Technical report 601/2022

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

Authors: Lukáš Vondrovic et al.

SÚRAO

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AUTHORS: Vondrovic L[1]., Augusta J. [1], Bílá M. [1], Dohnálková M. [1], Duda V.[1], Ehler T. [2], Gorčica L. [1], Hausmannová L. [1], Lahodová Z. [1], Máčelová M. [1], Popelová E. [1], Rosendorf T. [2], Urík J. [1], Vokál A[1].

Radioactive Waste Repository Authority (SÚRAO) [1] and the Ministry of Industry and Trade[2]

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Contents

List of abbreviations:

BAT	Best available technologies
ČBÚ	Czech Mining Office
Concept	Radioactive Waste and Spent Nuclear Fuel Management Concept of the Czech Republic, approved by Resolution of the Government of the Czech Republic No. 597/2019.
ČSÚ	Czech Statistical Office
DGR	Deep geological repository
DNSH	Do no significant harm
EDU	Dukovany nuclear power plant
EIA	Environmental impact assessment
ETE	Temelín nuclear power plant
EU	European Union
HLW	High-level waste
IAEA	International Atomic Energy Agency
ILW	Intermediate-level waste
KPI	Key performance indicator)
NEA	Nuclear Energy Agency
NPP	Nuclear power plant
OECD	Organisation for Economic Co-operation and Development
R&D	Research and development
RAW	Radioactive waste
SF	Spent (nuclear) fuel
SÚJB	State Office for Nuclear Safety
SÚRAO	Czech Radioactive Waste Repository Authority
SÚRO	National Radiation Protection Institute
TRL	Technical readiness level
URF	Underground research facility (Bukov)
VVER	Type of pressurised water reactor
WENRA	Western European Nuclear Regulators' Association

Abstract

This study provides an assessment of the requirements of the technical criteria set out in Commission Delegated Regulation (EU) 2022/1214 of 9 March 2022 amending Delegated Regulation (EU) 2021/2139 as regards economic activities in certain energy sectors and Delegated Regulation (EU) 2021/2178 as regards specific public disclosures for those economic activities, specifically Annex No. 1, points 4.26, 4.27, 4.28, 4.29, 4.30 and 4.31 in terms of the activities of the Czech Radioactive Waste Repository Authority (hereinafter referred to as “SÚRAO”). The conditions related to the schedule for the development of a deep geological repository and the conditions concerning capacity for the handling of low-level waste from the operation of nuclear power plants were identified as conditions that affect the activities of SÚRAO. This study presents the conditions for fulfilling the proposed criteria.

Keywords

Strategic study, schedule of activities, management of SF and HLW/ILW, management of LLW, licensing procedure, administrative procedure, RAW storage capacity, deep geological disposal, safety, project solution, communication, recommendations, Taxonomy, European Commission

1 Introduction

This study was prepared in response to a request from the Ministry of Industry and Trade (hereinafter referred to as the “MIT”) in the form of a letter dated 4 February 2022 (reference no. SURAO-2022-1184, MIT reference no. MPO 14112/22/91010/91000), which authorised SÚRAO to prepare an optimisation study that follows up on the Delegated Commission Regulation C (2022) 631/3 proposal submitted to the European Parliament and the Council on 2 February 2022 by the European Commission (hereinafter referred to as the “Commission”) amending Delegated Regulation (EU) 2021/2139 as regards economic activities in certain energy sectors and Delegated Regulation (EU) 2021/2178 as regards specific public disclosures for those economic activities. The subject matter of this study comprises an evaluation of the conditions that would lead to the fulfilment of the requirements of the technical criteria described in Commission Regulation (EU) 2022/1214, supplementing Annex No. 1 of Commission Delegated Regulation (EU) 2021/2139, specifically points 4.26, 4.27, 4.28 , 4.29, 4.30 and 4.31 (https://eur-lex.europa.eu/eli/reg_del/2022/1214/oj, hereinafter referred to as the “Taxonomy”).

The study focuses on the evaluation of the impact of the above-mentioned document on the field of radioactive waste disposal in the Czech Republic from the perspective of the activities of the implementer of this programme, i.e. SÚRAO.

Although the implementation of the EU Taxonomy is not binding as such, it is essential for the development of nuclear energy in the Czech Republic with respect to energy self-sufficiency. Concerning the supplementary Delegated Act that details the Taxonomy criteria for nuclear energy, annulment proceedings are underway at the Court of Justice of the European Union, i.e. a lawsuit filed by Austria and a lawsuit filed by 12 non-governmental organisations.

In terms of the Radioactive Waste and Spent Fuel Management Concept in the Czech Republic (hereinafter referred to as the “Concept”), the basic strategy of the Czech Republic concerning the disposal of spent fuel (hereinafter referred to as “SF”) comprises its direct disposal in a deep geological repository located in the Czech Republic. The options of the storage of radioactive waste (hereinafter referred to as “RAW”), or its transfer from the Czech Republic to an international regional repository is currently considered to be unrealistic and is, indeed, impossible from the viewpoint of currently valid legislation; moreover, it is not clear whether such a repository would accept all the waste that cannot be disposed of in surface repositories.

The first part of the study provides a description of Commission Regulation (EU) 2022/1214 and the conditions that affect the radioactive waste disposal programme. The second part provides an evaluation of the impact on the disposal of very low-, low- and intermediate-level waste. The following section of the study focuses on impacts on the development of a deep geological repository for that radioactive waste that does not meet the acceptability conditions for existing repositories. The final part describes the assumptions under which it will be possible to fulfil the evaluated conditions, including proposals for practical measures and activities.

2 Evaluation of conditions

2.1 Assessed Documents

In connection with measures aimed at tackling the impact of climate change on the environment and achieving carbon neutrality, Regulation (EU) 2020/852 of the European Parliament and of the Council and Commission Delegated Regulation (EU) 2021/2139 were adopted. These documents establish, *inter alia*, a general framework for determining whether a certain economic activity qualifies as environmentally sustainable. On 2 February 2022, the Commission approved a draft amendment to the above-mentioned documents that contained conditions pertaining to the fields of nuclear energy and natural gas. These documents were published in the Official Journal of the European Union on 9 March 2022 (C/2022/0631 final). The regulation is valid and will be effective from 1 January 2023.

With respect to the radioactive waste management system, the key conditions (the so-called technical screening criteria and *Do no significant harm* criteria (hereinafter referred to as "DNSH")) are defined in Annex No. 1 of the (2021/2139) EU document. This document and the supplement thereto define the conditions for the following types of facilities (Chapters 4.26, 4.27 and 4.28):

Pre-commercial stages of advanced technologies to produce energy from nuclear processes with minimal waste from the fuel cycle, i.e. nuclear facilities in the development phase (Chapter 4.26)

Such facilities are defined as facilities involved in the research, development, demonstration and implementation of innovative electricity production methods. They comprise facilities that are licensed by the competent authorities of the Member States in accordance with the applicable regulations, which produce energy from nuclear processes with the minimal generation of waste from the fuel cycle.

No such facilities were identified in the Czech Republic, therefore these conditions were not evaluated further.

Construction and safe operation of new nuclear power plants, for the generation of electricity or heat, including for hydrogen production, using the best-available technologies (hereinafter referred to as "new nuclear sources", Chapter 4.27)

This item refers to technologies that fully meet the requirements of Directive 2009/71/Euratom, the latest technical parameters as set out in IAEA recommendations and the safety objectives and reference levels determined by WENRA. This includes the construction and safe operation of new nuclear facilities for which the competent authorities of Member States issue a construction permit (planning permission) up to 2045 for the purpose of producing electricity or heat, including for the purposes of district heating or industrial processes such as the production of hydrogen.

With respect to the Czech Republic, three new nuclear sources with an operating life of 60 years and a territorial reserve for a fourth source are being considered as part of the Updated

State Energy Concept of 2015 and the Czech Radioactive Waste and Spent Fuel Management Concept.

Electricity generation from nuclear energy in existing installations (hereinafter referred to as "existing nuclear sources, Chapter 4.28)

This item refers to modifications to existing nuclear facilities in order to extend the period of safe operation for the production of electricity from nuclear energy (hereinafter referred to as "nuclear power plants"), as approved by the competent authorities of the Member States up to 2040 in accordance with the applicable national legislation.

In the case of the Czech Republic, this concerns the 60-year operation of the Temelín VVER 1000 (ETE 1-2) and Dukovany (VVER 440 EDU1-4) nuclear power plants.

The technical screening criteria and DNSH criteria related to the field of radioactive waste management were defined in summary form in Annex No. 1 to the Commission Regulation, points 4.26, 4.27 and 4.28. The following text evaluates selected criteria related to the area of radioactive waste management in terms of their impact on the activities performed by SÚRAO. The subsequent chapters of this study describe the conditions under which these criteria can be fulfilled.

2.2 Framework position of the Czech Republic concerning the Taxonomy for the sustainable operation of existing and new nuclear sources

While the Czech Republic welcomes the fact that nuclear energy is included in the Taxonomy for activities with sustainable financing under defined conditions, the text is considered to represent a rather fragile compromise. The proposed criteria in their full form do not take into account the conditions advocated by the Czech Republic in bilateral negotiations; nevertheless, the Czech Republic did not raise any objections in the context of discussions on the Delegated Act. In addition to the use of renewable energy sources, nuclear energy is seen as an instrument that ensures the stability of the electricity system; moreover, its role in terms of decarbonisation has been confirmed even after 2050. This has acted to motivate the acceleration of the decision-making process concerning investment in new nuclear sources, especially in the context of Russian aggression towards Ukraine and taking into account both the need for a more rapid green transition and the strategic autonomy of the EU.

The Taxonomy framework is also intended to support research and development aimed at the future use of generation IV reactors with a closed fuel cycle or fuel multiplication (once this technology becomes commercially available). The status of sustainability has been proposed by the Commission for all new nuclear sources that obtain a licence up to 2045, as well as for existing nuclear sources that obtain a licence/notification of modification to extend operation up to 2040. The criteria that follow from the notification of investment plans under Article 41 Euratom require a plan for the start of operation of a deep geological repository up to 2050 with a detailed outline of the various stages and technical solutions involved, which, in turn,

requires the modification of the Radioactive Waste and Spent Fuel Management Concept in the Czech Republic based, *inter alia*, on this study.

The sole operator of the Czech Republic's nuclear power plants, ČEZ a.s., also welcomed the classification of economic activities in the field of nuclear energy as providing motivation for new investment in nuclear sources. ČEZ a.s. called on the government, i.e. the Ministry of Industry and Trade, to fulfil the technical criteria of the Taxonomy, i.e. to enable the optimisation of the schedule for the development of a deep geological repository for radioactive waste in the Czech Republic, so that the operation of existing and new nuclear sources fulfils the sustainability conditions set by the Commission.

At the same time, as part of the regular review of the criteria, the Czech Republic will strive to revise the date of the commencement of deep geological disposal to 2050 and will set such criteria that correspond to the real need for deep geological repositories for each EU Member Country.

