parameters of the fuel assembly, the fuel type, enrichment, burnup, operational parameters and so on. Modelling also includes a sensitivity analysis and takes into account the uncertainty of the calculations.

The RW and SF inventory and properties (physical, mechanical, chemical, and radiological) of all types of RW and SF to be disposed of in the DGR, including changes to the inventory and the properties after the closure of the disposal facility are summarised in the HLW and ILW database that has been updated in 2023 for the needs of the design of the DGR. The database is supplemented and updated based on the actual operation of nuclear facilities and developments

in the research, medical, industrial and energy fields with concern to nuclear considerations. The database is modified as required, e.g. when updates of the Policy are issued or more information is delivered by generators.

The ARTEMIS Review Team notes that quantifying the number of packages for the RW section of the DGR is complex due to the diversity of the waste itself and its radiological characteristics.

The ARTEMIS Review Team notes the comprehensive approach to developing and maintaining the RW and SF inventory, the quality control procedures that have been implemented, and the clearly defined roles and responsibilities in relation to the inventory. The ARTEMIS Review Team considers that these are in line with current international practice.

4. CONCEPTS, PLANS AND TECHNICAL SOLUTIONS FOR SPENT FUEL AND RADIOACTIVE WASTE MANAGEMENT

Czech Republic position

The Atomic Act and Decree No. 377/2016, issued to implement various provisions of the Atomic Act, set out the requirements for the safe management of RW and the decommissioning of nuclear installations or category III or IV workplaces.

Concepts, plans and technical solutions for predisposal management and disposal of radioactive waste in operating and closed facilities

Predisposal management of RW is undertaken as a result of operation of the NPPs at Dukovany and Temelin, the research reactor operated by ÚJV Řež and generators of "institutional waste" outside the nuclear energy sector (e.g. hospitals and industry). Orphan sources (defined as radionuclide sources that are not under regulatory control) are also processed into a form suitable for disposal.

Some institutional waste is stored in ÚJV Řež until its radioactivity decreases to clearance levels. It is then disposed of as non-radioactive waste. ÚJV Řež is licensed to treat and process institutional waste, with solid waste sorted and processed mainly into 216-litre drums, and liquid waste conditioned by cementation into 216-litre drums. These are then disposed of in operating disposal facilities.

Radioactive material arising from NPP operation that meets clearance levels is disposed of as non-radioactive waste. This includes some spent ion-exchange resins which may be disposed of after a period of decay storage. Solid RW is collected, sorted and segregated depending on type and activity. Further processing techniques used include fragmentation, decontamination and low and high force compaction (the latter in a facility outside the Czech Republic). Some RW is incinerated, and some metals melted, also in facilities outside the Czech Republic. The residual materials are returned to the Czech Republic after processing.

Aqueous liquid RW from NPPs is segregated and treated using a variety of techniques including ion-exchange and mechanical filtration, sorption, sedimentation, centrifugation and evaporation. Concentrated liquid waste, sludges and used ion-exchange materials are conditioned using bitumen (for concentrates) and aluminosilicates (also known as geopolymers, for ion exchange materials. Conditioned solid waste and some unconditioned solid waste are disposed of in steel drums in the disposal facility at Dukovany (which is also used for disposal of waste from the NPP at Temelin).

Solid RW arising from operation of NPPs and small amounts of institutional waste are disposed of in the surface disposal facility at Dukovany, operated by SÚRAO. The facility's capacity is expected to accommodate the amounts of RW arising from operation and decommissioning of the existing NPPs and one new nuclear source. Any further new nuclear sources would need to be addressed by additional disposal capacity.

The Dukovany disposal facility consists of at-surface concrete vaults covered by grouted panels that allow rainwater drainage. Low-level radioactive solid waste is disposed of in the facility, including conditioned waste in drums and unconditioned solid waste, some of which are not packaged. Filled vaults are grouted with concrete. The main challenges for the future will be the physical state of the second double-row, development of preservation methods, and technical options for the cover to be used for facility closure.

/Most institutional waste and some orphan sources are disposed of at the Richard disposal facility operated by SÚRAO. This is a former underground mine with sufficient capacity in reconstructed chambers to dispose of institutional waste for many years. The facility is actively ventilated by means of a fan and ventilation shaft. RW packages disposed of at the Richard disposal facility include single and double-layered cemented drums, proprietary double-layered block packages with uncemented waste in inner steel containers and some waste not fixed in a matrix. Once a disposal chamber is filled it is backfilled with stabilising material. The main challenges for the future will be to ensure sufficient disposal capacity until the DGR comes into operation, the adaptation of underground space, the new waste reception hall and the improvement of waste acceptance control.

The Bratrství disposal facility is used exclusively for institutional waste containing only natural radionuclides, and for disposal of some orphan sources. The facility is a former uranium mine and the licensed disposal chambers are close to capacity. SÚRAO is considering a proposal to adapt the entrance gallery to one for disposal to provide additional disposal capacity. This facility is also ventilated by means of a fan. Waste is placed in double-layered drums (216 litre packages). The main challenges for the future will be to adapt the entrance corridor as new disposal segments and to prepare for final closure.

The Hostim disposal facility was the first site for disposal of RW resulting from industry and research in the former Czechoslovakia. The facility was constructed in the former limestone mine near the village of Hostim by adapting two of the old mining tunnels. The facility operated during the period 1959-1964 and was shutdown in 1965 following a decision of the authorities. Characterisation of the disposed waste and safety studies were performed between 1991 and 1994, following which part of the inventory was transported to the Richard disposal facility. In 1997 the facility was backfilled with concrete and finally closed.

Concepts, plans and technical solutions for the decommissioning of facilities

Decree 377/2016 sets out the legal requirements for the scope and method of decommissioning and the content of documentation. The decree allows for both immediate and gradual (deferred) decommissioning strategies. The concept for decommissioning of a facility is required to be aligned with the Policy. The documentation for the concept is required to contain information on decommissioning strategies, where immediate dismantling is always one of the strategies, together with a justification of the proposed strategy, information on the timeframe for decommissioning, and information on how to reduce the amount of waste to be disposed of and limit the radioactive substances released.

Decree 377/2016 also sets requirements for documentation of a concept for safe permanent shutdown, and for the production of a decommissioning plan which is consistent with the plan for safe permanent shutdown. The decommissioning plan should contain initial documentation for estimating decommissioning costs. The plan is updated at least once every five years, together with the decommissioning cost estimate. SÚJB reviews and approves the decommissioning plans at least once every five years, while SÚRAO is responsible for verifying the decommissioning cost estimates on the same frequency.

Concepts, plans and technical solutions for pre-disposal management and disposal of spent fuel and radioactive waste not meeting the acceptance criteria for operating disposal facilities

Spent fuel, HLW and other RW that do not meet the WAC for operating disposal facilities are stored safely prior to disposal in the DGR, due to start operation in 2050.

Institutional waste that does not meet the conditions for acceptance for disposal at the Richard facility, most notably some used sealed sources, is stored in drums in chambers licensed for this purpose. These waste will be disposed of to the DGR when available.

RW from operation of NPPs not suitable for disposal in the Dukovany facility, such as activated components and irradiated samples, is stored at the NPPs and will be treated and disposed of during decommissioning. Decommissioning of the NPPs and the research reactors will also produce RW not suitable for disposal in the Dukovany facility, such as parts of reactor vessels and irradiated concrete. A concrete container with inner and outer cladding is being designed for disposal of this waste in the DGR, for which R&D is being undertaken.

Highly enriched SF from the ÚJV Řež research reactor has been transferred to the Russian Federation for reprocessing. The residual HLW will be returned and stored in an existing facility at ÚJV Řež, pending disposal in the DGR. R&D activities are being undertaken in support of the design of the waste disposal package. Other spent research reactor fuel will be stored there prior to disposal.

SF from NPP operation is stored for several years in the SF pool for cooling and then transferred into dual-purpose transport and storage containers to dry storage facilities at each NPP, with two stores at Dukovany (one full) and one at Temelin. Options for the storage of SF arising from new NPP units at both sites are being evaluated (including a centralized storage facility). The strategy for management of SF is dry storage at the site in containers suitable for storage and transport, to be followed by packaging for disposal in the DGR. The SF will need to be transferred from the storage/transport containers into the disposal containers. SÚRAO currently assumes that this operation will take place in a “hot cell” or “hot chamber” in the supporting facilities at the DGR. Damaged SF (of which there is only a relatively small quantity) is currently stored in the SF pools at the NPPs and has not been transferred into containers for dry storage. Damaged fuel is stored in hermetic cases in the SF pools at the Dukovany NPP until its decommissioning. The damaged fuel from the Temelín NPP is currently stored in a similar manner, but will be transferred into dry packages for storage in advance of decommissioning.

The DGR will provide long-term containment and isolation of RW and SF by means of a multi-barrier system combining engineering and natural barriers.

The development programme for the DGR started in 1992; initial technical designs were prepared in 1999. In 2019 there were 9 sites considered for the DGR and in 2020, 4 potential sites were selected for further consideration. SÚRAO’s goal is to select a final and back-up site in 2028 and recommend these sites to the Governement for approval in the next phase.

SÚRAO’s design for the DGR is based on waste disposal in a crystalline rock environment based on the Swedish KBS-3 model, with some adjustment. The model assumes the disposal of SF in double-layer metal (carbon and stainless steel), hermetically sealed waste packages in vertical boreholes sealed with a bentonite buffer. The plan is to construct the facility in crystalline host rock and start operations in 2050. The concept is based on the requirement to dispose of SF from the two existing NPPs and three proposed new units, based on the assumption that SF is not reprocessed and will be stored for 65 years after removal from the reactor, to allow sufficient cooling prior to disposal. HLW and other RW not suitable for disposal in other facilities will be disposed of in a separate section of the DGR.

The technical design of the DGR consists of disposal wells for SF, disposal chambers for RW, a transfer node including a hot cell, loading corridors, transport and service areas, mining and ventilation shafts and an experimental and rock characterization facility.

The R&D plan (as noted in Chapter 2) is coordinated by SÚRAO and is approved by the SÚRAO Board. The R&D needs and priorities are based on safety and performance assessments

needs, current research outputs and international experience. Most R&D activities are focused on the development of the DGR in the siting process, and performance and safety assessments. For operating facilities, most activities are focused on the review of the safety assessment and possible optimisation. They also include activities on the inventory and waste characteristics, strategic studies on RW and SF and R&D on waste disposal packages.

There is an operational Bukov Underground Research Facility (URF) at former mine Rožná-I, located in crystalline rocks, the main aim of which is to prove the safety and feasibility of the final site selected. Another aim is the determination of the transferability of the knowledge gained from the surface parts of the Bukov URF rock environment to the deep parts for the prediction of the properties of the sites at the DGR depth. The URF will also be used to verify the properties of waste disposal package materials under real rock environment conditions.

ARTEMIS observation

Concepts, plans and technical solutions for predisposal management and disposal of radioactive waste in operating facilities

During the Review Mission, the NPP licensee provided a comprehensive overview of the management of solid and liquid RW arising from NPP operations. This included information on the collection and segregation of liquid and solid waste at source, the methods for waste characterization and the processing techniques used. Information was also provided on storage methods and capacity, including the storage of high activity items that do not meet the WAC for the disposal facility at Dukovany.

The NPP licensee provided data that demonstrated that the solid waste arising from bituminization and conditioning using geopolymers met the relevant WAC for disposal at Dukovany. The use of bitumenization achieves higher waste loadings per drum than alternative techniques and thus reduces the total volume of solid waste arising from the management of liquid concentrates, which constitute a major contributor to overall RW arisings. The NPP licensee has been able to make good progress in reducing the volumes of stored liquid waste after conditioning.

The NPP licensee provided information on techniques used to minimize the volume of solid RW, using low force compaction on site and sending waste to external treatment facilities which include incineration of combustible waste, high force compaction and melting of metal waste. The NPP licensee also makes extensive use of the clearance process to reduce the volume and activity of RW. Data on waste disposal from the Dukovany and Temelin NPPs indicates that cleared waste comprises a significant proportion of the total amount of radioactive material produced at the NPPs, particularly at Dukovany, whilst incineration has been applied to a significant proportion of the solid RW arising from Temelin.