The government of the Czech Republic, i.e. the Ministry of Industry and Trade and its representatives have presented this framework position to the Parliament of the Czech Republic for potential further discussion and the submission of its opinion to the Commission. The Committee for the Economy, Agriculture and Transport of the Senate of the Parliament of the Czech Republic in its 13th term supported the framework position of the Czech Republic via its resolution No. 179 from the 24th meeting held on 4 May 2022. Further acts stemming both from the government and the Parliament of the Czech Republic can be expected in the future in support of the development and construction of new nuclear sources.

2.3 Technical screening criteria

2.3.1 Criterion 1

The project is located in an EU member state and meets the following requirements:

a) the Member State has fully transposed Council Directive 2009/71/Euratom and Council Directive 2011/70/Euratom;

Evaluation:

Implemented in Act No. 263/2016 Coll., the Atomic Act.

Identified impact: No impact on the activities of SÚRAO.

b) the Member State complies with the European Atomic Energy Community (Euratom) Treaty and with legislation adopted on its basis, in particular, Directive 2009/71/Euratom, Directive 2011/70/Euratom and Directive 2013/59/Euratom, and with applicable Union environmental law adopted under Article 192 TFEU, in particular Directive 2011/92/EU and Directive 2000/60/EC;

Evaluation:

Implemented in Act No. 263/2016 Coll.,

Identified impact: No impact on the activities of SÚRAO.

c) the Member State has in place, as of the approval date of the project, a radioactive waste management fund and a nuclear decommissioning fund which can be combined;

Evaluation:

The field of radioactive waste management is addressed in Act No. 263/2016 Coll., the Atomic Act sections 115-135, which established the so-called nuclear account for the financing of RAW management. Deadlines for the creation of reserves for the decommissioning of nuclear facilities are defined in Decree No. 250/2020 Coll., on the methodology for determining reserves for the decommissioning of category III and IV nuclear facilities and workplaces. The cost estimate forms a part of the decommissioning plan and the content of the relevant documentation is set out in Decree No. 377/2016 Coll., on requirements for the safe management of radioactive waste and the decommissioning of nuclear facilities and category III and IV workplaces. Pursuant to sections 51-54 and section 75 of the Atomic Act, licence holders are required to create financial reserves so as to ensure the decommissioning of nuclear facilities and workplaces with significant or very significant sources of ionising radiation. Estimates of the total costs involved in the creation of decommissioning reserves are verified by SÚRAO in accordance with section 113 of the Atomic Act; such verifications are updated at five-year intervals. The updates serve to enhance the precision of the cost estimates and include the movement of price levels over the past five-year period. Licence holders are obliged to deposit funds in the amount of the reserve in an escrow account at a bank with its registered office in the Czech Republic or a branch of a foreign bank in the Czech Republic.

The disposal of RAW and SF, which has been declared as RAW, is ensured by SÚRAO. The amount of the payments is determined in the Atomic Act (section 121, the fee basis, section 122, the fee rate and section 123, the fee calculation) and Government Regulation No. 35/2017 Coll.; the waste generator pays such fees into the nuclear account (section 118 of the Atomic Act No. 263/2016 Coll.). The obligation of the RAW generator to pay fees into the nuclear account is set out in the Atomic Act, section 111 (1d).

Identified impact: No impact on the activities of SÚRAO.

d) the Member State has demonstrated that it will have resources available at the end of the estimated useful life of the nuclear power plant corresponding to the estimated cost of radioactive waste management and decommissioning in compliance with Recommendation 2006/851/Euratom;

Evaluation:

This item will be included in reports on the evaluation of the Taxonomy to be submitted at regular intervals; this issue is outside the competence of SÚRAO. For the evaluation, see the condition above.

Identified impact: No impact on the activities of SÚRAO.

e) the Member State has operational final disposal facilities for all very low-, low- and intermediate-level radioactive waste, notified to the Commission under Article 41 of the Euratom Treaty or under Article 1(4) of Council Regulation 2587/1999 and included in the national programme updated under Council Directive 2011/70/Euratom;

Evaluation:

According to chapter 7.1.3 of the RAW and SF Management Concept in the Czech Republic, low-level waste from the operation of nuclear power plants is disposed of at the Dukovany radioactive waste repository near the municipality of Dukovany; the repository has been in permanent operation since 1995. The total disposal volume amounts to 55 000 m^3 (approx. 180,000 waste packages consisting of 200 litre drums), which will be sufficient for the disposal of all the low-level waste from the existing Dukovany and Temelín nuclear power plants. The Concept further states that the capacity of the existing disposal facilities will probably not be sufficient to accept radioactive waste from planned new nuclear sources following the updating of the assessment of their waste production volumes. Other (non-energy-sector-related) radioactive waste is disposed of at the Bratrství and Richard repositories.

Identified impact: The necessity to ensure sufficient capacity at the Dukovany repository for the waste generated by new nuclear sources and/or the investigation of other facilities for the respective radioactive waste categories. This issue is evaluated in more detail in Chapter 3.

f) the Member State has a documented plan with detailed steps to have in operation, by 2050, a disposal facility for high-level radioactive waste describing all of the following:

i) concepts or plans and technical solutions for spent fuel and radioactive waste management from generation to disposal;

ii) concepts or plans for the post-closure period of a disposal facility's lifetime, including the period during which appropriate controls are retained and the means to be employed to preserve knowledge of that facility in the longer term;

iii) the responsibilities for the plan implementation and the key performance indicators to monitor its progress;

iv) cost assessments and financing schemes.

For the purposes of point (f), Member States may use the plans drawn up as part of the national programme required by Articles 11 and 12 of Directive 2011/70/Euratom.

Condition f) applies to new nuclear sources. In the case of existing facilities, it concerns sources authorised after 2025.

Detailed evaluation of point f:

i) concepts or plans and technical solutions for spent fuel and radioactive waste management from generation to disposal;

Evaluation:

Concepts and technical solution plans are described in the Concept or in reports compiled by the regulator (the SÚJB [online], 2022). According to these documents, the current state of RAW and SF management in the Czech Republic can be characterised as follows: Spent fuel, after being removed from reactors, is stored for several years in spent fuel storage pools located in the main production blocks of the respective nuclear power plants and is subsequently transferred to dry SF storage facilities, where it is emplaced in transport and storage packaging sets. Up to the time of the commissioning of the Czech deep geological repository, SF from nuclear power plants will be stored in the transport and storage packaging sets in the SF storage facilities located at the two nuclear power plants. The Dukovany nuclear power plant, which has been in operation since 1995, has an SF storage facility with a capacity of 600 tonnes of heavy metals, the capacity of which was fully exhausted in March 2006, and which has been supplemented by a new storage facility with a capacity of 1,340 tonnes of heavy metals, which has been in operation since December 2006. The Temelín nuclear power plant, which has been in operation since 2010, has an SF storage facility with a capacity of 1,370 tonnes of heavy metals. The storage capacity for SF from the existing EDU blocks is sufficient for approximately 45 years from the start of operation. Concerning the ETE blocks, the storage capacity is sufficient for approximately 30 years from the start of operation. Other generated high-level waste will also be stored at the sites of the waste generators or will be managed by SÚRAO (historical radioactive waste without an identified owner) until the deep geological repository comes into operation. According to the current version of the Concept, the date of the commencement of the construction of the deep geological repository is set for 2050, and the start of operation for 2065.

The schedule for the development of the deep geological repository was modified via a Resolution issued by the Government of the Czech Republic (1350/2020), which stipulates the requirement for the submission of a proposal for the selection of the final site and a backup site for the repository by 31 December 2030, with the date of commissioning set for 2065. Based on this resolution, a proposal was drawn up for the updating of the Concept, which was accepted by the relevant inter-ministerial comment procedure. As of the date of the compilation of this study, the draft of the updated Concept that takes into account Resolution No. 1350/2020 had not been submitted to the Government of the Czech Republic. Due to the approval of the proposed Taxonomy in the field of nuclear energy, the Ministry of Industry and Trade has requested the Office of the Government to postpone the previously stated deadline, or to suspend the process, until the impacts of the Taxonomy on the development of the deep geological repository have been evaluated and the limits of the modification, i.e. the updating, of the Concept have been approved.

Specific technical plans can be found in the relevant SÚRAO technical reports or in the Concept.

Identified impact: This item exerts an impact on SÚRAO's activities - specifically, the drawing up of a plan that outlines the detailed steps leading to the commissioning of the Czech deep geological repository in 2050. See Chapter 4.

ii) concepts or plans for the post-closure period of a disposal facility's lifetime, including the period during which appropriate controls are retained and the means to be employed to preserve knowledge of that facility in the longer term;

Evaluation:

Concepts and plans for the period following the closure of the repository are based on the requirements for obtaining a closure permit according to national legislation, specifically according to the Atomic Act, section 9, paragraph 3 (b) on the closure of radioactive waste repositories. Currently, this issue is not being considered in detail in the technical plans for the development of the deep geological repository. This documentation will be processed in the next stage of the preparation of the technical solution for the deep geological repository. In addition, such documentation must be prepared in order to satisfy the relevant licensing procedures, e.g. according to the Atomic Act, the submission of a concept proposal for the safe termination of operation is required as part of the documentation for obtaining a licence for the siting of a nuclear facility, a concept proposal must also be submitted as part of the construction licensing procedure, and a repository decommissioning and closure plan is required as part of the licence application procedure for the operation of such a nuclear facility.

Identified impact: This item exerts an impact on SÚRAO's activities – the compilation of technical studies in the pre-licensing phase of the deep geological repository development process, i.e. on the closure of the repository and on the activities involved in the institutional monitoring period, and strategic studies on knowledge management (e.g. in line with the content of the relevant OECD/NEA projects).

iii) the responsibilities for the plan implementation and the key performance indicators to monitor its progress;

Evaluation:

The Concept sets out deadlines and responsibilities for the fulfilment of the various defined objectives (Table 18 in the Concept). With respect to the establishment of key performance indicators (KPI) for the monitoring of the progress of the implementation of the plan, chapter 11.3 of the Concept sets out the following performance indicators (the institutions responsible for implementation): the availability of disposal capacity for low- and intermediate-level waste (SÚRAO is responsible), the availability of storage capacity for high-level waste (hereinafter referred to as "HLW") and SF (ČEZ a.s. is responsible) and the timely fulfilment of set milestones - this indicator will be monitored upon the attainment of the various milestones set for the development of the deep geological repository (hereinafter referred to as the "DGR"; SÚRAO is responsible).

The Government of the Czech Republic is kept regularly informed of the ongoing fulfilment of the aims of the Concept, as is the European Commission (in accordance with Council Directive 2011/70/Euratom).