Figure 4-1 illustrates waste routes from the Dukovany and Temelin NPPs (ČEZ).

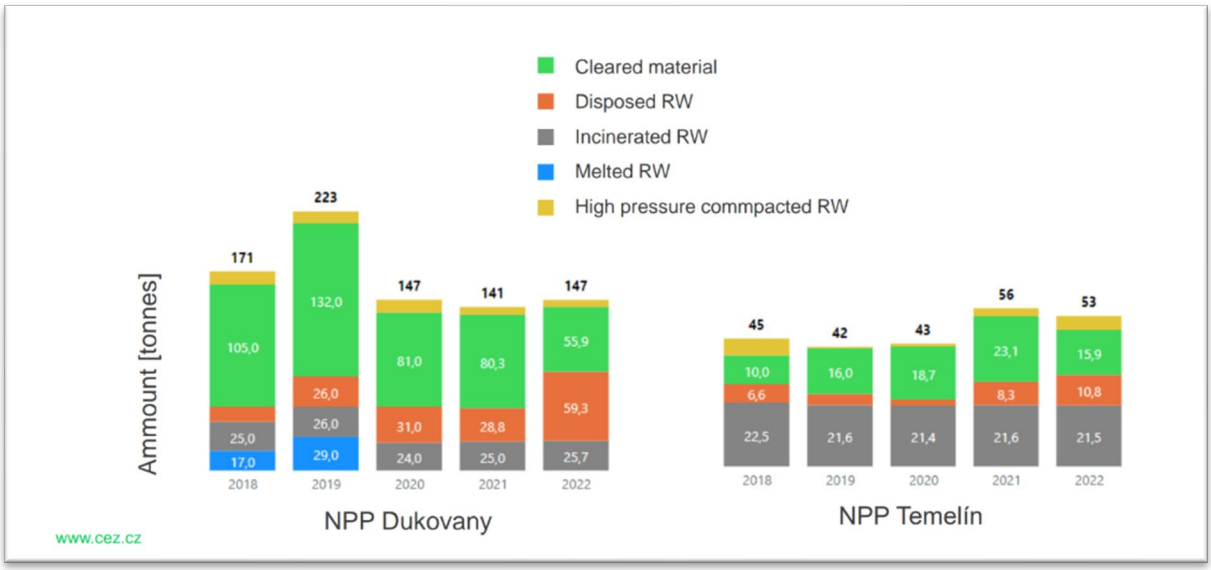


Fig. 4-1: *Waste routes from the Dukovany and Temelin NPPs (ČEZ)*

The ARTEMIS Review Team considers that the NPP licensee was able to demonstrate the application of other national practices in the predisposal management of RW and to dispose of waste in accordance with relevant WAC.

SÚRAO provided an overview of the disposal of RW at the Richard disposal facility, including a visit to the facility. The ARTEMIS Review Team notes the improvements made to enable its continued operation until the availability of the DGR. These include physical improvements to the chambers used for storage and disposal and the implementation of drums with higher integrity for stored waste that does not meet the disposal WAC. Further it is planned to build the Reception Hall, adapt additional chambers for disposal and update the control of compliance with WAC. There is ongoing work to repackage stored waste into the new waste storage packages.

SÚRAO demonstrated that stored waste is segregated from waste to be disposed of in the facility's chambers, and also provided evidence of the application of the separate WAC for storage and disposals that are derived mainly from safety demonstration (as noted in chapter 5 on safety case and assessment). SÚRAO is taking action to improve the assurance of compliance with WAC for all disposal facilities by means of undertaking or procuring independent measurement of the radionuclide content of waste packages (see also chapter 3). The ARTEMIS Review Team notes the ongoing programme of improvements at the disposal facilities operated by SÚRAO.

Concepts, plans and technical solutions for the decommissioning of facilities

The ARTEMIS Review Team notes that no nuclear installations or other facilities associated with SF management have been decommissioned in the Czech Republic. The decision to extend the operating life of the existing NPPs means that significant decommissioning activities will not be undertaken for many years. Information on future waste quantities indicates an assumption that the NPPs will have an operating lifetime of 60 years.

The two basic options of immediate and gradual (deferred) decommissioning are considered for the NPPs, and the decommissioning plans currently assume the option of deferred decommissioning. Given the significance of decommissioning waste in the inventory to be disposed of in the DGR, it is important that decommissioning strategies and plans, including

expected arisings of RW, are sufficiently well-developed to provide a robust basis for the relevant aspects of the design and programme for the DGR and waste disposal packages. The ARTEMIS Review Team notes the regular review of decommissioning plans by both SÚJB and the NPP licensee, which is beneficial in providing assurance in relation to decommissioning activities and the associated arisings of RW.

Decree No. 377/2016 Coll. specifies a number of technical measures to be addressed in the concept for decommissioning which are of benefit in reducing risks during decommissioning. These include limiting the possibility of release of radioactive substances due to infiltration and leaks, the selection of materials and chemistries to restrict induced activity and other measures relating to prevention of contamination and ease of decontamination. The decree sets a requirement for licensees to take decommissioning into account in the design of the facility, including features that facilitate decommissioning and consideration of physical and procedural methods to limit contamination and/or activation. The Decree also sets requirements for archiving of data and collection of data for decommissioning purposes.

The ARTEMIS Review Team notes that the requirements in Decree No. 377/2016 Coll. relating to decommissioning address Requirement 10 of GSR Part 6 on planning for decommissioning and those of paragraph 7.1 of GSR Part 6 relating to design for decommissioning. The Decree No. 329/2017 Coll. provides useful information to inform licensees of regulatory requirements for design for decommissioning. As the Czech Republic is planning a programme of new NPPs, these requirements will be of value in ensuring that the NPP designs minimise risks during their eventual decommissioning. Like many other countries, the Czech Republic has limited experience of decommissioning to date but will face significant challenges when facilities reach the end of their operational lives. By this time there will be extensive experience of decommissioning of NPPs and Research Reactors in other countries.

The ARTEMIS Review Team notes that SÚJB and the NPP licensee review Operational Experience/Learning from Experience (OPEX/LFE) on the decommissioning of NPPs and Research Reactors, including the management of decommissioning waste, in support of future decommissioning and the regular update of decommissioning plans. The Czech Republic also participates in relevant international activities on decommissioning. These measures help provide confidence that the Czech Republic will be prepared to meet its future decommissioning challenges. The ARTEMIS Review Team notes that these practices are in accordance with international practice.

Concepts, plans and technical solutions for pre-disposal management and disposal of spent fuel and radioactive waste not meeting the acceptance criteria for operating disposal facilities

The ARTEMIS Review Team notes that the hazardous nature of SF and the large number of disposal packages means it is important to define the process for the transfer of SF from storage/transport containers to disposal containers in the “hot cell”., This will provide input to the design and construction of a facility to carry out this process safely. The ARTEMIS Review Team notes the similarities of these operations to the management of SF at NPPs, and thus the benefits of learning from the experience of NPP licensees in managing SF in developing the future design and operation of the “hot cell” facility at the DGR. The ARTEMIS Review Team also notes that work is underway to develop a technical solution to enable the disposal of damaged fuel to the DGR.

It is thus important that interdependences in the process for the transfer of spent fuel from storage to disposal packages in DGR are taken into account. These interdependences should be

explored in the plans for the development of the DGR in order to maximise the learning from the predisposal management of SF at NPPs.

The ARTEMIS Review Team notes that the national policy and strategy presents the objectives and principal milestones for managing SF and RW that cannot be disposed of in operating disposal facilities. The policy and strategy document states that "SÚRAO is preparing short, medium, and long-term plans to meet these objectives and will be published once the Policy objectives have been approved."

There is a proposed acceleration in the date of commencement of operation of the DGR from 2065, in the Policy published in 2019, to 2050 as a result of adoption of the conditions to fulfil the technical criteria in the Complementary Delegated Act (Taxonomy) for nuclear energy. There is thus a need to update the milestones in the national policy and strategy, to take account of this change, which is discussed in Chapter 2 of this Report.

The ARTEMIS Review Team acknowledges the need to prioritise SF in the design and development of the DGR and notes that the level of detail on disposal of RW not suitable for the disposal in operating disposal facilities is less than for SF.

The ARTEMIS Review Team considers it would be beneficial for SÚRAO to update its design plans and milestones not only for SF, but also for the other RW to be disposed of in the DGR, recognizing the need to continue to apply a graded approach. This will enable identification of any activities needed to be carried out on relatively early timescales for the other RW, such as selection of and R&D in the materials for waste disposal packages and their interactions with materials such as buffer and backfill. Some experiments may be long-term in nature and thus early identification would reduce the risks of delays at a later stage.

The updating of the design plans and milestones for the development of the DGR will be of benefit in identifying interdependences between the various elements of the plan, underpinning the planning of and requirements for resources, and the identification and mitigation of risks to delivery of the plan. Development of the DGR on the planned timescale will be a complex undertaking requiring the definition and integration of many workstreams, so the ARTEMIS Review Team also notes the benefits of the application of project and risk management techniques in planning and delivering the development and construction of the DGR. SÚRAO prepared a schedule of activities and an initial work breakdown structure but this will need to be continuously updated as the programme of work progresses.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *The option of transfer of spent fuel from storage into disposal packages at the DGR has been selected in order to minimise the risk of damage to the disposal packages during transport to the DGR. Consideration of the transfer of damaged spent fuel is underway. There are interdependences between storage and disposal. There will be similarities between operations for the management of spent fuel at NPPs and the transfer of spent fuel from storage to disposal containers at the DGR.*	
(1)	**BASIS: GSR Part 5 Requirement 6 states that** *"Interdependences among all steps in the predisposal management of radioactive waste, as well as the impact of the anticipated disposal option, shall be appropriately taken into account."*
S3	**Suggestion: SÚRAO and the NPP operator should consider the interdependences between storage and disposal of spent fuel in the design of the process for the transfer of spent fuel from storage to disposal packages at the DGR and the transfer of damaged fuel to the DGR for disposal, to gain the benefit of experience in the predisposal management of spent fuel.**

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *In the milestones for the development of the DGR there is a lack of clarity on plans for disposal of radioactive waste that is not suitable for disposal in operating disposal facilities, as well as for radioactive waste from additional nuclear power reactor types not considered in current State Energy Policy. The milestones may not be consistent with the Complementary Delegated Act (Taxonomy).*	
(1)	**BASIS: SSR-5 Requirement 1 states that** *"The government is required to establish and maintain an appropriate governmental, legal and regulatory framework for safety within which responsibilities shall be clearly allocated for disposal facilities for radioactive waste to be sited, designed, constructed, operated and closed. This shall include: confirmation at a national level of the need for disposal facilities of different types; specification of the steps in development and licensing of facilities of different types; and clear allocation of responsibilities, securing of financial and other resources, and provision of independent regulatory functions relating to a planned disposal facility."*
(2)	**BASIS: SSR-5 Requirement 3 states that** *"The operator of a disposal facility for radioactive waste shall be responsible for its safety. The operator shall carry out safety assessment and develop and maintain a safety case, and shall carry out all the necessary activities for site selection and evaluation, design, construction, operation, closure and, if necessary, surveillance after closure, in accordance with national strategy, in compliance with the regulatory requirements and within the legal and regulatory infrastructure."*
(3)	**BASIS: SSR-5, Para. 3.12 states that** *"The operator has to be responsible for developing a disposal facility that is practicable and safe and for demonstrating its safety, consistent with the requirements of the regulatory body. This task has to be undertaken in consideration of: the characteristics and quantities of the radioactive waste to be disposed of […]."*
(4)	**BASIS: SSR-5 Requirement 11 states that** *"Disposal facilities for radioactive waste shall be developed, operated and closed in a series of steps. Each of these steps shall be supported, as necessary, by iterative evaluations of the site, of the options for design, construction, operation and management, and of the performance and safety of the disposal system."*
R2	**Recommendation: The Government should update the milestones for the DGR, in the national policy and strategy, to take account of the Complementary Delegated Act (Taxonomy). This should address all radioactive waste and spent fuel to be disposed of in the DGR, including those from additional nuclear power reactor types not considered in the State Energy Policy.**
R3	**Recommendation: SÚRAO should update existing design plans and milestones for the development of the DGR, in addressing all radioactive waste and spent fuel intended for disposal in the DGR, while continuing to apply a graded approach.**

5. SAFETY CASE AND SAFETY ASSESSMENT OF RADIOACTIVE WASTE AND SPENT FUEL MANAGEMENT ACTIVITIES AND FACILITIES

Czech Republic position

The safety case and its supporting safety assessment are the main documents used in the licensing process under the Atomic Act for facilities regulated by SÚJB, being compiled and maintained to support the decision-making process at each stage of a facility's lifecycle and which allows for independent review and approval. The licensing process requires the submission of the safety documentation to SÚJB.