Identified impact: This item exerts an impact on SÚRAO's activities – contributions within the context of the regular assessment of the various set indicators.

iv) cost assessments and financing schemes

Evaluation:

With respect to this condition, according to the provisions of section 111 of the Atomic Act and in accordance with internationally recognised principles, the regulation applies that all the costs associated with the management of RAW, i.e. the costs incurred in the period from its creation to its disposal, including the costs of the monitoring of disposal facilities following their closure and the costs of the related research and development work, are borne by the waste generator. The activities prior to the disposal of radioactive waste are performed by the waste generator or by specialised organisations on their behalf. In both cases, the costs of these activities are fully covered. According to the Atomic Act, SÚRAO ensures the disposal of RAW and, where required, the treatment and disposal of SF. The amount of payments for these services is set out in the Atomic Act (section 121, fee basis, section 122, fee rates and section 123 fee calculation) and in Regulation of the Government of the Czech Republic No. 35/2017 Coll.; the waste generator pays these fees into the nuclear account (section 118 of the Atomic Act).

Identified impact: This item exerts an impact on SÚRAO's activities – the regular updating of the final price of the DGR.

2.3.2 Criterion 4 (points 4.27 and 4.28)

The Member State concerned has committed to report to the Commission every five years for each project on all of the following:

a) the adequacy of the accumulated resources referred to in point 1(c);

b) actual progress in the implementation of the plan referred to in point 1(f).

On the basis of the reports, the Commission shall review the adequacy of the accumulated resources of the radioactive waste management fund and the nuclear decommissioning fund referred to in point 1(c) and the progress in the implementation of the documented plan referred to in point 1(f) and it may address an opinion to the Member State concerned.

Evaluation:

It will be implemented if necessary.

Identified impact: Contribution to the regular reporting of the national programme.

2.3.3 Criteria 8 (point 4.27) and 7 (point 4.28)

Radioactive waste as referred to in point 1(e) and (f) is disposed of in the Member State in which it was generated, unless there is an agreement between the Member State concerned and the Member State of destination, as established in Directive 2011/70/Euratom. In that case, the Member State of destination has radioactive waste management and disposal programmes and a suitable disposal facility in operation in compliance with the requirements of Directive 2011/70/Euratom.

Evaluation:

According to the current version of the Concept, the basic option comprises the disposal of radioactive waste in a DGR located in the Czech Republic.

Identified impact: No impact on the activities of SÚRAO.

2.4 Additional Criteria (hereinafter referred to as DNSH = "do no significant harm")

2.4.1 Criterion 4

Transition to a circular economy

A plan for the management of both non-radioactive and radioactive waste is in place and ensures maximal reuse or recycling of such waste at end of life in accordance with the waste hierarchy, including through contractual agreements with waste management partners, the reflection in financial projections or the official project documentation. During operation and decommissioning, the amount of radioactive waste is minimised and the amount of free-release materials is maximised in accordance with Directive 2011/70/Euratom, and in compliance with the radiation protection requirements laid down in Directive 2013/59/Euratom.

A financing scheme is in place to ensure adequate funding for all decommissioning activities and for the management of spent fuel and radioactive waste, in compliance with Directive 2011/70/Euratom and Recommendation 2006/851/Euratom. An Environmental Impact Assessment is completed prior to the construction of a nuclear power plant, in accordance with Directive 2011/92/EU. The required mitigation and compensatory measures are implemented. The relevant elements in this Section are covered by Member States' reports to the Commission in accordance with Article 14(1) of Directive 2011/70/ Euratom.

Evaluation:

The amount of low- and medium-level waste (i.e. the material prior to its being declared as waste) is minimised by the waste generator on the basis of *best available technologies* (hereinafter referred to as "BAT") and the adopting of an economic approach. During the operation and decommissioning stages, the amount of radioactive waste is minimised by releasing that radioactive material that meets the criteria for release into the environment; such material is not treated as radioactive waste and is either recycled or disposed of in landfill sites.

In the case of spent fuel, the decision whether to recycle is that of the waste generator based on economic considerations.

With concern to financing systems, all decommissioning activities and the management of spent fuel and radioactive waste are financed in accordance with Directive 2011/70/Euratom and Recommendation 2006/851/Euratom, see Criterion 1.

Identified impact: No impact on the activities of SÚRAO.

2.4.2 Criterion 5

Pollution prevention and control

Non-radioactive emissions are within or lower than the emission levels associated with the best available techniques (BAT-AEL) ranges set out in the best available techniques (BAT) conclusions for large combustion plants. No significant cross-media effects occur.

For nuclear power plants greater than 1 MW thermal input but below the thresholds for the BAT conclusions for large combustion plants to apply, emissions are below the emission limit values set out in Annex II, part 2, to Directive (EU) 2015/2193.

Radioactive discharges to air, water bodies and ground (soil) comply with individual licence conditions for the specific operations, where applicable, and/or national threshold values in line with Directive 2013/51/Euratom and Directive 2013/59/Euratom.

Spent fuel and radioactive waste is safely and responsibly managed in accordance with Directive 2011/70/Euratom and Directive 2013/59/ Euratom.

An adequate capacity of interim storage is available for the project, while national plans for disposal are in place to minimise the duration of interim storage, in compliance with the provision of Directive 2011/70/Euratom that considers radioactive waste storage, including long-term storage, as an interim solution, but not an alternative to disposal.

Evaluation:

From the viewpoint of radioactive waste management, according to the Concept, the RAW storage capacity for current production needs is ensured by the respective waste generator. The national storage plan is represented by the Concept.

Identified impact: No impact on the activities of SÚRAO.

2.5 Summary

The Czech Republic and the energy company ČEZ a.s. welcome the fact that nuclear energy was included in the Taxonomy for activities with sustainable financing under the defined conditions, so that the operation of existing and future/new nuclear sources fulfils the sustainability conditions set by the Commission. The text is, however, considered to represent a rather fragile compromise. The proposed criteria in their full form do not take into account the conditions advocated by the Czech Republic in bilateral negotiations; nevertheless, the

Czech Republic did not raise any objections in the context of discussions on the Delegated Act. Sustainability status is proposed by the Commission for all new nuclear sources that obtain a licence up to 2045 and for existing nuclear sources that obtain a licence/notification of modifications to extend operation up to 2040. The criteria that follow from the notification of investment plans under Article 41 Euratom require a plan for the start of operation of a deep geological repository up to 2050 with a detailed outline of the various stages and technical solutions involved, which, in turn, requires the modification of the Radioactive Waste and Spent Fuel Management Concept in the Czech Republic based, *inter alia*, on this study.

The following were identified as the criteria that affect the activities of SÚRAO:

Points 4.27 1e and 4.28 1e: The Member State has under operation a facility for the final disposal of all very low-, low- and intermediate-level radioactive waste as notified to the Commission under Article 41 of the Euratom Treaty or Article 1(4) of Council Regulation (Euratom) 2587/1999, as included in the respective national programme updated according to Directive 2011/70/Euratom.

Furthermore, impacts on SÚRAO's activities were identified for criteria 4.27 1f and 4.28 1f: the Member State has a documented plan with detailed steps to have in operation, by 2050, a disposal facility for high-level radioactive waste describing all of the following:

> i) concepts or plans and technical solutions for spent fuel and radioactive waste management from generation to disposal;
>
> ii) concepts or plans for the post-closure period of a disposal facility's lifetime, including the period during which appropriate controls are retained and the means to be employed to preserve knowledge of that facility in the longer term;
>
> iii) the responsibilities for the plan implementation and the key performance indicators to monitor its progress;
>
> iv) cost assessments and financing schemes

For the purposes of point (f), Member States may use the plans drawn up as part of the national programme required by Articles 11 and 12 of Directive 2011/70/Euratom.

The final influencing factor concerns the obligation to provide reports as part of the fulfilment of Criterion 4:

The Member State concerned has undertaken to report to the Commission every five years on all of the following issues for each project:

a) the adequacy of the accumulated resources referred to in paragraph 1 c);

b) actual progress in the implementation of the plan referred to in paragraph 1 f).

On the basis of the reports, the Commission shall review the adequacy of the accumulated resources of the radioactive waste management fund and the nuclear decommissioning fund referred to in point 1(c) and the progress in the implementation of the documented plan referred to in point 1(f) and it may address an opinion to the Member State concerned.

3 The management of low- and intermediate-level waste from the operation of nuclear power plants

Based on the evaluation conducted in Chapter 2, it is necessary to prove that condition e) is met, i.e. that the Member State has a functional facility for the disposal of all very low-, low- and intermediate-level waste, as set out by the Commission under Article 41 of the Euratom Treaty or Article 1(4) of Council Regulation 2587/1999, and that it is included in the national programme according to Directive 2011/70/Euratom.

3.1 Description of the current situation

Currently, low- and intermediate-level waste is disposed of at the Richard, Bratrství and Dukovany repositories. Low-level waste generated from the operation of nuclear power plants is disposed of at the Dukovany repository, whereas the Richard repository is used for the disposal of intermediate-level so-called institutional waste.

According to the Atomic Act, the Dukovany repository is classified as a nuclear facility and a category IV workplace for low-level waste. It is located in the eastern part of secured area of the Dukovany nuclear power plant (hereinafter referred to as “NPP”). It is used for the disposal of radioactive waste from both the Temelín and Dukovany NPPs and will be used for the disposal of RAW from the future decommissioning thereof. Radioactive waste is disposed of in waste disposal packages or in the form of solid waste. The repository currently occupies an area of 13,370 m^2 and consists of two double rows of concrete disposal chambers located on the surface. The total number of chambers is 112. Each chamber has dimensions of 17.3 x 5.3 m, with a height of 5.4 m. The maximum disposal capacity amounts to 55,450 m^3; currently the total free volume of the chambers is approximately 42,260 m^3, which corresponds to a free capacity of 27,314 m^3 following conversion to 200-litre disposal drums, i.e. enough space for the disposal of 136,570 such drums assuming a capacity of 1,600 drums per chamber (Dobrev et al. 2022).

3.2 Evaluation of the disposal capacity for existing and new nuclear sources

Current estimates of the filling of the Dukovany repository (as summarised by Dobrev et al. 2022) assume the disposal of RAW from the sixty-year operation of currently operational nuclear sources and one new nuclear source (the volume estimates were determined on the basis of production from the Temelín NPP). The filling predictions also take into account the disposal of radioactive waste from NPP decommissioning and a reserve for the disposal of institutional radioactive waste. According to the Concept, the capacity will be sufficient for this volume of waste.

In the case of the construction of other new nuclear sources (in total, the disposal of radioactive waste from the operation and decommissioning of existing nuclear sources and three new nuclear sources) as stated in the updated State Energy Concept, the prediction of the filling of

the Dukovany repository is shown in Fig. 1. At the given rate of filling, current capacity will be sufficient up to 2092. According to a study by Dobrev et al. (2022), it would then be necessary to expand the disposal capacity by 35 new chambers to enable the disposal of all the radioactive waste expected from the operation of the country's NPPs, including three new nuclear sources (hereinafter referred to as "NNS"). The prediction includes the earmarking of 2 chambers for the disposal of institutional radioactive waste and 7 chambers for radioactive waste from the reconstruction work involved in extending the lifetimes of the NPPs to 60 years and other unforeseen events.

According to Dobrev et al. (2022), one of the approaches to ensuring sufficient capacity for the disposal of radioactive waste from the operation and decommissioning of the NPPs, including future NNS, involves the expansion of the Dukovany repository via the construction of a third double row with the same parameters as the existing double rows. This would result in the expansion of the capacity by 56 new chambers in two rows of 28. This capacity would cover the expected amount of radioactive waste for disposal with a substantial reserve.