Safety cases are compiled and maintained for all stages of the life cycles of the Czech Republic facilities.

Different waste management facilities and activities are addressed in different ways. The Atomic Act, specifically section 111, requires the consideration of the interdependences between the individual stages of RW management. It takes into account the fundamental principle that any activity in each of the stages of RW and SF management must not negatively affect subsequent activities.

Safety case for predisposal management and disposal of radioactive waste in operating and closed facilities

Pre-disposal facilities

Facilities for predisposal management of RW at NPPs, including the storage of RW and SF in NPPs, are covered by the NPP's safety cases.

The development of the Interim Spent Fuel Storage Facility (ISFSF) at the Dukovany NPP was accompanied by safety documentation at each stage for approval by SÚJB. Operations of the now-full dry storage facility (ISFSF) meet the requirements of the safety analyses, while monitoring demonstrates the facility has negligible impact on the environment. Issue of the operational licence for the second Spent Fuel Storage Facility (SFSF) at Dukovany was based on a similar stage-wise approach, including a period of trial operation to verify design assumptions. Operations of the facility are in compliance with the safety analyses and continue to demonstrate negligible environmental impact. This dry storage facility continues to accept SF from ongoing NPP operations. A similar approach was taken for the development of the SFSF at the Temelin NPP; this facility meets safety requirements and has negligible impact on the environment.

The LVR-15 research reactor at ÚJV Řež has a number of written programmes and working procedures for activities affecting nuclear safety, including operation of the SF storage facility and the Higher Activity Waste (HAW) storage facility, approved by SÚJB.

SÚRAO facilities

The safety documentation of SÚRAO's facilities is prepared in accordance with according the Atomic Act (263/2016 Coll). For each life cycle of the nuclear facility, the safety documentation is also prepared in accordance with Annex 1 of the Atomic Act, the content of the safety report defined in SÚJB guide BN_JB_1.3.

The Dukovany Disposal Facility is currently operated in accordance with safety documentation approved in 2016. In 2012, updated safety analyses based on operational experience at the disposal facility were completed. The analyses were used to update the WAC for the Dukovany

disposal facility, which allow potential disposal of other forms of RW including limited amounts of institutional waste.

The Bratrstvi Disposal facility is currently operated in accordance with safety documentation approved in September 2013. The safety analyses performed in 2003-2013 verified the capacity of the disposal facility and the limits and conditions for its operation.

The Richard disposal facility is currently operated in accordance with safety documentation approved in June 2016. The safety analyses performed in 2003-2016 verified the capacity of the disposal facility and reassessed the previously proposed closure and decommissioning approach.

For the closed Hostim disposal facility, SÚRAO performs post-closure monitoring based on an internal methodological document ("monitoring programme") according to a SÚJB decision. The results of the monitoring programme are reported to SÚJB. In addition, data and information concerning the Hostim facility and the waste deposited there is retained as an archive, which will be maintained by SÚRAO over an extended period (several decades). Information about the nature of the facility is maintained in the national property register.

In accordance with the requirements of the Atomic Act., in 2026, SÚRAO will submit a safety report to SÚJB for each of the Dukovany, Bratrstvi and Richard facilities for a first periodic safety review. Within ten years of the previous periodic safety review, SÚRAO will update the safety cases and submit them to SÚJB. SÚRAO is undertaking a project to update the safety cases and their supporting safety assessments.

The safety review for each facility has a SÚRAO project coordinator. SÚJB participates once a year at a meeting of each SÚRAO project. SÚRAO will also commission independent reviews (expected to be an IAEA Expert Mission), which are planned before submission to SÚJB.

Each safety re-assessment will be based on the latest scientific and technical knowledge. The nature of the topical areas addressed in the re-assessment are the same for each operating facility. They will include updated information on the geological and hydrogeological models, features, events and processes, inventory, evaluation of engineered barriers and an experimental programme on barrier materials for modelling purposes, operational safety, long-term safety scenarios and dose assessments.

In addition, information has been produced on the optimisation of disposal capacity and options for decommissioning and closure.

Waste acceptance criteria (WAC)

In accordance with the Atomic Act each licensee is responsible for the development of WAC, which are submitted to SÚJB in annexes to OLCs as a part of the safety case. The WAC are derived from safety assessments within the safety case.

A WAC document is established by SÚRAO for each operational disposal facility. For each facility, WAC are derived from operational and post-closure safety demonstration as well as from operational considerations. In the case of the Richard disposal facility there are two sets of WAC documents. One relates to the acceptance of RW packages to be disposed of. Another WAC document relates to the acceptance of RW packages that do not meet the WAC for operating disposal facilities. This type of waste is accepted for storage under the WAC and then stored in dedicated chambers, before being transferred to the future DGR.

SÚRAO has put in place procedures for RW package acceptance and various control activities in accordance with its management system. These include administrative controls to check compliance of RW package with the information declared in RW passport for the package,

measurements at the reception of waste packages (e.g., dosimetric control, visual inspection of integrity of packaging, checking the weight of the RW package).

As mentioned in chapter 3, each waste generator has to characterize the waste to demonstrate it complies with the WAC for storage and disposal facilities. Procedures for RW characterisation form part of the management system of the RW generator.

Deep geological disposal

The first preliminary safety assessment for a DGR was carried out in 1999 to support future R&D, based on a hypothetical site in crystalline rock. Following identification of nine possible sites, a number of screening safety assessments were undertaken in 2018 and reviewed by SÚJB, after which the number of potential sites was reduced to four. In accordance with the milestones of the National Policy and Strategy, there will be preliminary safety evaluation of these four sites for selection of a final and back-up site planned in 2028.

Development of the safety case for the DGR is an important aspect of the overall work programme. It will be based on Czech legislative requirements and international recommendations in documentation from IAEA. The safety case will justify the safety of the DGR, based on scientific and technical arguments and evidence. This will include information on site geological, geomechanical and hydraulic properties and performance assessment of the design, including the functionality and reliability of the engineered barriers. It will include the evaluation of effective doses received by a representative person under various disposal facility development scenarios, which is a key part of the demonstration of long-term safety.

This safety case is in addition to the safety report needed to apply for authorisations to site, construct and operate a nuclear facility in accordance with the requirements of the Atomic Act and Decree No. 378/2016 Coll. on the siting of nuclear installations. These legislative measures set out required information on the properties of sites capable of siting a DGR in relation to nuclear and technical safety, nuclear security and radiation protection, including monitoring and emergency management. They also specify requirements for the scope and method of assessment for construction of nuclear facilities. Decree No. 378/2016 Coll. identifies site characteristics that exclude construction of nuclear facilities.

SÚRAO has established a safety strategy, which identifies safety functions and allocates these safety functions to the safety important components in the DGR. The safety assessment is based on the identification of all features, events and processes that may influence safety, both during the period of operation when RW is being placed in the DGR and the period following closure.

There is an ongoing process of pre-licensing dialogue between SÚRAO and SÚJB to facilitate the submission of the licence application for the siting, construction and operation of the DGR, based on a joint memorandum defining the relationship between the two bodies. SÚJB has undertaken several independent reviews, including of site safety documents and the SF disposal package design, has issued regulatory guides supporting the development of safety case and safety assessment and takes part in the work of the Expert Advisory Board as an observer.

The programme of safety assessment work for the period 2020 –2030 includes the preparation of a post closure safety assessment to demonstrate the safety and feasibility of the proposed technical design for the underground part of the DGR under Czech conditions, based on information from the Bukov Underground Research Facility and relevant international data.

Other work includes the post closure safety assessment methodology and identification of features, events and processes affecting safety, the definition of reference and alternative evolution scenarios for various disposal system options.

A safety requirements and process management system will be established, and models will be developed and verified for the disposal facility safety analysis.

A safety assessment will be developed for the long-term disposal system for a selected reference design, including sensitivity and uncertainty analyses.

There will also be performance assessment of the function and reliability of the proposed engineered barriers and research on the behaviour of radionuclides within the barriers.

SÚRAO has appointed a project coordinator to manage the safety case and the safety assessment. There is dialogue with SÚJB by means of regular meetings. There will be international review of the final reports. The main objective is to prepare the documentation to demonstrate the long-term safety and feasibility of the proposed technical designs of the DGR.

ARTEMIS observation

Safety case for predisposal management and disposal of radioactive waste for operating and closed facilities

The demonstration of the safety of the RW management facilities in the Czech Republic relies on safety assessment reports which are available for all operating facilities. The ARTEMIS Review Team notes that the requirements for developing a safety case are well developed, as is the regulatory process for assessment.

The contents of the safety case and supporting safety assessment reports for the operating SÚRAO facilities, which were presented to the ARTEMIS Review Team, appear to be developed at a sufficient level of detail. The ARTEMIS Review Team notes that SÚRAO is conducting a first periodic safety review and has launched a six-year project on the updating of the safety assessment supporting the safety case for each operating facility. The ARTEMIS Review Team also notes that SÚRAO will perform a periodic safety review every ten years. The ARTEMIS Review Team recognizes that periodic reviews are consistent with IAEA guidance and international practices.

The ARTEMIS Review Team acknowledges the importance of the long-term issues, but the operational period should be considered in more detail, based on lessons learnt from operations and monitoring. Complementary information was provided by SÚRAO during the ARTEMIS Mission confirming that the periodic review addressed both storage and disposal.

SÚRAO has developed WAC as well as a Waste Acceptance System which contributes to the safe management of RW for operating facilities.

Based on the documentation and presentations provided, the ARTEMIS Review Team notes a comprehensive and thorough application of the safety assessment concepts for the operating disposal facilities. The ARTEMIS Review Team notes the information made available about the closed disposal facility at Hostim.

Deep geological disposal

During the mission SÚRAO described the approach to performing the long-term safety assessment that will support the next safety case that will be submitted to SÚJB. SÚRAO also presented the organisation that will implement the safety assessment for each envisaged site.

The ARTEMIS Review Team considers that the implementation of the safety approach is consistent with international standards and national practices and should be acknowledged.

The ARTEMIS Review Team recognizes the work carried out by SÚRAO to adapt the Swedish KBS-3 design to the Czech Republic context and include this in the safety concept and assessment (e.g., characteristics and lifetime) and on engineered backfill (e.g., characteristics of bentonite).

The ongoing development of the safety case and supporting safety assessment for the DGR are based on SF and include only limited consideration of all RW to be disposed of in the DGR. Priority is given to SF due to the high levels of radioactivity and the large number of waste disposal packages, applying a graded approach. Priority is also given to long-term safety in accordance with the national roadmap and the DGR development plan.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *The safety case for the DGR is under development. Currently it is based on spent fuel and with limited consideration of all radioactive waste to be disposed of in the DGR. Priority is given to spent fuel due to the high levels of radioactivity and the large number of waste disposal packages, applying a graded approach.*	
(1)	**BASIS: GSR Part 1 (Rev.1) Para. 4.40 states that** *"The regulatory body shall review and assess the particular facility or activity in accordance with the stage in the regulatory process (initial review, subsequent reviews, reviews of changes to safety related aspects of the facility or activity, reviews of operating experience, or reviews of long term operation, life extension, decommissioning or release from regulatory control). The depth and scope of the review and assessment of the facility or activity by the regulatory body shall be commensurate with the radiation risks associated with the facility or activity, in accordance with a graded approach."*
(2)	**BASIS: SSR-5 Requirement 2 states that** *"The regulatory body shall establish regulatory requirements for the development of different types of disposal facility for radioactive waste and shall set out the procedures for meeting the requirements for the various stages of the licensing process. It shall also set conditions for the development, operation and closure of each individual disposal facility and shall carry out such activities as are necessary to ensure that the conditions are met."*
(3)	**BASIS: SSR-5 Requirement 14 states that** *"The safety case and supporting safety assessment for a disposal facility shall be documented to a level of detail and quality sufficient to inform and support the decision to be made at each step […]."*
(4)	**BASIS: SSR-5 Requirement 15, para. 4.28. states that** *"A graded approach has to be adopted, depending on the hazard potential of the waste and the complexity of the site and disposal facility design."*
R4	**Recommendation: When providing the safety case for siting, SÚRAO should update the current safety assessment to include all radioactive waste to be disposed of in the DGR, applying a graded approach.**

6. COST ESTIMATES AND FINANCING OF RADIOACTIVE WASTE AND SPENT FUEL MANAGEMENT

Czech Republlic position

General framework

Under the provisions of the Atomic Act, the costs of RW management throughout the period from the occurrence of the RW up to its disposal, including the costs of post-closure monitoring, are borne by the respective generator, as are the costs incurred by the respective R&D work. The Nuclear Account was established via the provisions of the Atomic Act to hold funds to cover the costs of all activities relating to both RW and future SF disposal.

Activities conducted prior to RW disposal are performed by waste generators or by specialised organisations. RW disposal and SF treatment and disposal services are provided by SÚRAO. In all cases, the costs incurred are met by generators.

Under the provisions of the Atomic Act, nuclear operators and operators of workplaces with (significant) sources of ionising radiation are obliged to create financial reserves for the decommissioning of nuclear facilities and category III and IV workplaces (workplaces with significant or very significant sources of ionising radiation. These Decommissioning Reserves must be deposited in blocked ("escrow") accounts.

Cost assessments

A cost assessment of the national strategy is performed every time the strategy is updated. This is the responsibility of the MPO. These cost assessments incorporate economic data obtained from the relevant available sources and organisations.

The national strategy includes the costs of RW and SF management prior to disposal, the costs of disposal and those of the decommissioning of facilities. In the case of operating facilities, cost assessments are based on current expenditure and estimates of the costs of future operation. Concerning the DGR, the cost estimate forms a part of the design process. In all cases, the costs must include all the required activities related to RW and SF management.

SÚRAO provides the necessary economic data on the costs of RW and SF disposal. The data is based on both current expenditure (operating disposal facilities) and future plans (DGR). SÚRAO also has economic data related to decommissioning, since SÚRAO is responsible for the review of decommissioning plans and the verification of the decommissioning reserves. Other economic data is provided directly by the generators of RW and SF.

The costs of the storage of SF (the use of the dry SF storage technology in transport-storage containers approach) and the conditioning of RW for disposal are based on the currently known costs of such activities and converted to the MWh produced.

The largest proportion of the cost of the national strategy relates to the DGR. The cost estimates incorporate the basic technical data concerning the DGR provided in the DGR Reference Design. The investment calculation was divided into the technological and construction parts, subdivided into multiple modules for detailed cost assessment. The assessment of individual modules was conducted on the basis of consultation with potential suppliers, an internet survey of price lists published by relevant generators, an estimate provided by an expert with experience of the construction of proposed or completed nuclear facilities and, to a lesser extent, detailed calculations especially with concern to the most financially significant operational packages (laboratories, radiation control, equipment for the disposal of SF). The costs

associated with other categories were determined by a variety of methods, chosen specifically to be suitable for each cost category.

The fundamental technical and economic basis for the cost assessment of the DGR was outlined in the Reference Design of the DGR of 1999, which was updated in 2011; further updates were performed in 2020 and 2023. Currently the cost estimate for the development, construction, operation (commencing in 2050) and closure of the DGR is close to CZK 200 billion (in 2022 values). Due to the significant share of fixed costs in the total costs of the DGR, the unit cost (based on 1 tonne of disposed SF) is highly dependent on the quantity of disposed SF. Thus, the disposal of higher amounts of SF (e.g. from the operation of new nuclear power units) will reduce the unit-specific disposal cost.

Decommissioning cost estimates are prepared by the licence holder, who must update decommissioning cost estimates at five-year intervals. The quinquennial updates serve to refine the preliminary cost estimates and incorporate the price level movement and inflation over the preceding five-year interval. For the NPPs, they are prepared by contractor, and have been developed using a consistent method since 2008 thereby facilitating comparison between cost estimates over time.

The decommissioning cost assessments are facility and site-specific (i.e, not generic), and decommissioning scenario-specific. The cost of the collection, segregation and treatment of LLW and ILW from the decommissioning of nuclear power plants represents around 15% of the total decommissioning costs. The storage cost of SF during the decommissioning of nuclear power plants represents around 6% of the total decommissioning costs. The NPP decommissioning cost assessments include provision for “in-scope” uncertainties (i.e. uncertainties relating to the defined scope of the decommissioning plan), and that these constitute roughly 10% of the total. The current NPP decommissioning cost estimates are shown in Figure 6-1 below.

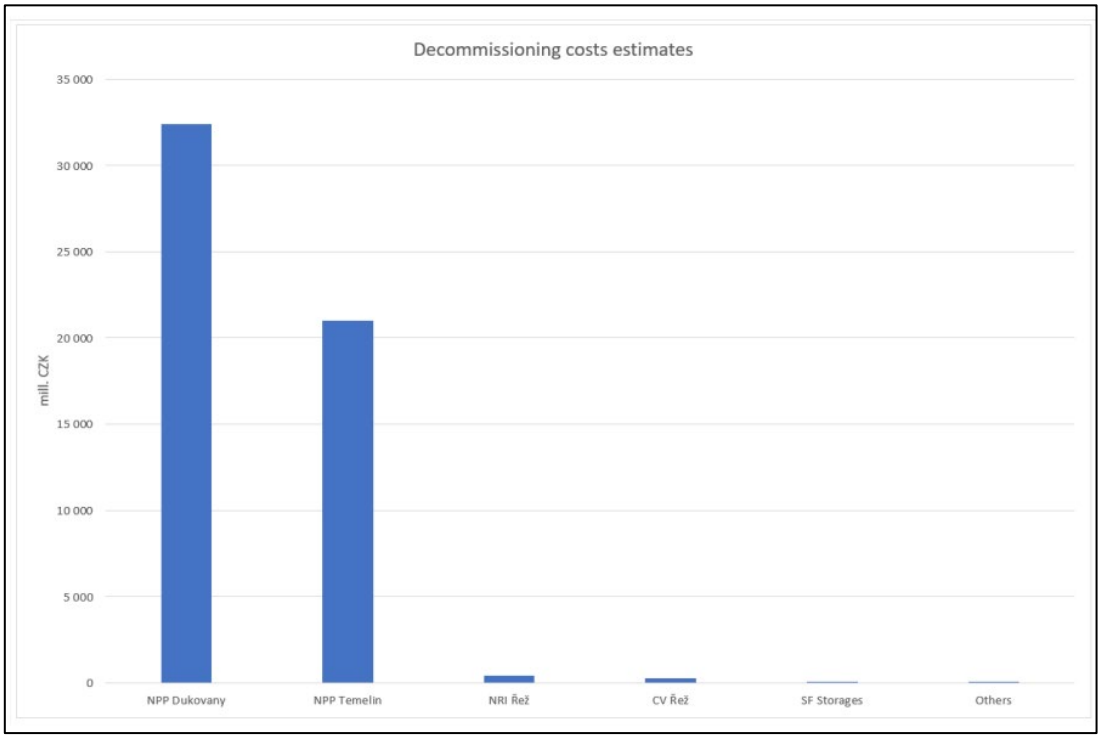


Figure 6-1. Estimated costs for decommissioning of NPPs and workplaces with ionising radiation cat. III and IV (from counterparts presentation to the ARTEMIS review mission)

Financing arrangements

Two primary funding mechanisms have been established in the Czech Republic:

1. Decommissioning reserves with funds held in blocked ("escrow") accounts. These are internal, segregated funds owned and managed by nuclear operators or operators of workplaces with major sources of ionising radiation, for the purpose of meeting their future decommissioning costs.
2. A segregated external Nuclear Account owned by the State and managed by the Ministry of Finance. The Nuclear Account receives contributions from NPP operator and RW generators and provides financing for the disposal of RW, including spent nuclear fuel, and the development of the DGR

Decommissioning reserves

Licence holders are required to establish financial reserves for the decommissioning of nuclear installations or workplaces with major sources of ionising radiation, Decommissioning Reserve accounts. These funds must be available for the preparation and implementation of decommissioning at the time and in the amount required, following the schedule of progress and the decommissioning technology approved by SÚJB.

The decommissioning reserve provisions are verified by SÚRAO, as provided for in section 113 of the Atomic Act. SÚRAO, in accordance with the Atomic Act, inspects and verifies the decommissioning reserve provisions created by operators in the Decommissioning Reserve "escrow" accounts. As noted above, cost estimates and decommissioning plans are updated (and hence revised contribution schedules) to SÚRAO at least every five years. External auditors also validate the balances in these decommissioning reserve accounts on an annual basis.

The assets held in the escrow accounts are invested within framework established by the Atomic Act, with the portfolio subject to oversight by SÚRAO. Permissible investment classes are defined by decree, allowing some of the assets to be held in state bonds if approved by SÚRAO.

Nuclear Account

The costs of the operation and closure of existing repositories are paid from the Nuclear Account into which individual waste generators pay contributions depending on the nature and amount of the waste disposed of. The amounts of one-off charges are determined according to the relevant methodology and are published in the form of a Government Regulation. The operational costs of LLW and ILW disposal facilities (Dukovany, Richard and Bratrství) amount to CZK 90 million annually and cover disposal, the maintenance of land, buildings, technological equipment and underground areas (Richard and Bratrství), radiation protection, security, fire safety, technical safety, emergency preparedness and the monitoring of impacts on the environment, as well as SÚRAO's overheads and contributions paid to local communities in whose areas the repositories are located.

The costs of the development, construction, operation and closure of the DGR, the processing of SF into a form suitable for disposal and the final disposal of SF and HLW will be covered by the Nuclear Account. Total costs have been estimated close to CZK 200 billion including research & development, construction, operation, closure and post-closure period. Benchmarking assessments indicate that these are comparable with similar estimates in other countries.

The use of Nuclear Account funds is based on the Annual plan of activities approved by the Government, and the methodology concerning, and levels of, fees paid into the Nuclear Account are determined by the Atomic Act and Government Regulations. SÚRAO administers payments made into the Nuclear Account and drafts the documentation that specifies the levels of charges.

A substantial proportion of payments into the Nuclear Account are intended for covering the costs of future activities. The methodology for determining the level of charges is based on current prices and takes into consideration estimates of future costs, uncertainties and risks and other relevant factors (e.g. the expected development of the national economy, interest rates and inflation) and respects the Policy.

The assets held by the Nuclear Account are invested according to a strategy which is required to be in compliance with the respective regulations set out in the Article 116 of the Atomic Act. There are a range of permitted asset classes. Overall, the investment strategy is conservative, with a rate of return close to the repo rate of the Czech National Bank (CNB).

The value of assets in the Nuclear Account amounted to 36.6 billion CZK at the end of 2022. The annual contribution by NPPs is approximately CZK 1.7 billion. The investment strategy is in compliance with the respective regulations (Article 116 of the Atomic Act). The investment strategy is considered to be conservative, with the investment yield being close to the repo rate of the Czech National Bank. The growth in the fund assets held in the Nuclear Account is illustrated in Figure 6-2 below.