Concerning the very low-level waste category, a study by Trtílek et al. (2020) pointed out the fact that in view of the very low amount of such waste currently produced it will not be necessary to build a special repository for this type of RAW in the near future. This type of waste will continue to be disposed of in existing disposal facilities. However, the need to build a repository for this category of radioactive waste may arise in the future as a result of the decommissioning of NPPs or following the updating of the estimated inventory of RAW that will be generated by new nuclear sources.

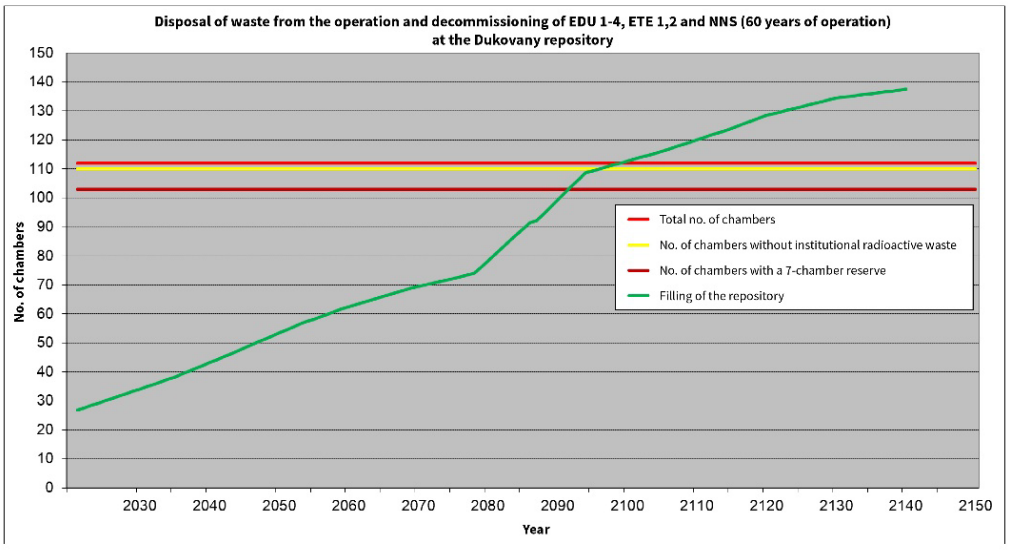

Fig. 1 Prediction of the rate of the filling of the Dukovany repository (according to a study by Dobrev et al. 2022)

3.3 Proposal of measures

In 2050, sufficient capacity will be available for the disposal of radioactive waste from the operation and eventual decommissioning of existing nuclear sources (depending on the period of operation of these nuclear sources and the decommissioning option selected), as well one NNS. In the event of the construction of other NNS, it will be necessary to plan the expansion of the capacity of the Dukovany repository or the construction of another (near-)surface repository well in advance, or alternatively to investigate the potential for the disposal of this type of RAW in the future deep geological repository. The respective measure involves the conducting of a study on the further use of the Dukovany site as part of the fulfilment of the currently valid Medium-term Research and Development Plan of SÚRAO (Vokál et al. 2020). A further measure in this respect concerns the preparation of a separate study on the prediction of the amount, and proposal for the disposal, of very low-level waste.

4 The management of SF and other high- and intermediate-level RAW

4.1 Identified Conditions

Based on the evaluation provided in Chapter 2 of this study, SÚRAO's activities are affected by the following condition in points 4.27 and 4.28, i.e. point 1f:

f) the Member State has a documented plan with detailed steps to have in operation, by 2050, a disposal facility for high-level radioactive waste describing all of the following:

i) concepts or plans and technical solutions for spent fuel and radioactive waste management from generation to disposal;

ii) concepts or plans for the post-closure period of a disposal facility's lifetime, including the period during which appropriate controls are retained and the means to be employed to preserve knowledge of that facility in the longer term;

iii) the responsibilities for the plan implementation and the key performance indicators to monitor its progress;

iv) cost assessments and financing schemes.

For the purposes of point (f), Member States may use the plans drawn up as part of the national programme required by Articles 11 and 12 of Directive 2011/70/Euratom.

According to the evaluation provided in Chapter 2 of this study, the greatest impact on SÚRAO's activities concerns the requirement to have a plan that considers the commencement of operation of the deep geological repository in 2050, concerning which the conditions can be divided into two groups. The first group consists of the specific technical prerequisites and the various stages involved in the following activities:

- selection of a final and a back-up site for the deep geological repository, characterisation of the sites
- safety documentation and the related research and development
- research and development of the engineered barriers and the development of the disposal concept
- construction preparations and a project design solution
- operation of the nuclear facility.

The second group concerns the requirements and deadlines related to the relevant main permission and administrative processes.

This concerns processes that are related in particular to the following regulations, as amended

- the Atomic Act No. 263/2016 Coll., as amended (hereinafter also referred to as the "Atomic Act" or "Act No. 263/2016 Coll."),
- the Geological Act No. 62/1988 Coll., as amended,
- the Environmental Impact Assessment Act No. 100/2001 Coll., as amended,
- the Building Act No. 283/2021 Coll., as amended,

- the Mining Act No. 44/1988 Coll., as amended,
- Act No. …/2022 Coll., on a unified environmental position (currently under discussion by the Chamber of Deputies of the Parliament of the Czech Republic).

Chapters 4.2 and 4.3 of this study provide descriptions of the optimisation of the deep geological repository development programme in terms of the technical conditions and administrative processes, and the proposed schedule of these activities (Chapter 4.9, Annex 2).

4.2 Description of the current state of the technical design solution for the deep geological repository

The technical design of the Czech deep geological repository is based on the assumption of the disposal of all SF and other high- and intermediate-level waste generated in the Czech Republic that does not meet the acceptability conditions for disposal in the country's existing repositories. The deep geological repository will consist of a surface service infrastructure, a so-called hot chamber for the transfer of SF and other high- and intermediate-level waste into waste disposal packages, and underground areas for the disposal of SF and other RAW (Holub et al. 1999, Pospíšková et al. 2011). The concept for the disposal of SF comprises its direct disposal in a rock environment at a depth of several hundred metres in metal disposal packages, which will be surrounded by a damping layer of bentonite, i.e. the so-called buffer; the waste packages will be emplaced either vertically or horizontally (Pospíšková et al. 2011). The remaining free space in the underground complex will then be filled (sealed) using bentonite or a mixture of bentonite and aggregate. Concerning other RAW, it is assumed that the waste will also be disposed of in waste disposal packages emplaced in disposal chambers that will be filled with a backfilling material. The extent of the disposal inventory and the amount of anticipated waste are verified and updated on a regular basis (Touš 2017). From the technical point of view, the development of the Czech deep geological repository is described in SÚRAO internal document S.36. With regard to the preparation of new amendments to existing and future legislation[1], it will be necessary to continuously modify the S.36 internal document. In view of the afore-mentioned aspects, the following two phases have been defined:

Phase 1: Site selection, in which a final site and a backup site will be defined based on the characterisation of the existing candidate sites and an assessment process that will serve to reduce the present number of sites considered. This phase will be concluded with the selection

[1] The process of the adoption of new relevant legislation is currently underway:

a) A draft Act amending Act No. 283/2021 Coll., the Building Act, and certain other related Acts (submitted to the Parliament of the Czech Republic, reg. no. 330/0);

b) A draft Act on a unified environmental position (submitted to the Parliament of the Czech Republic, reg. no. 328/0) and a draft Act amending certain other Acts related to the adoption of the Act on a unified environmental position (submitted to the Parliament of the Czech Republic, reg. nos. 328/0 and 329 /0)

of the final site and the determination of a protected area for special intervention into the earth's crust.

Phase 2: Preparations for the issuance of the relevant administrative decisions concerning the design and engineering-related activities and the processes that must be followed in order to obtain the relevant licences related to the provisions of the Atomic and Building Acts and procedures related to the environmental impact assessment and the issuance of a unified environmental position, as well the purchasing of land.

The information and procedures involved in the implementation of subsequent stages of the programme and the obtaining of the relevant licences (related to the commissioning and operation of the deep geological repository nuclear facility) have not yet been considered in detail in the technical plans due to the considerable uncertainty in terms of planning at the current stage of the deep geological repository development process; it is assumed that these aspects will be planned in more detail once the final site has been selected.

The schedule for, and the general principles governing, the development of the deep geological repository are set out in the Management of RAW and SF Concept, which will have to be modified with regard to new terminology introduced in the new Building Act. In the case of an application to amend the schedule, it will be necessary to revise the Management of RAW and SF Concept, primarily in terms of the procedures, processes and activities, the method for the selection of the final and back-up sites, research and development aspects and other related principles included in the schedule.

The following text provides a description of the conditions that must be met in order to at least begin the process of putting the deep geological repository into operation in 2050. Two types of conditions are involved in this respect, i.e. technical conditions, which set out the requirements for the technical development of the project, and permission and administrative conditions, which concern the various licences required and serve for the estimation of the period of time that will be needed prior to the commencement of the operation of the deep geological repository in 2050.

4.3 Optimisation of the development of the deep geological repository in terms of the technical conditions

4.3.1 Selection of a final site and a back-up site for the deep geological repository, site characterisation

Research objectives: The implementation of activities aimed at determining a suitable rock block, the selection of the final and back-up sites and the compilation of the documentation required for the reservation of the area (protected area for special intervention into the earth's crust). Following the selection of the final and back-up sites, the characterisation work will be aimed at providing support information for the subsequent permission application processes (the siting, construction and operation of the deep geological repository).

Solution approach: The selection of the final and back-up sites and the locations of the various surface areas of the deep geological repository will be performed based primarily on the data obtained from the characterisation of the sites, principally via geological research (e.g.

detailed geological mapping) and geological exploration work that includes targeted (deep) drilling according to the Geological Act, No. 62/1988 Coll. An exploratory area for special intervention into the earth's crust will be established primarily for the purpose of verifying the characteristics of the respective site (in accordance with Vondrovic et al. 2020) via the drilling of deep boreholes only. The site selection process will be based mainly on the application of criteria related to the impact of the deep geological repository on the environment and the most important safety criteria as indicated by the data obtained (in accordance with Vondrovic et al. 2020).

Following the selection of the final and back-up sites and the determination of a protected area, the characterisation of the site will continue mainly via mining work at the site in the form of detailed survey and follow-up research, which, following its completion, will serve to support the relevant licence application processes.

Conditions: A change in the site selection method as set out in the current Concept (chapter 8.4) and a positive opinion issued by the Ministry of the Environment (MoE) regarding the implementation of geological research and survey work (i.e. a positive decision from the MoE regarding the determination of the exploration area for special intervention into the earth's crust) and a positive opinion from the SÚJB regarding the method for the selection of the final and back-up sites (without the safety documentation for the siting of a nuclear facility, see the section: Preparation of the safety report).