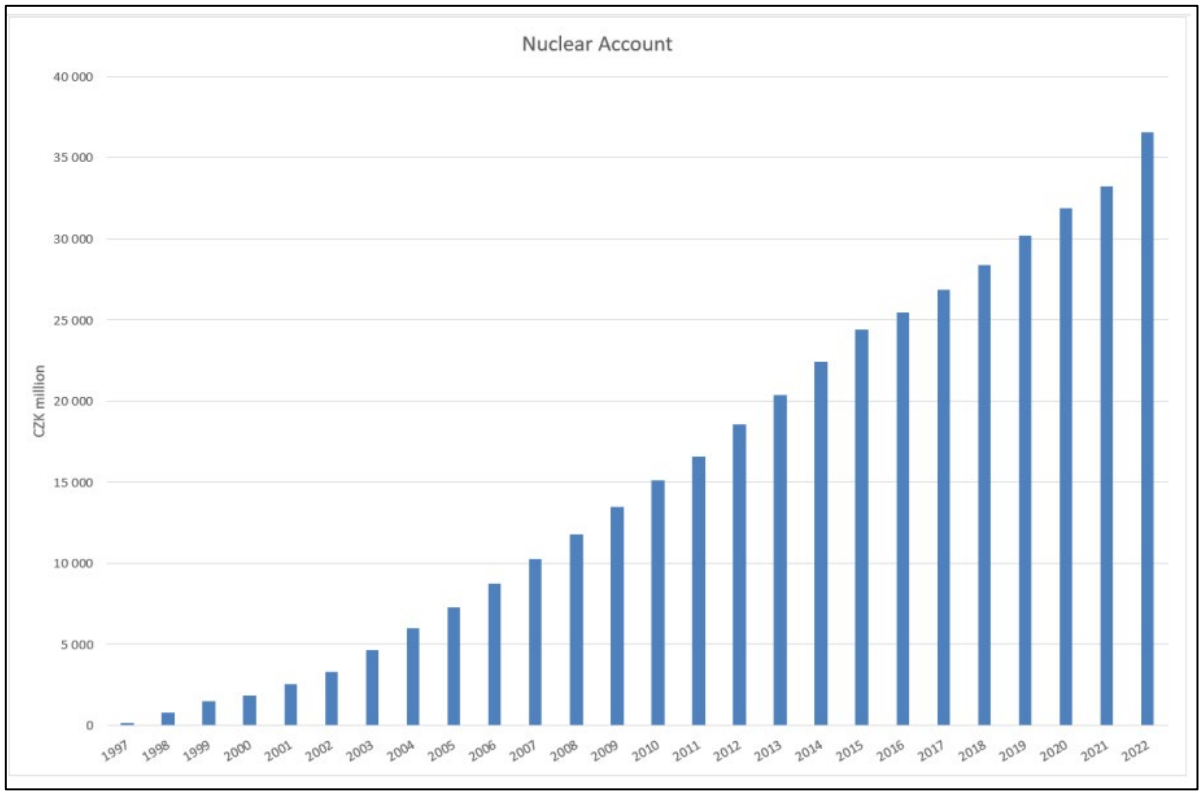


Figure 6-2. The net growth in the Nuclear Account (from counterparts' presentation to the ARTEMIS review mission)

There are processes in place for updating fees for the Nuclear Account in the foreseen amendment of the Atomic Act. The nuclear account balance is determined by income,

expenditure and yields on investment. The accumulation of funds in the Nuclear Account is compared with expected future expenditure at appropriate intervals, at least every five years. Under the system, if the amounts are found to differ substantially, the relevant legislation is amended. A financial model of future income and expenditure serves for the calculation of the required fees. Uncertainties of the parameters are factored into the model (electricity generation by NPPs, costs of the DGR, inflation, yields on investment, etc.).

A monitoring procedure is in place to assess disbursement of the Nuclear Account funds according to the government-approved plan. In the framework of the annual reports, the Government assesses once a year the status and trends in disbursements from the Nuclear Account. A timeline for disbursements from the Nuclear Account has also been developed.

Other costs

The costs of the handling of LLW and ILW prior to its disposal are covered by the relevant RW generators and form a part of routine operating expenses. In the case of institutional waste generators, the collection, classification, processing and treatment of almost 90% of such waste is provided for by ÚJV Řež, a.s. In the case of waste generated by nuclear power plants, such costs are also part of operating expenses and amount around 3 CZK/MWh.

The costs of the storage of ILW/HLW/ SF prior to its disposal are covered by the waste generators and form a part of routine operating expenses. With respect to institutional waste generators, RW storage is provided for by ÚJV Řež, a.s. In the case of SF produced by nuclear power plants the costs amount to approx. 25 CZK/MWh.

There are contingency arrangements which can be applied, if necessary, in the event that the generator of RW (such as the licence holder of a disused sealed source) cannot be identified or is unable to meet payment obligations due to bankruptcy.

Considerations related to potential expansion of the nuclear power programme

The State Energy Policy for the Czech Republic addresses construction of additional nuclear power generation facilities. In the future this may include further additional and new nuclear power reactors.

Scenarios have been developed (and provided to the ARTEMIS team for the purpose of the mission) to explore some of the implications of additional nuclear generation facilities for the Nuclear Account. The amendment of the Atomic Act is currently under development. Generally, the impacts of adding additional power generation facilities are seen to be positive in relation to the Nuclear Account. The scenarios presented during the ARTEMIS Mission show certain benefits to the Nuclear Acount with the planned additional generation units. The positive impacts on the Nuclear Account derive primarily from the extra income volume and duration of power generation. A prerequisite for a balanced Nuclear Account in such expansion scenarios is that the fees need to be adjusted in line with inflation.

In the event that certain types of additional nuclear power facilities are used to produce heat energy rather than electricity, the fees bases would need to be modified for example to allow fees to be levied on the basis of thermal generation in addition to electricity production.

ARTEMIS observation

General framework

The Czech Republic has put in place arrangements designed to ensure that there is sufficient financial provision for the safe management of its RW and SF, through to the closure of all disposal facilities. The Czech Republic also requires nuclear operators and operators of workplaces with (significant) sources of ionising radiation to create financial reserves for the decommissioning of nuclear facilities and category III and IV workplaces (workplaces with significant or very significant sources of ionising radiation). In doing so, the principle of "the polluter pays" is applied and there are well-defined processes in place for implementing and overseeing the arrangements.

The ARTEMIS Review Team also notes that representatives from the Czech Republic are involved in international activities to exchange experience on and further develop cost assessment methods and practices, and financing arrangements, such as those at the IAEA, OECD Nuclear Energy Agency, and participate in the EC Group of experts on financial aspects of nuclear decommissioning and SF and RW management (NuBaFa).

The following sub-sections of this chapter discuss:

— Cost assessments
— Financing arrangements
— Considerations related to potential expansion of the nuclear power programme

Cost assessments

The Czech Republic has developed detailed cost estimates for the management and disposal of its RW, to the point of disposal. These estimates are detailed, specific to the operating and planned facilities and activities. The cost assessments are regularly updated and have been developed using methods consistent with international practice. The ARTEMIS Review Team notes the high level of effort that is devoted to ensuring that cost estimates methods are appropriate, and that the data used are accurate and regularly updated. The licensees have prepared similarly detailed cost estimates for the decommissioning of their facilities, that are also regularly updated. The use of consistent approach and methods for cost assessment over time facilitates comparison between cost estimates, enabling trend analysis on cost evolution over extended time periods.

The ARTEMIS Review Team notes that the cost estimates for the management and disposal of its RW and SF for the purposes of financing the Nuclear Account, take into account a range of uncertainties and risks, such as inflation and wider economic factors. The updating of cost assessments every five years allows new information to be incorporated as it becomes available, and the impacts of changes due to inflation to be incorporated in the estimates. However, the approach to cost and financing risk is somewhat selective for the purposes of financing for the Nuclear Account, and there is not a comprehensive, systematic approach.

The ARTEMIS Review Team notes that the decommissioning cost assessments also are updated every five years, which allows new information to be incorporated as it becomes available, and the impacts of changes due to inflation to be incorporated in the estimates. However, the decommissioning cost assessments include consideration of uncertainties to a more limited extent than is the case for the cost assessments for the Nuclear Account. Specifically, the decommissioning cost assessments include contingencies for uncertainties within the defined project scope ("in-scope"). The decommissioning cost assessments do not

include analysis of wider uncertainties that are not within the defined scope of the plan (such as external and systemic risks) and, for example, the impact of potential early closure is not addressed. The ARTEMIS Review Team notes that NPP licence holders recognize that such wider uncertainties exist, particularly in the context of the milestones contained in the national policy and strategy. In this context, in addition to the primary decommissioning plan, the licence holders have developed two alternative decommissioning plans to cover different scenarios, and there are cost assessments for these. However, the alternative decommissioning plans do not form the basis of financing for the Decommissioning Reserves.

The ARTEMIS Review Team considers that further developing the assessment of risks and uncertainties would provide a more complete understanding of the potential costs for the Nuclear Account and the Decommissioning Reserves accounts. This would entail developing a comprehensive, systematic approach to analyzing and addressing uncertainty and risk. The ARTEMIS Review Team notes that there is international guidance specifically on addressing uncertainties in decommissioning cost assessments in the joint IAEA and OECD Nuclear Energy Agency publication *Addressing Uncertainties in Cost Estimations for Decommissioning Nuclear Facilities*.[4]

Financing arrangements

The ARTEMIS Review Team notes that the Czech Republic has put in place comprehensive arrangements to ensure that there is financial provision for the safe management of its nuclear RW and SF, and for the decommissioning of nuclear facilities. The costs of the handling of LLW and ILW prior to its disposal are covered by the relevant waste generators and form a part of routine operating expenses. Where funds are collected in the Nuclear Account and in the Decommissioning Reserves accounts, they are closely managed, and there are rules in place to ensure that they can only be used for the purposes for which they were collected. There is oversight of the current status of the Nuclear Account and Decommissioning Reserve accounts, and regular assessment of current trends and forecasts of future disbursements. The ARTEMIS Review Team notes that these arrangements are consistent with internationally recognized principles and practices.

An overview of funding arrangements in the Czech Republic for the different categories of liabilities is presented in Table 6-1 below.

[4] Addressing Uncertainties in Cost Estimations for Decommissioning Nuclear Facilities, IAEA & OECD NEA, 2017 [NEA No. 7344], *https://www.oecd-nea.org/jcms/pl_15036/addressing-uncertainties-in-cost-estimates-for-decommissioning-nuclear-facilities*

Type of liability	Long term management policy	Funding
Spent fuel	Preferred alternative - direct disposal in DGR but other options are not excluded (reprocessing, regional disposal facility)	Nuclear Account
Nuclear Fuel Cycle waste	Disposal in operating disposal facilities and in planned DGR	Nuclear Account
Institutional waste	Disposal in operating disposal facilities and in planned DGR	Nuclear Account
Decommissioning liabilities	Immediate/deferred decommissioning (NPP) and immediate decommissioning (research reactors and other NIs), RW will be disposed in Dukovany disposal facility	Decommissioning reserve accounts
Used sealed sources	Disposal in operating disposal facilities and in planned DGR; return to the country of origin	Licensee; if the licensee is not known then the state budget

Table 6-1. Overview of funding arrangements in the Czech Republic for the different categories of liabilities (from counterparts' presentation to the ARTEMIS review mission)

Decommissioning Reserves

The ARTEMIS Review Team notes that the routine oversight of the Decommissioning Reserve accounts had identified concerns about the status of the reserves and the need to increase provisions. A comparison between the current NPP decommissioning cost estimates and the status of the Decommissioning Reserve accounts is shown in Figure 6-3 below. This indicates that the amount in the Decommissioning Reserve for both NPPs is lower than might be expected, given the remaining years of planned operation.