A positive decision by the MoE on the determination of the exploration area must be valid for all the stages involved in the geological exploration work (including the exploratory mining work). In terms of the time frame, the geological survey work should commence no later than shortly after 1 January 2023 (including the detailed mapping work) and the geological survey work no later than January 2024, with the completion of the fieldwork for the selection of the final and back-up sites no later than mid-2027.

From the point of view of the technical conditions, it will be necessary to gradually strengthen SÚRAO's personnel base in the geological barriers and project activities departments in accordance with expected further developments when attaining the various milestones of the programme (for example, following the selection of the final and back-up sites). Personnel requirements will be addressed according to the approved programme and notified in SÚRAO's plans of activities that are submitted for approval to the government on an annual basis. A further condition concerns the updating of SÚRAO's research and development plan, including the addition of sections on topics that have not yet been addressed, but which will be clarified following the selection of the final and back-up sites (e.g. activities related to the underground mining exploration work and the precise location of the nuclear facility).

4.3.2 Safety documentation and the related research and development

Research objectives: The aim of the work is to fulfil all the requirements of the Atomic Act with concern to the relevant licence procedures (in particular, the siting, construction, and operation of the deep geological repository and a licence for the handling of radioactive waste). The main aim during the preparatory phase prior to submitting an application for the siting of the facility will be to conduct the research and development (R&D) necessary for implementing

the nuclear safety assessment procedures relevant to the deep geological repository and to establish a sufficiently robust database for the compilation of the required safety analyses.

Solution approach: The preparation procedure (documentation for obtaining the relevant licences and the compilation of safety reports) is described in SÚRAO's R&D plan (Vokál et al. 2020), which assumes the commencement of the operation of the deep geological repository in 2065. The priority in this respect concerns the safety assessment of the existing disposal concept for the assumed conditions of a crystalline rock environment in the form of the so-called commissioning safety report. This assessment should be available in 2026. Since no detailed site descriptive models concerning the location of the deep geological repository will be available at this time, the subsequent stage of the research will concentrate on the preparation of the documentation required in this respect. Following the selection of the final and back-up sites, documentation will be prepared for obtaining the licences required for the siting of the deep geological repository based on the detailed characterisation of the final site. The procedure for the preparation of follow-up safety reports (preliminary, operational) will be adjusted via the updating of SÚRAO's R&D plan.

In general, it can be stated that bringing forward the date of the commencement of operation of the deep geological repository to 2050 significantly reduces the time available for the design, development, production and verification of the safety of the various components of the repository. It is probable that the priorities of the R&D plan will have to be adjusted so as to meet the 2050 commencement of operation date and to focus to a greater extent on adopting the results of R&D that has already been conducted on the various repository components/technologies in countries that are on the verge of opening their deep geological repositories (Sweden, Finland). However, due to differences between the geological environments of these countries and the Czech Republic, it will not be possible to simply adopt all of the results of their R&D programmes. In many areas, the R&D plan will remain unchanged; however, the priorities in other areas will change significantly. One of the biggest changes will concern a change in the project management approach via the introduction of a strict, project-based approach to the deep geological repository project. This approach will require, in particular, the updating of the management of both the human and financial resources available. Furthermore, it will be necessary to update those guidelines that directly concern the repository project, to introduce a requirements-based management system taking into account legislative requirements, and a data and information management system. R&D work will have to be prioritised so that those items that are critical to achieving the required milestones (the selection of the final and back-up sites, completion of the R&D of the engineered components) are addressed. Major decisions regarding the safety and technical concepts of the repository will need to be made as soon as possible.

Conditions: The conditions for the above solution approach comprise a discussion on the selected procedure with, and recommendations from, the SÚJB (on the basis of the concluded Cooperation Agreement in the field of the development of the deep geological repository), the updating of the relevant parts of the Concept and obtaining a sufficiently robust database for the purposes of the assessment of safety for each of the authorisation processes according to the details defined in the Atomic Act. The solution approach is conditional on increases in personnel capacity with respect to the approved systemisation in the safety assessment department of SÚRAO. A further condition consists of the updating of SÚRAO's R&D plan, including the addition of sections on those areas that have not yet been considered in detail,

and which can only be addressed following the selection of the final and back-up sites (e.g. the compilation of a safety report on the commissioning of the repository).

4.3.3 Research and development of the engineered barriers and the development of the disposal concept

Research objectives: The aim of the research concerns the development and verification of the engineered barriers and selected deep geological repository components, the production thereof and the generation of the data required for the various licensing and administrative processes involved.

Solution approach: Bringing forward the date of commencement of operation of the repository to 2050 significantly reduces the time available for the design, development, production and verification of the safety of the repository components (in particular, the waste disposal package, the buffer and the sealing layer). The technological readiness level of the various engineered components and technologies, including alternative approaches, will have to be newly defined. Moreover, these components and technologies will have to be subjected to intensive testing under in-situ conditions (at the Bukov URF) with the gradual introduction of the newly-acquired procedures and knowledge into the planning and operation of the underground characterisation facility to be located at the final site (or into the underground exploration work) from 2035 at the latest. A further step will concern the definition and validation of procedures for the testing, manufacturing and emplacement of the engineered components. An integral part of the process in the pre-licensing phase will comprise the establishment of an effective method of communication with the regulatory authority. For the purposes of optimising the process of fulfilling the various objectives of the R&D plan in the current period (2020-2025), the number of tested SF disposal concept variants will be reduced (Dohnálková et al. 2022). A further possible alternative comprises the evaluation of only those disposal concepts that passed the safety evaluation process in other (foreign) deep geological repository programmes (e.g. Posiva 2012).

Conditions: The conditions of the design solution approach consist of the intensive development of all the engineered components and other structural elements, the development of the relevant schedules and technical readiness levels, the verification of the technology required for the production of the components, and mass production including in-situ testing under underground conditions. One of the essential conditions concerns the intensification of activities at the Bukov URF by SÚRAO via the hiring of highly-qualified personnel and the application of mining exploration procedures at the final site. Further necessary conditions include the hiring of new personnel in the engineered barriers department and the updating of SÚRAO's R&D plan, including the addition of sections on those areas that have not yet been considered in detail, and which can only be addressed following the selection of the final and back-up sites (e.g. the emplacement technology, closure, production of the waste disposal packages, etc.).

4.3.4 Construction preparations and the project design solution

Research objectives: The application of all the activities related to the design of the deep geological repository, including planning permission and the EIA process (including a unified environmental position) and, subsequently, the construction of both the surface and underground complexes.

Solution approach: Site studies will be prepared for the selection of the final and back-up sites that focus primarily on the surface area and the access infrastructure. Furthermore, the relevant studies related to the evaluation of the technical and environmental criteria and the provision of input data for the safety assessment of the disposal concept will be updated. Following the selection of the final and back-up sites, construction preparation and project design work will focus primarily on meeting the requirements of the relevant licensing and administrative procedures (the EIA, the unified environmental position, the siting of the nuclear facility according to the Atomic Act and framework/project licences). This will be followed by the settlement of property rights and the delineation of both sites in the respective territorial planning documentation. Aimed at refining the design of the facility, underground exploration work will be conducted at the final site in the form of geological (mining) exploration work. This will be followed by the construction of the underground disposal and the surface complexes, including the auxiliary operation elements of the facility and the specifically nuclear facility-related components (the hot chamber and the SF and high- and intermediate-level disposal areas – expressed in the terminology of the upcoming amendment to the Building Act, see Chapter 4.2, as follows: the nuclear facility buildings and related buildings located inside and outside the nuclear facility). Up to this time, the project preparation and technology development procedures for the various components (the surface area, the waste transfer hub, the underground access infrastructure and the SF and high- and intermediate-level disposal areas) will continue.

Conditions: The conditions of the solution approach consist of the preparation of detailed schedules for the preparation of the various components in the deep geological repository complex in accordance with the new Building Act and the current version of the Atomic Act (for selected equipment in the various components of the complex according to the Atomic Act). The commencement of intensive preparations for construction and the phasing and detailed design thereof and the development of a detailed work schedule. The construction work will also depend on securing the ownership of the land.

4.3.5 Preparations for the operation of the nuclear facility

Research objectives: The granting of a licence for the commissioning of the nuclear facility (the deep geological repository) and its operation.

Solution approach: This issue has not yet been addressed in SÚRAO's plans or other strategic documents prepared in connection with the expected commencement of operation of the repository in 2065. The essential conditions for the commencement of operation include the construction of the underground disposal complex and the completion of the research and development of the various components thereof, their verification and industrial production (the waste disposal package and the damping and sealing layer). As part of the updating of the R&D plan, it will be necessary to provide detailed descriptions of all these aspects and to define

the key milestones in the development of the various components of the repository (e.g. the waste disposal package, the damping and sealing layer, the waste transfer node, etc.) including requirements related to the licensing management system and the related verification processes.

Conditions: The updating of the R&D plan, preparations for initialising the research of issues planned for the period following the selection of the final and back-up sites, definition of the stages involved in the preparation of projects on the various components (technical readiness level).

4.3.6 Communication

Communication of the development of the deep geological repository following the changes associated with the new Taxonomy will be directed towards both the general public and the directly affected municipalities and regions.

The communications strategy will focus both on the expected new Taxonomy and the continuation of communication activities concerning the Concept and the requirements of the Atomic Act.

The basic thesis of the communications approach is to stress the safe and responsible management of radioactive waste that is generated in the Czech Republic. Disposal in deep geological repositories is currently the only internationally and scientifically recognised approach to the isolation of nuclear waste from the environment. In this respect, the first SF and high-level waste disposal variant (disposal in a deep geological repository), as mentioned in the Concept in Chapter 8.2, should be prioritised, and other storage/disposal alternatives that do not provide a final solution should be assessed over longer-term cycles than the time period specified in section 2.3.2, e.g. in the case of the development of commercially viable and authorised best available technologies that result in the operationally and economically advantageous disposal of SF and high-level waste.

1. the general public – the changes that the Taxonomy will bring about in terms of the development of the Czech deep geological repository; to explain the changes in the process and to present the various stages involved in the field of research and development.

2. the municipalities and regions concerned – both the municipalities and higher level local authorities (regions) should be more intensively involved in the communication process relating to the search for a final site for, and the subsequent construction of, the deep geological repository. This process should be supported by an Act of Parliament, currently in the preparation stage, on management related to the deep geological repository for radioactive waste, which follows on from section 108, paragraph 4 of Act No. 263/2016, the Atomic Act, as amended, and which has already been discussed by the Legislative Council of the Government and will be further discussed at government meetings in the coming months.

Local working groups and other communication channels

Communication through so-called local working groups should be intensified with the active participation of the respective regional authorities. Such groups allow for a rapid response to

the requirements of the affected municipalities and regions and, in the case of such groups in Switzerland, the involvement of all the participants in terms particularly of determining the form and location of the surface area of the repository.

Given that some of the municipalities involved have, for many years, refused any approach to working with SÚRAO, it would be appropriate to consider whether other interested parties should be invited to participate in the discussion process (as in other countries, e.g. the relevant ministry, the regulatory authority, representatives of the Parliament of the Czech Republic or the Academy of Sciences or other, inter-disciplinary, commissions), with SÚRAO's participation related solely to its clearly-defined responsibilities based on the Concept and the Atomic Act. This approach has been successfully applied in other European countries, where the discussion process is not coordinated by the organisation that is responsible solely for the technical aspects of the deep geological repository. This procedure would be enhanced in the case that the concerns of the affected municipalities with respect to the construction of the deep geological repository in their cadastral areas might be compensated for by, for example, the construction of noise barriers, bypasses, etc. SÚRAO has no authority to provide financial resources or to manage the construction of such structures; however, agreement on, and compliance with, local requirements has the very real potential to enhance communication between the state and the municipalities directly concerned.

Expert advisory panel

During the evaluation stage and the subsequent selection of the final and back-up locations it would be appropriate to include the participation of an expert advisory panel, which proved invaluable in the process of the reduction of the candidate sites from nine to four. The panel should be made up of representatives of the relevant state institutions and organisations, local municipality representatives and experts. If necessary, the panel of experts could also provide a framework for addressing expert issues above the level of local working groups, see the previous point.

Activities

SÚRAO should continue to present its operational repositories to the public with an emphasis on their safety and the regular monitoring of their surroundings. Moreover, activities such as presentations for students, open days and the SÚRAO summer school, etc., which contribute to increasing awareness of the issue of radioactive waste generated in the Czech Republic, should continue and be expanded. Such activities should also focus on the candidate sites for the deep geological repository with the presentation of the stages involved in its development, construction and operation However, the expansion of these activities will require the strengthening of the personnel capacity of the communications department of SÚRAO, a matter that should be addressed in the context of the annual plan of activities that must be submitted to the government for approval.

4.4 Optimisation of the programme in terms of the main administrative procedures

4.4.1 Authorisation procedure for the selection of the final and back-up sites for the deep geological repository

This chapter describes the key licensing processes and technical prerequisites concerning the process of putting the deep geological repository into operation in 2050. The licensing processes are divided into the site selection phase and preparations for the siting of the various buildings, including the preparation of the buildings.

The procedures listed below have been initially addressed taking into account the expected (see chapter 4.2) state of the relevant legislation. As part of subsequent follow-up studies, the various details and scheduling will be considered in greater detail and updated in line with the ongoing implementation of the proposed updated schedule in SÚRAO's S.36 internal document.

Determination of an exploration area for special intervention into the earth's crust

Description: This procedure is based on the requirements of Act No. 62/1988 Coll., on geological work, as amended. One of the essential conditions concerns an application for the determination of an exploration area according to section 4a of the Act. The output comprises a decision issued by the MoE on the determination of an exploration area for special intervention into the earth's crust, which enables the performance of geological research in the form of a geological survey within the set period and under the given conditions. The conducting of the geological survey, its successful outputs and the submission of the relevant application is a necessary condition for the subsequent MoE procedure and decision on the determination of protected areas for special intervention into the earth's crust (or the procedure for the determination of a protected deposit area) and is specified in paragraphs 1 to 8 of section 17 of Act No. 44/1988 Coll., on the protection and use of mineral resources, as amended. An exploration area will also be determined for the construction phase of the underground characterisation workplace and will, therefore, include all the relevant stages of the exploration process (search, exploration and detailed exploration according to the Geological Act).

Output: Determination of an exploration area for special intervention into the earth's crust (in all stages). The outcome of this procedure forms an essential prerequisite for the determination of a protected area for special intervention into the earth's crust and the commencement of excavation work for the underground characterisation workplace (one of the stages of the detailed geological survey).

Deadline: Obtaining a licence - a positive decision from the MoE on the determination of an exploration area for special intervention into the earth's crust by 1 January 2024 at the latest; the application should be submitted by the beginning of 2023 at the latest.

4.4.2 Licensing procedure for the siting of the deep geological repository

Protected area for special intervention into the earth's crust and its inclusion in the territorial development policy and the respective territorial planning documentation

Description: The purpose of this procedure is to determine a protected area for special intervention into the earth's crust for the disposal of radioactive waste in underground areas (hereinafter referred to as the "protected area") for the final deep geological repository site. This will result in the protection of the defined area in the context of its suitability for the purpose of disposing of radioactive waste. The determination of a protected (deposit) area for special intervention into the earth's crust is governed by paragraphs 1 to 8 of section 17 of Act No. 44/1988 Coll., on the protection and use of mineral resources (the Mining Act), as amended.

The consideration of protected areas in the territorial development policy and in the subsequent territorial planning documentation will be governed by the amended Building Act (with the concurrent application of section 73, paragraph 3 of the Act).

Output: A decision from the MoE on the establishment of a protected area for special intervention into the earth's crust according to section 17 of Act No. 44/1988 Coll., on the protection and use of mineral resources (the Mining Act), as amended.

Deadline: Obtaining a positive decision from the MoE on the designation of a protected area by 1 January 2029 at the latest

The territorial requirements of the surface areas and the transport connections thereof in the territorial development policy and subsequent territorial planning documentation

Description: The purposes of updating the territorial development policy and subsequent changes to the territorial planning documentation (state, regional and municipality levels) will be to resolve any territorial claims and to address the territorial context of the surface area of the final site.

This process will then form (following the legislation in force at the time) one of the basic inputs for the settlement of land property issues concerning the construction of the surface complex and its connection to the transport infrastructure.

Output: The delineation of the surface area and its connection to the transport network in the context of the territorial development policy.

Deadline: No later than 1 January 2029.

The EIA according to Act. 100/2001 Coll., on environmental impact assessment (the EIA Act)

Description: The assessment of the environmental impact of the deep geological repository construction plan (the EIA process) is governed by Act No. 100/2001 Coll., on environmental impact assessments, as amended. The process for assessing the effects of the repository on the environment is based on the systematic investigation and assessment of the potential impact of this construction on the environment[2].

The deep geological repository is included in Annex 1 of the EIA Act in category I, i.e. items that must always be subject to an environmental impact assessment. Given the importance of the project, it can be expected that section 13 of the EIA Act will apply to the plan for the construction of the repository, i.e. the international assessment of a plan to build a facility in the Czech Republic. The time required for the process in its entirety, including the international assessment concerning other affected countries to the extent set by the MoE (section 13(1) of the EIA Act), is estimated at a maximum of 4 years.

Output: The output of the process will comprise the conclusion from the investigative procedure, an expert opinion and the issuance of the binding opinion of the MoE. This output is a necessary condition for the follow-up procedure, which will concern the licensing process, i.e. a framework licence according to the Building Act (which will be clarified later) and, possibly, a unified environmental position.

Deadline: Start no later than 1 January 2029; end of the process no later than 31 December 2033.

Settlement of land property rights

Description: For the needs of the underground mining exploration work and preparations for obtaining the project licence, it will be necessary to ensure the purchase, or the consent of the owners, of the land in question (section 187 of the Building Act). In the case of non-purchased land, the owners of the land will become participants in the licence proceedings (section 182).

Ideally, the resolution of the property issue will consist of the purchase of the land. The acquisition of land rights can be accelerated in a number of ways. Currently, extensive discussions are underway on the preparation of favourable legislative conditions for the siting, licensing and operation of low-carbon energy production buildings, as well as on the approach to achieving this aim (e.g. by amending or expanding Act No. 416/2009 Coll., on the acceleration of the construction of transport, water and energy infrastructure and the electronic

[2] The intention to construct the deep geological repository according to the EIA Act may also be the subject, or part of the procedure, according to the draft law on a unified environmental position, which is currently under preparation (see chapter 4.2). Since the opinion under the EIA Act can be expected to take a relatively long time and, moreover, the Unified Environmental Position Act has not yet come into force, the conservative approach is to expect that the two proceedings under the EIA Act will be conducted separately. Follow-up studies will be compiled for decision-making on whether the EIA process will be conducted independently of the requirements of the Unified Environmental Position Act as part of the ongoing update of the SÚRAO S.36 internal regulations document, at the latest during the final site selection period.

communications infrastructure, as amended, or the "Line Act", in which these conditions would be enshrined). However, since the preparation of such legislative conditions is at an early stage, for the purposes of this study it is more appropriate to consider the option of expropriation (compulsory purchase) according to Act No. 184/2006 Coll., as amended, or draft legislation on expropriation (Ministry for Regional Development)[3]. The approach to the acquisition of land rights will be addressed according to current needs and the project schedule, and will be specified following the selection of the final site.

Output: The output will comprise the consent of the respective land owners in accordance with the requirements of the Building Act, where possible.

Deadline: Start no later than 1 January 2030.

Licensing for mining activities and the realisation of exploration work

Description: This issue concerns obtaining a licence from the District Mining Office for the purpose of special intervention into the earth's crust, including a geological survey conducted applying mining methods. The requirements governing an application for a mining permit are set out in section 6 of Czech Mining Office Decree No. 104/1988 Coll., on the rational use of deposits and on the licensing and reporting of mining activities, as amended, The applicant must substantiate the application with documentation according to Annexes 9, 10 and 12 and other documentation specified in section 6 (3) of Decree No. 104/1988 Coll. The application must be submitted to the relevant District Mining Office in two copies.

Output: Addressing this issue is a necessary condition for the implementation of investigative mining work. The output will comprise a licence for mining activities according to section 8 of Decree No. 104/1988 Coll. The total time required for the process is 1 year.

Deadline: Obtaining of a licence no later than 1 January 2031.

Siting licences according to section 9 (1a) of the Atomic Act

Description: Details of the application process are listed in section 16 of the Atomic Act. The application is accompanied by the documentation listed in Annex No. 1 to the Atomic Act, article 1a). The total time requirement of the process is expected to be at least 12 months from the start of proceedings.

Output: A licence to site a nuclear facility according to the Atomic Act.

Deadline: Start of proceedings 2031; securing of authorisation no later than 1 January 2033.

Framework licence (according to section 221 of the Building Act)

An optional (according to a proposed amendment - see Chapter 4.2) step in the process for obtaining a licence for the construction of the deep geological repository concerns the granting

[3] Draft legislation on expropriation (Plan of the legislative work of the government for the remainder of 2022) - no. MMR-54798/2022-31, status as of 25 November 2022: comments procedure.

of a so-called Framework Licence. Concerning the current state of the preparation of the new Building Act, an amendment to the Act is currently being discussed in the Chamber of Deputies, which suggests the availability of such a licence in the case of nuclear facilities and buildings related to them (inside and outside the nuclear facility site) as an optional variant; this process must be addressed in the context of the updating and defining of follow-up studies no later than 2035.

Description: Since this procedure is optional, it will be necessary to proceed with this instrument only if some components or buildings within the nuclear facility area have not been described in the required detail in the earlier (on time) procedure for planning permission. According to Annex No. 2, an example of such a risk concerns the transfer node (hot chamber) project, the development of which cannot be accelerated any further due to the complex nature of the R&D work involved. In order to obtain planning permission that ensures the on-time construction of the other buildings inside and outside the nuclear facility area, it may be advisable to obtain a Framework Licence in advance and, with concern to structures such as the hot chamber, to delineate a part of the nuclear facility area with the maximum parameters and permissible distances for the subsequent obtaining of planning permission for this structure.