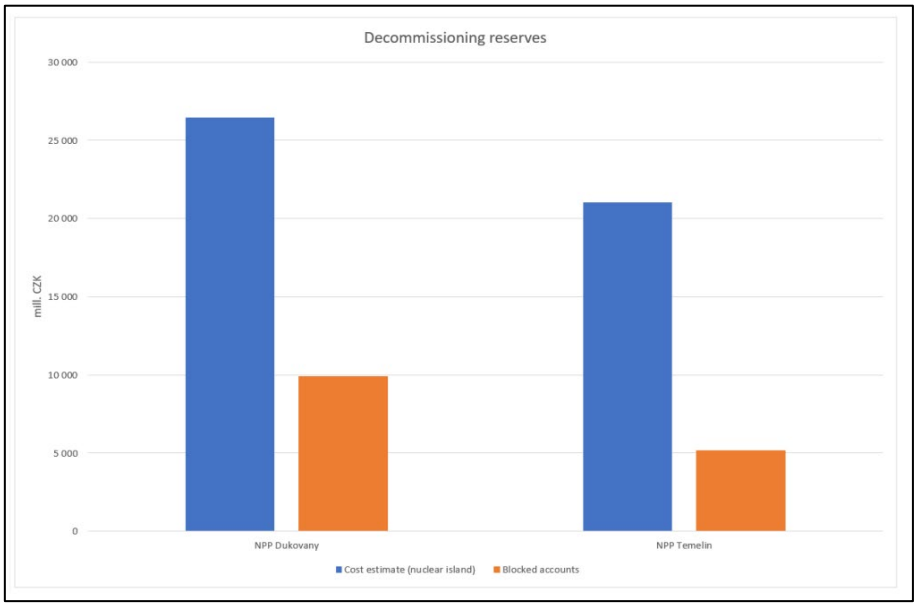


Figure 6-3. Current NPP decommissioning cost estimates and the status of the Decommissioning Reserve accounts, (from counterparts' presentation to the ARTEMIS review mission)

The ARTEMIS Review Team notes that a number of refinements proposed to address this issue. In particular, changes introduced at start of 2023 require that Decommissioning Reserves are to be fully funded at the planned end of operation for NPP Dukovany like it was set for the NPP Temelín before the amendment of the Decree 250/2020 Coll.. The rate of provisions to the reserve accounts is to be recalculated at every five-year interval with the aim of ensuring that this fully funded level is achieved. In the event of shortfall, additional payments to the Decommissioning Reserves may be required after the end of operation.

The ARTEMIS Review Team notes that these changes would provide additional confidence that the Decommissioning Reserves would reach the required levels by the end of operation. However, the ARTEMIS Review Team also notes that earlier than planned closure in particular could lead to a significant shortfall in the provisioning of the Decommissioning Reserve accounts. The risk of early closure and financing risks associated with the Decommissioning Reserve accounts should form part of a systematic, comprehensive approach to risk and uncertainty.

Nuclear Account

The ARTEMIS Review Team notes that SÚRAO has identified a need to update the current level of fees by the nuclear operator, and an increase is planned. The ARTEMIS Review Team notes that alongside the proposed increase in the current level, there are also a number of refinements proposed to improve the present system. The proposed amendments to the Atomic Act required to implement the proposed changes are progressing through the government and legislative processes. It is anticipated that they will enter into effect during 2025. According to these proposals, in future, it is assumed that the regular fee level will be adjusted every five years, based on calculations performed by SÚRAO, taking into account:

- Updated information on the DGR cost estimate, and other cost estimates as appropriate
- Current balance of the Nuclear Account at each five-year interval
- Expected (forecast) nuclear energy generation
- Adjustment of fee levels will be through the decree mechanism instead of requiring a legislative amendment of the Atomic Act

The ARTEMIS Review Team notes that these proposals for improving the arrangements for the Nuclear Account would result in a significantly improved system of financing, which aligns well with the most recent guidance developed based on international experience.[5] In doing so, the ARTEMIS Review Team notes that the financing arrangement includes certain uncertainties and risks (e.g. the underlying cost estimates, forecasts of nuclear generation, rates of return on investment, inflation, etc.) which should form part of a systematic, comprehensive approach to risk and uncertainty.

Investment framework

The ARTEMIS Review Team notes that the investment framework for assets held in the Nuclear Account and Decommissioning Reserve accounts is conservative, providing a predictable stable rate of return. While offering a high level of security on the management of

[5] See, in particular, NEA (2021), Ensuring the Adequacy of Funding for Decommissioning and Radioactive Waste Management, OECD Publishing, Paris.

assets, this approach poses certain challenges for ensuring the adequacy of financing arrangements, particularly in a context where there are higher rates of inflation. The ARTEMIS Review Team notes that the current fund asset investment strategies used for the Nuclear Account and Decommissioning Reserve would not be expected to provide sufficient returns to allow these funds to outperform the expected inflation of the costs of decommissioning and waste disposal.[6] The ARTEMIS Review Team considers that it could be worthwhile to explore whether a less conservative investment framework could be developed for management of the assets in the Nuclear Account and Decommissioning Reserve provisions, whilst not jeopardising security of these funds. In this regard, expanding the range of permissible investment classes could be accompanied by modification of the oversight and reporting requirements in order to ensure that security of the funds is maintained.

Considerations related to potential expansion of the nuclear power programme

The ARTEMIS Review Team notes the information provided in relation to implications for the financing system of additional nuclear power reactors. The ARTEMIS Review Team notes in particular that certain positive consequences for the financing arrangements in the event of additional nuclear power reactors were identified by counterparts. The ARTEMIS Review Team observes that the information related to certain aspects of the system, in particular the Nuclear Account.

An expanded scope and extended duration of the nuclear power programme might create challenges for the system of financing arrangements for RW management and decommissioning. The ARTEMIS Review Team considers that it would be desirable to identify potential impacts and challenges at the earliest possible stages of development. This would enable consideration of potential modifications to the system of financing arrangements in order to ensure they are appropriate for an expanded nuclear power programme, including potential modifications to institutional arrangements for implementing the financing arrangements.

[6] See, for example, Study on the risk profile of the funds allocated to finance the back-end activities of the nuclear fuel cycle in the EU (No. ENER/D2/2016-471-2), European Commission, Brussels.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *The approaches taken to address uncertainty and risk differ between the cost assessments relating to the Nuclear Account and for the Decommissioning Reserves. There is no national requirement to perform a systematic assessment of the full range of uncertainties and risks that may impact on the costs.*	
(1)	**BASIS: GSR Part 1 (Rev. 1), Requirement 10, para. 2.33 states that** *"Appropriate financial provision shall be made for: (a) Decommissioning of facilities […]".*
(2)	**BASIS**: **GSR Part 6, Requirement 9, para. 6.2 states that** *"The cost estimate for decommissioning shall be updated on the basis of the periodic update of the initial decommissioning plan or on the basis of the final decommissioning plan. The mechanism used to provide financial assurance shall be consistent with the cost estimate for the facility and shall be changed if necessary."*
(3)	**BASIS**: **SSG-47, Para. 6.10 states that** *"Cost estimates and financial provisions should be reviewed periodically and should be adjusted as necessary to allow for proper consideration of inflation and other factors, such as technological advances, waste management costs or regulatory changes, especially in the case of a deferred dismantling strategy where decommissioning might be completed only decades after shutdown of the facility."*
(4)	**BASIS: Addressing Uncertainties in Cost Estimations for Decommissioning Nuclear Facilities, IAEA and OECD Nuclear Energy Agency [NEA No. 7344], p. 39, states that** *"In-scope uncertainties are associated with situations and events that, based on past experience, can be considered sufficiently likely to occur, and thus should be fully reflected in the cost estimate. […] It is recommended […] that out-of-scope uncertainties, irrespective of their origin and nature, be designated as risk events and treated as such, since they relate to situations which, though not expected to occur, could impact the total project cost."*
S4	**Suggestion: The Government should consider requiring further development of the methods for cost assessment used by SÚRAO and NPP licensees, in order to apply a comprehensive, systematic approach to analyzing and addressing uncertainty and risk.**

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *The investment frameworks for assets held in the Nuclear Account and Decommissioning Reserve accounts are conservative. Whilst offering stable, predictable returns at low risk, conservative investment approaches may not provide sufficient returns to allow funds to outperform the expected inflation of the costs.*	
(1)	**BASIS: GSR Part 1 (Rev. 1), Requirement 10, para. 2.33 states that** *"Appropriate financial provision shall be made for: (a) Decommissioning of facilities; (b) Management of radioactive waste, including its storage and disposal; (c) Management of disused radioactive sources and radiation generators; (d) Management of spent fuel."*
S5	**Suggestion: The Government should consider the development of less conservative investment frameworks for assets, by expanding the range of permissible investment classes, recognizing the need to ensure the continued security of the assets in the funds.**

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *An expanded scope and extended duration of the nuclear power programme might create challenges for the system of financing arrangements for radioactive waste management and decommissioning.*	
(1)	**BASIS: GSR Part 1 (Rev. 1) Requirement 10 states that** *"The government shall make provision for the safe decommissioning of facilities, the safe management and disposal of radioactive waste arising from facilities and activities, and the safe management of spent fuel."*
S6	**Suggestion: The Government should consider undertaking an in-depth review of the potential impacts on the financing arrangements of an expanded scope and extended duration of nuclear power programme.**

7. CAPACITY BUILDING FOR RADIOACTIVE WASTE AND SPENT FUEL MANAGEMENT – EXPERTISE, TRAINING AND SKILLS

Czech Republic position

Capacity Building and Human Resource Planning

The Czech Republic has transposed international provisions into its legal system and refined a number of requirements concerning the activities of the various responsible organisations based on domestic research and experience, foreign best practice and other information available within the professional sphere. The basic requirements given by legislative framework are supplemented by internal regulations of all the actors of RW management. The practical application of the requirements is verified on a continuous basis by the regulator via the performance of annual audits.

The national Policy lists a number of responsibilities, including the transfer of information on the disposal of RW via agreements with universities and research organisations and, on R&D programmes in the field of RW management. It directly promotes the systematic training and education of experts.

Coordination and co-operation in research, development and training

In the Czech Republic there are 12 universities that have activities relevant to the energy sector. There is information exchange between these technical universities and the government and waste organisation, but in general coordination on research and education activities is limited. In addition, staff from the waste organisation make contributions to both the content and teaching of technical courses for higher level education. There is cooperation with elementary and secondary schools on teaching in the field of nuclear energy generally.

ARTEMIS observation

Capacity Building and Human Resource Planning

The ARTEMIS Review Team notes that the main problem identified by the counterparts of the Czech Republic is to ensure an adequate number of experts to cover all the fields of RW and SF management. In this context, the ATEMIS Review Team notes that the counterparts have identified the declining demographic trend, the decline of pupils and students in demanded fields, the lack of teachers in demanded fields and the lack of cooperation between schools and companies, especially in practical training.

The ARTEMIS Review Team notes Policy Issue 2 set out in the [draft] report of the 2023 IRRS Mission to the Czech Republic which considers challenges for the regulatory body arising from the shortage of experts in the nuclear field (p. 77). This highlighted that SÚJB faces additional challenges to recruit new young staff "… *related to external factors like the limited number of available candidates on the job market, the low interest for the nuclear sector in the recent decades, the less attractive financial conditions for public service, compared to the industry and the shift of mindset among young people entering the job market, with diverse interests, expectations, plans for their professional life.*"

Similar to the conclusions reached by the IRRS Mission, the ARTEMIS Review Team considers that there are a number of significant challenges for maintaining, developing and expanding the workforce needed for the management of RW and spent nuclear fuel and decommissioning. These arise, in part, due to the number and diversity of existing facilities,

which require the maintenance of a workforce with a diverse range of competences and specialist skills. The planned further development and construction of new facilities, in particular the DGR, requires an additional range of diverse and specialist competences as well as additional human resources in line with the accelerated timetable for DGR development.

The ARTEMIS Review Team notes that an expansion and extension of the nuclear power programme will require sufficient human resources to be available over a wider range of activities and facilities over an extended period of time.

The ARTEMIS Review Team notes the scenario for potential increase in the size of SÚRAO, taking into account potential additional nuclear power generation in the Czech Republic and the accelerated schedule for the DGR. The estimates provided by SÚRAO benchmarked to advanced programmes of the IAEA's Member States with similar RW inventory and level of knowledge is illustrated in Figure 7-1 below. The final number of employees may vary over time, will be affected by the actual needs of the project, use of external experts, freelancers, suppliers and contractors (hereinafter "contractors") as well as the legal status of SÚRAO in the next thirty years.