Output: Once a Framework Licence has been obtained, the construction office delimits the respective construction area, accompanied by details of the type and purpose of the building concerned and its maximum/minimum spatial parameters, in particular the external floor plan and height limits, the distance between it and other buildings, the boundaries of the land and neighbouring buildings, connections to the transport and technical infrastructure and the limit values for inputs and outputs.

Deadline: Validity no later than 1 January 2037.

Unified environmental position

This draft legislation, which is currently under preparation (see Chapter 4.2 for more details), envisages the adjustment of the procedures and powers of the relevant administrative bodies when issuing a unified environmental position in order to ensure the public interest in terms of the protection of the environment and to contribute to sustainable development when making planning permission decisions according to the Building and/or the EIA Acts.

With regard to the state of preparation of the deep geological repository after 2035, it can be expected that the EIA opinion will be available and that a binding unified environmental position has been issued in place of administrative responsibilities established by other regulations[4].

[4] Assumption of the application of these regulations depending on the choice of the final site

Act No. 114/1992 Coll., on nature and landscape protection, as amended.

Act No. 334/1992 Coll., on the protection of agricultural land, as amended.

Both the constructing party and the construction office are permitted to apply for a unified environmental position or even a specialised and appeals construction authority in the context of planning permission proceedings, including the use of a Framework Licence.

Output: The securing of a unified environmental position in accordance with the opinion on the EIA.

Deadline: Validity no later than 1 January 2037.

4.5 Construction of the deep geological repository

Proceedings for obtaining a construction licence according to section 9 (1b) of the Atomic Act

Description: One of the conditions for the construction of the deep geological repository concerns obtaining a licence from the SÚJB for the construction of a nuclear facility according to section 9 (1b) of Act No. 263/2016 Coll., the Atomic Act, as amended. The details of the application process are listed in section 16 of the Atomic Act. The application is accompanied by the documentation listed in Annex No. 1 to the Atomic Act, Article 1b). Section 21 of the Atomic Act sets out the requirements for obtaining the licence. The licence applicant is the only party to the proceedings (section 19 (1) of the Atomic Act). The Atomic Act allows the issuance of the project licence at an earlier date under the Building Act, provided that the SÚJB provides a statement during the procedure. The two processes may run in parallel. The process of obtaining the data required for the construction licence according to the Atomic Act may commence at an earlier date, i.e. the procedure according to the Atomic Act should commence as early as possible in line with the conservative approach. It is advisable to decide whether the procedures should run simultaneously no later than following the granting of the unified environmental position.

Output: Licence for the construction of a nuclear facility according to the Atomic Act.

Deadline: Validity no later than 1 January 2040

Planning permission (Chapter III of the Building Act)

Description: The management of the planning permission procedure for the construction of the deep geological repository is of key importance in terms of the completion of the facility (assuming that the Framework Licence option is not chosen). All the details of the procedure are governed by the Building Act. During the process of obtaining planning permission, the building authority undertakes a review of whether the construction plan is in accordance with

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Act No. 289/1995 Coll., on forests and on the amendment and addition of certain acts (the Forest Act), as amended.

Act No. 254/2001 Coll., on water resources and on the amendment of certain acts (the Water Act), as amended.

section 193 of the Building Act or whether the fulfilment of the respective conditions can be ensured via the inclusion of conditions in the final planning permission decision. With regard to the ongoing amendment of the Building Act (see Chapter 4.2) and the estimated date for the start of the preparatory work, it is not possible to define these processes in detail at this time. They will be considered as part of a separate study at a later date and incorporated into the SÚRAO S.36 internal directive on an ongoing basis.

SÚRAO will submit the documentation, the content of which and annexes thereto are set out in section 184 of the Building Act.

Output: Decision on planning permission for the construction of the deep geological repository.

Deadline: Validity no later than 31 December 2041.

Considerations regarding the Euratom Treaty

Description: Article 41 of the Euratom Treaty sets out an obligation to notify the Commission of investment plans for new nuclear facilities, as well as for the replacement or conversion of selected existing nuclear facilities. According to Article 42, these plans must be communicated to the Commission and, for information purposes, to the participating Member States, no later than three months prior to the conclusion of initial contracts with suppliers or three months prior to the start of the work if it is to be conducted using one's own resources. According to Article 37 of the Euratom Treaty, SÚRAO is obliged to inform the Commission of plans for facilities for the disposal of radioactive waste so that the Commission can assess the potential cross-border impacts of such facilities.

SÚRAO will submit the documentation, the content of which and annexes thereto are specified in an Annex to Commission Regulation (EC) No. 1209/2000.

Output: A statement from the EU Commission

Deadline: Validity no later than 31 December 2040.

4.6 Licensing procedure for the commissioning and operation of the deep geological repository

Licensing procedure for activities in the field of radioactive waste management (according to section 9 (3a) of Act No. 263/2016 Coll.) and a licence to operate a category IV workplace (according to section 9 (2b) of Act No. 263/2016 Coll.)

Description: Authorisation:

- for activities in the field of radioactive waste management according to section 9, paragraph (3a) of Act No. 263/2016 Coll., the Atomic Act, as amended, on the

management of radioactive waste with the exception of the collection, classification and disposal of radioactive waste directly at its source, which is treated as an open radionuclide source and

- a licence to operate a category IV workplace according to section 9 (2b) of Act No. 263/2016 Coll., the Atomic Act, as amended.

The details of the application are listed in section 16 of the Atomic Act. The application is accompanied by the documentation listed in Annex 1 to the Atomic Act, part 3a).

Output: A licence to manage radioactive waste and a licence to operate a category IV workplace.

Deadline: Up to 31 December 2049.

Approval of the waste disposal package

Description: The approval of the waste disposal package (type D waste disposal package) according to section 137 (1a) of Act No. 263/2016 Coll., the Atomic Act, as amended. The details of the application process are listed in section 16 of the Atomic Act. The application is accompanied by the documentation listed in Annex No. 2 to the Atomic Act (letter a), for example, the detailed technical specification of the waste disposal package including a detailed description of the construction type thereof and further including the construction documentation, complete technical drawings and a list of the materials and technological methods that were used in its production; if it is a waste disposal package that has been approved abroad: proof of its approval, the technological and production documentation with detailed descriptions of the materials and technological methods used in the production of the retardation system and documentation on the related testing, calculations employed and subsequent analyses with independent verification by an authorised person, etc.

Output: Approval of the type D waste disposal package for SF and, potentially, high- and intermediate-level waste.

Deadline: Up to 31 December 2049.

Licence for the introduction into operation of a nuclear facility without a nuclear reactor according to section 9 (1e) of the Atomic Act

Description: The condition for introducing the deep geological repository into operation comprises a licence from the SÚJB for introducing into operation a nuclear facility without a nuclear reactor according to section 9, paragraph (1e) of Act No. 263/2016 Coll., the Atomic Act, as amended. The details of the application are set out in sections 16 and 21 of the Atomic Act. The licence applicant is the only party to the proceedings (section 19 (1) of the Atomic Act). Details of the application process are listed in section 16 of the Atomic Act. The application is accompanied by the documentation listed in Annex No. 1 to the Atomic Act, part 1e). The administrative deadlines are listed in Tab. 1.

Output: Licence to operate a category IV workplace.

Deadline: Up to 31 December 2050.

The administrative deadlines for the various processes according to the Atomic Act are as follows:

Tab. 1 Administrative deadlines related to the commissioning of a nuclear facility

Type of workplace in which RAW is handled	**Life cycle stage**	**Decision of the SÚJB according to sections 9 and 137 of the Atomic Act**	**Deadline for issuing a decision of the SÚJB according to sections 19 and 139 of the Atomic Act**
category IV workplace with a nuclear facility	putting into operation of the nuclear facility	disposal of RAW	90 days
		commissioning of a nuclear facility without a nuclear reactor	6 months
		operation of a category IV workplace	90 days
		Approval of the type of waste disposal package	12 months

Licence for the operation of a nuclear facility according to section 9 (1f) of the Atomic Act

Description: The condition for the operation of a nuclear facility concerns the securing of an SÚJB licence for the operation of a nuclear facility pursuant to section 9 (1f) of Act No. 263/2016 Coll., the Atomic Act, as amended. Details of the application procedure are set out in sections 16 and 21 of the Atomic Act. The licence applicant is the only party to the proceedings (section 19 (1) of the Atomic Act).

Output: Licence for the operation of a nuclear facility.

Deadline: 2053 (after the completion of the commissioning procedure).

4.7 Critical paths of the licensing processes and uncertainty

The general uncertainty in this respect concerns the duration of the various administrative proceedings and the potential for appeals against the outcome of such proceedings, or the interruption thereof. Furthermore, the limited personnel capacity of SÚRAO (and the other

participating bodies, e.g. the SÚJB and SÚRO v.v.i.) for the management of all the technical prerequisites for the successful submission of applications may comprise a limiting factor.

In the case of administrative proceedings related to the determination of exploration areas and protected areas for special intervention into the earth's crust and the implementation of the various stages of the geological survey work, the length of these proceedings and potential appeals will be critical. Based on previous experience, it may take several years for the granting of exploration areas for special intervention into the earth's crust. Concerning the geological research work, a number of critical paths can be eliminated via the conducting of some of the work in the geological survey mode. Applications for the determination of exploration areas should be submitted by the beginning of 2023 at the latest.

In the case of proceedings related to the Atomic Act, the related critical paths concern both the level of preparation of the documentation required according to the annex to Act No. 263/2016 Coll. (a necessary condition for obtaining a licence) and the degree of preparation of the technical design solution of the deep geological repository. Both these issues can be solved assuming an increase in investment, the gradual strengthening of SÚRAO's personnel capacity and constructive dialogue with the relevant authorities (the SÚJB) in the period prior to the initiation of licence application proceedings.

A further critical point concerns the simultaneous performance of the research work and the ongoing application for licences for the various related procedures (e.g. mining exploration work prior to the start of the EIA process for the construction of the deep geological repository and the siting of nuclear facilities according to the schedule in Chapter 4.9 and Annex 2.)

Concerning the management of the EIA process and issues relating to the new Building Act, this study is based on the assumption that the current wording of the Building Act will not change with respect to reserved structures, which, according to the Act comprise those structures listed in Annex No. 3 of the Building Act. The jurisdiction of the construction authority in reserved structure issues will be exercised by the specialised and appeals construction authority (see section 33, paragraph 2 of the Building Act).

Potential appeals against decisions and judicial reviews will lead to delays in the planning permission procedure. The optimisation of the construction process and previous licensing procedures will need to be continuously revised going forward in the light of potential changes to legislation.

Due to the bringing forward of the milestone for the introduction of the deep geological repository into operation by 15 years, it cannot be ruled out that a framework licence will be applied for concerning certain selected buildings in the nuclear controlled area. According to Annex No. 2, this concerns particularly the proposal for the final waste transfer node project (the hot chamber), the research and development of which cannot be accelerated any further.