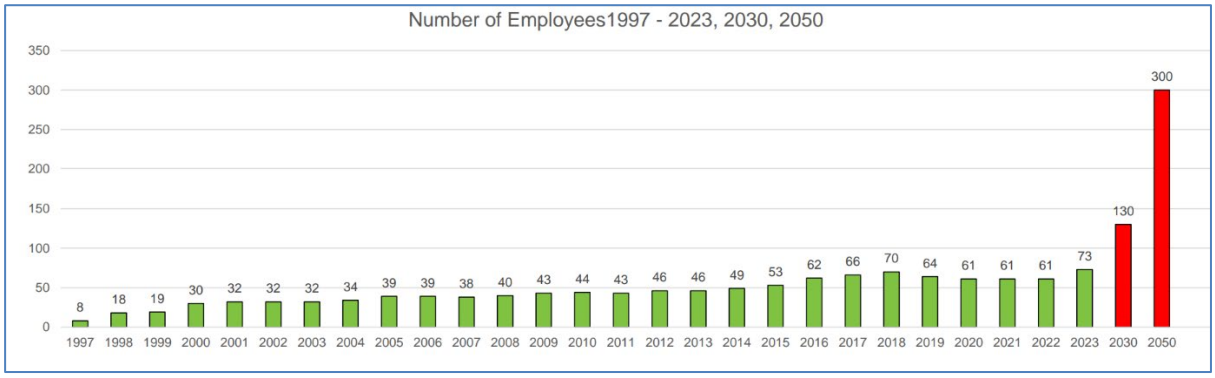


Figure 7-1. Scenario for the number of SÚRAO employees and contractors with an accelerated DGR schedule and potential additional nuclear power generation, (estimation provided by SÚRAO in presentation to the ARTEMIS review mission)

The ARTEMIS Review Team further notes that such an expansion in size of an organisation from some tens of employees to several hundred employees in the timeframe illustrated in Figure 7-1, entails not only the net addition of 8-9 FTEs annually from now to 2050, but it will also require a commensurate degree of organisational change and development appropriate for this larger organisation. A suitable strategic development plan would be needed to manage this transformational change.

The ARTEMIS Review Team notes that a recurring theme during discussions on capacity building concerned budgetary processes and limitations in the context of human resource needs. In this respect the ARTEMIS Review Team notes that public service employment regulations could give rise to difficulties in addressing human resource needs. The ARTEMIS Review notes that such concerns have been observed in some other Member States and raised during a number of ARTEMIS Review Missions. The ARTEMIS Review Team notes that there are of examples of national waste organisations which have been exempted from certain civil service regulations, for example on salary. There are also examples of national waste organisations which have moved from annual budget allocations to multi-year programmatic funding models.

The ARTEMIS Review Team considers that an integrated overview of future human resource requirements is a prerequisite for planning for the necessary development of the organization and its staffing to meet these ongoing and future challenges. The ARTEMIS Review Team considers it likely that adjustments to existing arrangements, including financial and institutional aspects, will be needed to ensure that sufficient human resources are available with the required expertise, training and skills in both the short and long-term.

Coordination and co-operation in research, development and training

The ARTEMIS Review Team notes that there are a range of opportunities for information exchange and discussions related to research, development and training, etc. This information exchange results in a degree of co-operation and coordination between the different parties involved or having interest in research, development and training, (government, regulator and SÚRAO, the institutions of education and research). There is also involvement of industry in some of these discussions. Nonetheless, the ARTEMIS Review Team notes that there is not currently an integrated coordinated approach involving all concerned parties.

The ARTEMIS Review Team notes that there is extensive participation in a range of international activities, as well as efforts to identify and learn from experiences outside of the Czech Republic. The ARTEMIS Review Team acknowledges this engagement in and awareness of international developments. However, the ARTEMIS Review Team also notes that there is limited coordination of international engagement.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *There are significant challenges for maintaining, developing and expanding the workforce needed for the management of radioactive waste and spent fuel and decommissioning. In the absence of an integrated overview, difficulties may arise in predicting future human resource requirements necessary for such programmes. There are also external factors to be considered such as competition between employers and a low level of interest amongst younger people for careers in relevant scientific and engineering fields.*	
(1)	**BASIS: GSR Part 1 (Rev. 1) Requirement 10 states that** *"The government shall make provision for the safe decommissioning of facilities, the safe management and disposal of radioactive waste arising from facilities and activities, and the safe management of spent fuel."*
(2)	**BASIS: GSR Part 1 (Rev. 1) Requirement 11 states that** *"The government shall make provision for building and maintaining the competence of all parties having responsibilities in relation to the safety of facilities and activities."*
(3)	**BASIS: GSR Part 2 Requirement 9 states that** *"Senior management shall determine the competences and resources necessary to carry out the activities of the organization safely and shall provide them."*
R5	**Recommendation: The Government should conduct an in-depth analysis of the human resource needs for all entities involved in radioactive waste and spent fuel management and for decommissioning, in particular for SÚRAO and SÚJB, and in both the short and long-term. This should take into account ongoing and planned activities as well as anticipated developments, and make recommendations for ensuring the maintenance and strengthening of the human resource capacity.**

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *Although there are a number of valuable discussions, information exchange and co-operations ongoing between the government, regulator and SÚRAO in the field of research, development and training, there is not an integrated coordinated approach involving all concerned parties. There is limited coordination of participation in international activities.*	
(1)	**BASIS: GSR Part 1 (Rev. 1) Requirement 10 states that** *"The government shall make provision for the safe decommissioning of facilities, the safe management and disposal of radioactive waste arising from facilities and activities, and the safe management of spent fuel."*
S7	**Suggestion: The Government should consider improving the coordination of information exchange, cooperation and planning of activities in relation to research, development and training, including international activities, to ensure they are commensurate with the ongoing and future needs for decommissioning, and the management of radioactive waste and spent fuel.**

APPENDIX A: TERMS OF REFERENCE

Terms of Reference

1. Introduction

On 31st October 2018, the Czech Republic requested the IAEA to organize an Integrated Review Service for Radioactive Waste and Spent Nuclear Fuel Management, Decommissioning and Remediation Programmes (ARTEMIS). On 7th July 2021, the Ministry of Industry and Trade proposed the IAEA to organize back-to-back Integrated Regulatory Review Service (IRRS) and ARTEMIS missions, with the IRRS mission in May 2023 and the ARTEMIS mission in second half of 2023.

Czech Republic's request for the ARTEMIS review is to satisfy its obligations under Article 14(3) of the European Council Directive 2011/70/EURATOM of 19 July 2011 establishing a Community Framework for the Responsible and Safe Management of Spent Fuel and Radioactive Waste (hereinafter the EU Waste Directive).

In line with the requests, the ARTEMIS review will be carried out in October 2023 in a coordinated manner with the IRRS mission, scheduled in May 2023. The ARTEMIS review will be led by the IAEA by the Department of Nuclear Safety and Security who will be supported by the Department of Nuclear Energy.

2. Objective

The ARTEMIS review will provide an independent international evaluation of Czech Republic's radioactive waste and spent fuel management programme.

The review will be conducted by an international team of experts selected by the IAEA and will be based on the relevant IAEA Safety Standards and proven international practices.

3. Scope

The ARTEMIS review will evaluate the Czech national programme and the national framework for executing country's obligations for safe and sustainable radioactive waste and spent fuel management.

The Czech Republic requested that management of residues from the NORM industries and management of waste from remediation activities are excluded from the scope of the ARTEMIS review. The regulatory aspects related to both topics will be discussed as part of the IRRS review mission.

The outcomes from the 2023 IRRS mission to Czech Republic will be taken into account as appropriate to avoid unnecessary duplication in line with the Supplementary Guidelines on the Preparation and Conduct of IRRS-ARTEMIS back-to-back Missions, applicable for situations when an IRRS mission is conducted before an ARTEMIS mission. These Supplementary Guidelines are not a substitute for the ARTEMIS Guidelines but supplement them with the

specific provisions that need to be taken into account while conducting IRRS-ARTEMIS back-to-back missions.

4. Reference material

The ARTEMIS review will cover all documentation submitted by National Counterpart for the scope of the review, including the results of a national self-assessment, which should be based on the ARTEMIS self assessment questionnaire provided by the IAEA.

For IRRS-ARTEMIS back-to-back missions, the National Counterpart will include in the reference material the sections of the IRRS Reference material relevant to the ARTEMIS review (e.g. parts of the IRRS self-assessment report dealing with radioactive waste and spent fuel management) as soon as they are available as well as the IRRS final draft mission report.

For IRRS-ARTEMIS back-to-back missions, identified areas of possible overlap will be addressed only by one mission, either IRRS or ARTEMIS, depending on the scope and nature of the reviews. The National Counterpart will be able to bypass in each self-assessment certain questions to avoid addressing twice the same issues. Namely, questions dealing with the General Safety Requirements (GSR) Part 1 Requirement 10 in Module 1 of eSARIS Self-assessment will be covered in the ARTEMIS mission and certain questions of topics 1, 3, 5 and 7 of ARTEMIS self-assessment questionnaire dealing with legal and regulatory framework will be covered by IRRS mission.

The provisional list of reference material is provided in **Annex 1** (this list is subject to updates and should be finalized by submission of the advance reference material).

All documents for the purpose of the ARTEMIS review will have to be submitted in English.

Reference material for the purpose of the ARTEMIS review shall be submitted to the ARTEMIS mission webpage on the Global Nuclear Safety and Security Network (GNSSN) of the IAEA.

5. Modus operandi

The working language of the review, including the review mission, will be English.

- The National Counterpart is the Radioactive Waste Repository Authority (SÚRAO). The National Counterpart Liaison Officer for the review is Mrs Martina Máčelová, Deputy Director, Head of the LILW Repositories Operation Department of SÚRAO. Mr Tomáš Rosendorf, Head of the Unit of Back-End Fuel Cycle, Section of Energy and Nuclear Resources of the Ministry of Trade and Industry, will be responsible for the administrative issues related to ensuring the mission.

The timeline for the key steps of the review process is provided below:

- Self-assessment: questionnaire was made available to the Czech Republic as of **7 March 2023**.
- Preparatory Meeting: **7 March 2023 (WebEx meeting)**.
- The reference material and the results of the self-assessment questionnaire will be provided to the IAEA as soon as they are available and not later than **15 August 2023**.

- Questions based on a preliminary analysis of the reference material and the self-assessment results will be provided to the National Counterpart from the Review Team by **29 September 2023**.
- The review mission will be held during **15 – 25 October 2023 (11 days) in Prague, Czech Republic.** The mission schedule is included in annex 2 and summarized in the bullets below:
    - Sunday: arrival of experts and internal meeting of the Review Team;
    - Monday to Friday: interviews/exchange/discussion with Counterparts on the basis of the preliminary analysis and drafting of recommendations and suggestions
    - Wednesday: site visit to the Richard LILW Repository. Indicative programme of the site visit will be provided by Counterparts by 15 August 2023 and can be further adapted to facilitate requests by the Review Team.
    - Saturday-Sunday: Presentation of draft Suggestions & Recommendations to Counterparts, preparation of the draft ARTEMIS Review Report (by the Review Team);
    - Sunday noon: Delivery of draft ARTEMIS Review Report to the Counterparts for fact checking;
    - Tuesday: discussions between the Review Team and the Counterparts and finalization of draft ARTEMIS Review Report;
    - Wednesday: exit meeting - delivery of the draft ARTEMIS Review Report and mission closure.

6. International peer review team

The IAEA will convene an international team of experts to perform the ARTEMIS review according to the agreed Terms of Reference. The team will comprise:

- Six qualified and recognized international experts from government authorities, regulatory bodies, waste management organizations and technical support organizations, with experience in the safe management of radioactive waste and spent fuel. The list of experts is included in annex 3. Among the experts, the IAEA will identify one expert with enough knowledge and experience in the regulatory field as well as in the radioactive waste and spent nuclear fuel management, decommissioning and remediation field to participate in both the IRRS and ARTEMIS missions. This Expert will cover IRRS Modules 5 to 9 on aspects for waste and spent fuel management facilities and will ensure that the ARTEMIS mission is informed on the IRRS review findings and mission.
- Two IAEA staff to coordinate the mission. The coordinator of the ARTEMIS review is Mr Vladan Ljubenov from the Waste and Environmental Safety Section of the Department of Nuclear Safety and Security. The deputy coordinator is Ms Karina Lange from the Waste Technology Section of the Department of Nuclear Energy.
- One IAEA staff for administrative support who will assist the Review Team to assemble the Review Report.

- A senior member of IAEA staff from the Department of Nuclear Safety and Security will oversee the closure of the review mission.

The peer review team will be led by a Team Leader. The Team Leader will be Ms Sylvie Voinis, ANDRA, France.

The review mission may include the presence of up to two observers, including the possibility of an observer from the EC. The National Counterparts will be notified of any proposed observers; the presence of any observers will be agreed between the IAEA and the National Counterpart in advance of the mission.

7. Reporting

The findings of the ARTEMIS review will be documented in a final ARTEMIS Review Report that will summarise the work of the review and contain any recommendations, suggestions and good practices. The report will reflect the collective views of the review team members and not necessarily those of their respective organizations or Member States, or of the IAEA.

Prior to its finalization, the ARTEMIS Review Report will be delivered to the National Counterpart for fact-checking.

8. Funding of the peer review

The ARTEMIS review will be funded by Czech Republic. The costs for the services will be limited to the travel costs and per diem of the peer review team (external experts and IAEA staff) in line with IAEA Financial Regulations and Rules.

The cost of the ARTEMIS review is were paid to the IAEA as voluntary contribution before the start of the mission. The Czech Republic is aware that the review cost includes 7% programme support costs.

If the actual cost of the ARTEMIS review exceeds the estimated voluntary contribution, the Czech Republic agrees to cover such additional cost to the IAEA. Similarly, if the actual cost is less than the estimated voluntary contribution, any excess will be refunded to the Czech Republic through the Counterpart.

These Terms of Reference have been agreed between the IAEA, Ministry of Trade and Industry of Czech Republic and SÚRAO during the preparatory meeting held on-line on 15 March 2023.

Annex 1: List of reference material

- Responses to the ARTEMIS Self-assessment Questionnaire
- Czech Republic IRRS ARM Summary Report
- The IRRS self-assessment report including parts dealing with radioactive waste and spent fuel management
- The IRRS Review Report
- Atomic Act No. 263/2016 Coll.
- National Policy of RW and SF Management
- Evaluation of the influence of the EU Commission Nuclear Energy Taxonomy Regulation on the Radioactive Waste Management System in the Czech Republic with concern to the activities of SÚRAO
- National Report
    - under the Joint Convention on Safety in SF Management and Safety in RW Management (2020)
    - under Article 14.1 of the Council Directive 2011/70/EURATOM of 19 July 2011 establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste (2021)
- The SÚRAO medium-term R&D plan for the period 2020-2030

APPENDIX B: MISSION PROGRAMME

Time	Sun 15 Oct	Mon 16 Oct	Tue 17 Oct	Wed 18 Oct	Thur 19 Oct	Fri 20 Oct	Sat 21 Oct	Sun 22 Oct	Mon 23 Oct	Tue 24 Oct	Wed 25 Oct
9h00 - 10h00	Arrival of the Review Team members	**Entrance meeting** General presentation Feedback on IRRS findings (legal and regulatory aspects of RW and SF mgt)	Waste and Spent Fuel Inventory	**SITE VISIT** **Richard LILW Repository**	Cost estimates and financing	Session reserved for further discussions if required/ drafting of the report	**Presentation of draft Suggestions & Recommendations to Counterparts**	Report drafting	Review of the draft report by the Czech counterparts	**Discussion with the Counterparts on the draft report**	Delivery of the final draft report **Exit Meeting**
10h00 - 12h00		National Policy and Framework									Departure of Team Members
12h00 - 14h00		Lunch	Lunch	Lunch	Lunch	Lunch				Lunch	
14h00 - 18h00	Initial meeting of the Review Team (at the hotel)	National Strategy	Concepts, Plans and technical solutions	Safety case and safety assessment	Capacity building	Finalization of Recommendations and Suggestions	Report drafting	**Delivery of the draft report to the Counterparts**		Finalising the report	
18h00 - 19h00		Team meeting	Team meeting	Team meeting	Team meeting	Team meeting					
19h00		Report drafting	Report drafting	Report drafting	Report drafting	Report drafting					

APPENDIX C: RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

Area		R:Recommendations S: Suggestions G: Good Practices	Recommendations, Suggestions or Good Practices
1.	NATIONAL POLICY AND FRAMEWORK FOR RADIOACTIVE WASTE AND SPENT FUEL MANAGEMENT	S1	The Government should consider undertaking a review of the potential impact of additional and new types of nuclear facilities which could be included in a future State Energy Policy.
2.	NATIONAL STRATEGY FOR RADIOACTIVE WASTE AND SPENT FUEL MANAGEMENT	GP1	The Government has established mechanisms for ensuring alignment of the strategies and plans developed by organizations involved in the management of radioactive waste and spent fuel with the National Policy, both individually and collectively.
		S2	SÚRAO should consider further enhancing plans and resources for engagement with interested parties, and in particular, with potential host communities to ensure they are properly engaged beyond the site selection phase of the DGR.
		R1	SÚRAO should update the existing plans and schedules for the development of the DGR, taking into account the Complementary Delegated Act (Taxonomy).

Area		R:Recommendations S: Suggestions G: Good Practices	Recommendations, Suggestions or Good Practices
4.	CONCEPTS, PLANS AND TECHNICAL SOLUTIONS FOR SPENT FUEL AND RADIOACTIVE WASTE MANAGEMENT	S3	SÚRAO and the NPP operator should consider the interdependences between storage and disposal of spent fuel in the design of the process for the transfer of spent fuel from storage to disposal packages at the DGR and the transfer of damaged fuel to the DGR for disposal, to gain the benefit of experience in the predisposal management of spent fuel.
		R2	The Government should update the milestones for the DGR, in the national policy and strategy, to take account of the Complementary Delegated Act (Taxonomy). This should address all radioactive waste and spent fuel to be disposed of in the DGR, including those from additional nuclear power reactor types not considered in the State Energy Policy.
		R3	SÚRAO should update existing design plans and milestones for the development of the DGR, in addressing all radioactive waste and spent fuel intended for disposal in the DGR, while continuing to apply a graded approach.
5.	SAFETY CASE AND SAFETY ASSESSMENT OF RADIOACTIVE WASTE AND SPENT FUEL MANAGEMENT ACTIVITIES AND FACILITIES	R4	When providing the safety case for siting, SÚRAO should update the current safety assessment to include all radioactive waste to be disposed of in the DGR, applying a graded approach.
6.	COST ESTIMATES AND FINANCING OF	S4	The Government should consider requiring further development of the methods for cost assessment used by SÚRAO and NPP licensees, in order to

Area		R:Recommendations S: Suggestions G: Good Practices	Recommendations, Suggestions or Good Practices
	RADIOACTIVE WASTE AND SPENT FUEL MANAGEMENT		**apply a comprehensive, systematic approach to analyzing and addressing uncertainty and risk.**
		S5	**The Government should consider the development of less conservative investment frameworks for assets, by expanding the range of permissible investment classes, recognizing the need to ensure the continued security of the assets in the funds.**
		S6	**The Government should consider undertaking an in-depth review of the potential impacts on the financing arrangements of an expanded scope and extended duration of nuclear power programme.**
7.	**CAPACITY BUILDING FOR RADIOACTIVE WASTE AND SPENT FUEL MANAGEMENT – EXPERTISE, TRAINING AND SKILLS**	**R5**	**The Government should conduct an in-depth analysis of the human resource needs for all entities involved in radioactive waste and spent fuel management and for decommissioning, in particular for SÚRAO and SÚJB, and in both the short and long-term. This should take into account ongoing and planned activities as well as anticipated developments, and make recommendations for ensuring the maintenance and strengthening of the human resource capacity.**
		S7	**The Government should consider improving the coordination of information exchange, cooperation and planning of activities in relation to research, development and training, including international activities, to ensure they are commensurate with the ongoing and future needs for decommissioning, and the management of radioactive waste and spent fuel.**

APPENDIX D: LIST OF ACRONYMS USED IN THE TEXT

IAEA	International Atomic Energy Agency
ČEZ	the operator of the NPPs
DGR	deep geological repository
HLW	High-Level Waste
ILW	Intermediate Level Waste
IRRS	Integrated Regulatory Review Service
KPIs	Key Performance Indicators
LLW	Low-level waste
MPO	the Ministry of Industry and Trade
NPP	Nuclear Power Plant
RW	radioactive waste
SEA	Strategic Environmental Assessment
SF	spent nuclear fuel
SÚJB	the State Office for Nuclear Safety
SÚRAO	the Radioactive Waste Repository Authority
ÚJV Řež	the research centre
VLLW	very low-level waste
WAC	Waste Acceptance Criteria

APPENDIX E: IAEA REFERENCE MATERIAL USED FOR THE REVIEW

[1] INTERNATIONAL ATOMIC ENERGY AGENCY, Fundamental Safety Principles, Safety Fundamentals No. SF-1, Vienna (2006).

[2] INTERNATIONAL ATOMIC ENERGY AGENCY, Governmental, Legal and Regulatory Framework for Safety, General Safety Requirements No. GSR Part 1 (Rev. 1), Vienna (2016).

[3] INTERNATIONAL ATOMIC ENERGY AGENCY, Leadership and Management for Safety, General Safety Requirements No. GSR Part 2, IAEA, Vienna (2016).

[4] INTERNATIONAL ATOMIC ENERGY AGENCY, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, IAEA Safety Standards Series No. GSR Part 3, IAEA, Vienna (2014).

[5] INTERNATIONAL ATOMIC ENERGY AGENCY, Safety Assessment for Facilities and Activities, IAEA Safety Standards Series No. GSR Part 4, IAEA, Vienna (2009).

[6] INTERNATIONAL ATOMIC ENERGY AGENCY, Predisposal Management of Radioactive Waste, IAEA Safety Standards Series No. GSR Part 5, IAEA, Vienna (2009).

[7] INTERNATIONAL ATOMIC ENERGY AGENCY, Decommissioning of Facilities, IAEA Safety Standards Series No. GSR Part 6, IAEA, Vienna (2014).

[8] INTERNATIONAL ATOMIC ENERGY AGENCY, Disposal of Radioactive Waste, IAEA Safety Standards Series No. SSR 5, IAEA, Vienna (2011).

[9] INTERNATIONAL ATOMIC ENERGY AGENCY, Safety of Nuclear Fuel Cycle Facilities, IAEA Safety Standards Series No. SSR-4, IAEA, Vienna (2017).

[10] INTERNATIONAL ATOMIC ENERGY AGENCY, Nuclear Energy Basic Principles, Nuclear Energy Series, NE-BP, Vienna (2021).

[11] INTERNATIONAL ATOMIC ENERGY AGENCY, Radioactive Waste Management Objectives, Nuclear Energy Series, NW-O, Vienna (2011).

[12] INTERNATIONAL ATOMIC ENERGY AGENCY, Nuclear Fuel Cycle Objectives, Nuclear Energy Series, NF-O, Vienna (2013).

[13] INTERNATIONAL ATOMIC ENERGY AGENCY, Policies and Strategies for Radioactive Waste Management, IAEA Nuclear Energy Series No. NW-G-1.1, IAEA, Vienna (2009).

[14] INTERNATIONAL ATOMIC ENERGY AGENCY, Policies and Strategies for the Decommissioning of Nuclear and Radiological Facilities, IAEA Nuclear Energy Series No. NW-G-2.1, IAEA, Vienna (2012).

[15] INTERNATIONAL ATOMIC ENERGY AGENCY, Policy and Strategies for Environmental Remediation, IAEA Nuclear Energy Series No. NW-G-3.1, IAEA, Vienna (2015).

[16] INTERNATIONAL ATOMIC ENERGY AGENCY, Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, INFCIRC/546, IAEA, Vienna (1997).

[17] INTERNATIONAL ATOMIC ENERGY AGENCY, Nuclear Safety and Security Glossary, IAEA, Vienna (2022 interim edition).

[18] Official Journal of the European Union No. L 199/48 from 2nd Aug 2011, Council Directive 2011/70/Euratom of 19 July 2011 establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste, Brussels (2011).

[19] Addressing Uncertainties in Cost Estimations for Decommissioning Nuclear Facilities, IAEA and OECD Nuclear Energy Agency [NEA No. 7344].