4.8 Summary of the amount of radioactive waste intended for the deep geological repository that will be ready for disposal in 2050

A detailed analysis of the amount of RAW that will be ready for disposal in 2050 is provided in Annex No. 1 to this report. Under currently valid technical and safety assumptions (Pospíšková et al. 2011, Vokál et al. 2020) it is possible to dispose of the waste stored at the Richard repository that was vitrified following the reprocessing of the fuel from the LVR 15 research reactor and, in the case of immediate decommissioning, most likely some of the radioactive waste from the decommissioning of the Dukovany power plant. In the case of spent fuel, it is now possible to dispose of fuel sets from the first phases of the operation of the Dukovany power plant, i.e. 14 CASTOR 440/84-type waste disposal packages, each of which contains 84 fuel sets. By 2050, the amount of SF that will meet the conditions for disposal in terms of its residual heat output will comprise 168 waste disposal packages. In the case of the earlier commencement of operation, i.e. in 2050, it will be necessary to modify the operation of the repository in terms of the disposal layout so that it is possible to operate the facility in a feasible and economical way. It will also be necessary to verify some of the project requirements for the engineered barriers (e.g. the limit temperature) in the case of the need to dispose of SF earlier than after the expected storage period of 65 years.

4.9 Schedule of the main activities

A detailed schedule is provided in Annex 2 to this report. It includes both the administrative processes and the technical requirements. The main deadlines from the point of view of the administrative processes are listed in Tab. 2, whereas other deadlines for the initial development stages (selection of the final and back-up sites) are listed in Tab. 3. The subsequent continuation of this study will set out the schedules for, and interrelationships between, the various technical phases and the attainment of the respective licences in greater detail. Moreover, the proposed simultaneous approach to the various licensing proceedings and the level of technical preparation should be discussed with the relevant authorities (e.g. the underground mining exploration work as part of the detailed geological survey phase and the licensing process for the siting of the repository nuclear facility itself).

Tab. 2 Deadlines for the main administrative processes (licence validity dates)

Administrative process	Deadline
Exploration area for special intervention into the earth's crust (according to Act No. 62/1988 Coll.)	**2024**
Selection of the final and back-up sites	**2028**
Protected area for special intervention into the earth's crust (section 17 of Act No. 44/1988 Coll.)	**2029**
EIA process (Act No. 100/2001 Coll.)	**2029 (commencement)**
Land property settlement	**2030**
Mining activity licences and the implementation of survey work (detailed survey of the final location using mining techniques)	**2031**
Siting licences according to section 9 (1a) of the Atomic Act	**2033**
Unified environmental position (legislation under preparation)	**2037**
Framework licence (the Building Act) if required by the nature of the R&D work	**2037**
Construction licence according to section 9 (1b) of the Atomic Act	**2040**
Construction planning permission (according to section 182 of the Building Act No. 283/2021 Coll.) including a valid unified environmental position	**2041**
Decision of the SÚJB according to sections 9 and 137 of the Atomic Act – the disposal of radioactive waste, waste disposal package type approval and the operation of a category IV workplace	**2049**
Commissioning of a nuclear facility without a nuclear reactor, section 9, paragraph 1e) of the Atomic Act	**2050**
Operation of a nuclear facility, section 9, paragraph 1f) of the Atomic Act	**2053**

Tab. 3 Activities at the sites up to the commencement of mining exploration work

Activity	Deadline
Start of work in the geological research mode (e.g. monitoring work, detailed geological mapping including geophysical measurements, etc.)	**2023**
Start of work in the geological exploration mode	**2024**
Termination of work at the sites	**06/2027**
Compilation of site studies for the purpose of selecting the final and back-up sites	**06/2027-03/2028**
Evaluation and selection of the final and back-up sites	**2028**
Completion of the explorationof the final site	**2031**
Initiation of mining exploration work (underground characterisation workplace)	**2032**

The main uncertainties in the schedules in this chapter and in Annex 2 concern:

- The acceleration of the determination of survey areas.
- The successful management of gaining access to land and tenders for contractors.
- Future amendments to related legislation and the preparation of new legislation.
- The method of the application of the EIA process.
- The proposed procedure for the underground mining exploration work (in the geological survey mode)
- Start of the construction of the surface infrastructure for the underground mining exploration work.
- Uncertainties associated with the research and development of the engineered components and selected equipment.
- Unexpected discoveries of a geological nature during the conducting of the underground mining exploration work and the need to consider the back-up site for the construction of the deep geological repository.

5 Summary of the conditions

The fulfilment of the conditions described in proposal C (2022) 631/3 for the Czech radioactive waste disposal programme in terms of the activities of SÚRAO is possible under the following assumptions:

5.1 Handling of low- and intermediate-level RAW

The regular assessment of the anticipated generation of low-level radioactive waste from the operation of nuclear power plants and, if necessary, a timely decision on the expansion of the Dukovany repository according to the expected nuclear energy development scenario (e.g. according to the SF and RAW Management Concept). This step is conditional on the development of a strategic study.

5.2 Handling of SF and HLW

- Preparation of a reporting system on the requirements of the Taxonomy.
- Updating of the conditions, schedules and milestones in the SF and RAW Management Concept and the modification of Government Resolution No. 1350/2020.
- Updating and evaluation of the whole of the SÚRAO research and development plan (Vokál et al. 2020) and the definition of the various project preparation phases from the point of view of the development of technology for the commencement of operation of the deep geological repository in 2050.
- Optimisation of the current schedule for the preparation of the deep geological repository from the point of view of the administrative processes involved; detailed evaluation of the effects of upcoming legislation (including amendments thereto) and their incorporation into the SÚRAO S.36 internal document.
- Shortening of the period and changes to the methodology for selecting the final and back-up sites.
- Start of the implementation of the geological characterisation work, especially in the geological research mode, including mapping work. The geological survey should focus on deep-drilling research and the work performed in the context of the excavation of underground workings (for the final siting of the deep geological repository).
- Commencement of the EIA process after selecting the final and back-up sites.
- Commencement of the underground mining exploration work at the final site for the deep geological repository as soon as possible and, simultaneously, the initiation of the process of the siting of the nuclear facility.
- Optimisation of plans for the operational phase of the deep geological repository in terms of the amount of expected radioactive waste for disposal and the economy of operation.

- Preparation of technical studies for the closure period, subsequent institutional control and the preservation of knowledge on the deep geological repository.
- Compilation of detailed schedules for the development, production and placement of the engineered barriers and other repository components in terms of the requirements of the Atomic Act.
- Detailed definition of the processes involved in the pre-operation phase of the repository.
- Clear definition of communication channels with the affected municipalities and the related competencies.
- Consultation of the findings set out in this study with the various actors involved in the process.

5.3 Organisational conditions

One of the essential conditions for the successful attainment of the various objectives concerns the engagement of professional specialists in the process. In the case of SÚRAO[5], this concerns principally the following areas; the geological characterisation of the site, project preparation, safety aspects, preparations for construction, the research and development of the engineered components, and management and support processes (Tab. 4). All emerging requirements in terms of personnel and remuneration will be ensured exclusively within the set limit for the number of employment positions and the amount of funding for salaries in the budget set by the Ministry of Industry and Trade. A consistent personnel strategy for the entire scope of the deep geological development programme must also be designed. A further essential condition concerns the involvement of all the relevant participants in the deep geological development programme and communication with the affected municipalities (in addition to the Ministry of Industry and Trade, the Ministry of the Environment, the Ministry of Finance, the Ministry for Regional Development, the Mining Authority and the SÚJB). The final recommendation consists of the critical revision of the existing strategic documents (the RAW and SF Management Concept, site selection indicator requirements, etc.) and the amendment of legislative regulations and standards for which the Ministry of Industry and Trade and the SÚJB are responsible.

From the point of view of research and development, it can be stated that the bringing forward of the date of the commencement of at least the trial operation of the repository to 2050

[5] One of the important prerequisites for the acceleration of the process surrounding preparations for obtaining the licences for the development of the deep geological repository and maintaining the necessary level of safety thereof under the resulting conditions concerns the provision of adequate human resources and the related funding for the SÚJB. This requirement follows, *inter alia*, from Article 6, paragraph 3 of Council Directive 2011/70/EURATOM of 19 July 2011, which establishes a Community framework for the responsible and safe management of SF and radioactive waste, and Article 20, paragraph 1 of the Joint convention on safety in the management of SF and radioactive waste. The personnel and budgetary needs of the SÚJB are not within the scope of this study; however, the government of the Czech Republic should devote attention to this issue at the appropriate time.

significantly reduces the time available for the design, development, production and verification of the safety of the various disposal components. The R&D plan, as related to the 2050 start date, will most likely need to be adjusted in terms of its priorities so that it focuses to a greater extent on adopting the R&D results, including already-developed disposal components/technologies, of countries that are close to commissioning their deep geological repositories, i.e. Sweden, Finland, France and Switzerland. However, this does not mean that it will be possible to adopt all the results of such research and development due to differences between the geological environments of these countries and the Czech Republic. The research and development plan concerning certain areas will be changed only to a minor extent; however, in some areas it will change significantly. One of the biggest developments will concern a change in the project management approach via the introduction of a systems project approach to the management of the deep geological repository project. This approach will require, in particular, an increase in the amount, and the updating of the management, of the human and financial resources available. The need to ensure the provision of the relevant qualified personnel will have to be regularly balanced by the termination of job positions that are no longer required depending on the demands of the various stages of the deep geological repository development programme. Significant personnel support will also be needed for the supplier tendering process, the timely execution of which will be crucial to commissioning the repository at the planned time. The application of a high-quality selection procedure in terms both of expertise and the project management approach, as well as regarding the contractual and financial conditions, will be fundamental to the successful completion of the deep geological repository project. It will further be necessary to update existing SÚRAO guidelines directly aimed at the deep geological repository project so as to introduce a requirements-based management system based on legislative requirements supplemented by a data and information management system. The research and development work will need to prioritise those items that are critical to achieving the required milestones. Major decisions regarding the safety and technical concept of the repository will need to be made as soon as possible.

Tab. 4 Estimation of the requirements for strengthening SÚRAO's personnel capacity

Area	Estimated increase in the number of personnel	Justification
Project management	3	Concerning project management, a strictly project-based approach must be adopted. The demand for staff increases is due mainly to the complexity of the selection procedures and the need to reduce the administration tasks currently undertaken by professional staff. Furthermore, support for project management concerning communication with the various stakeholders in the process must be strengthened.
Communication and the	4	Concerning communication, it is necessary to strengthen communication with the affected communities directly at

involvement of the affected parties		the sites. The estimated staffing capacity relates to one staff member for each candidate site.
Selection of the final and back-up deep geological repository sites, site characterisation	7	The proposed increase is due to the need to process and manage the whole range of projects related to the characterisation of the sites, their monitoring and the resolution of conflicts of interest.
Safety documentation and related research and development	2	The required staff will cover the preparation of the relevant licensing processes and communication with the administrative authorities involved.
R&D of the engineered barrier and disposal concepts	3	The required expertise is related to the necessity for addressing those aspects of the R&D programme that have not yet been resolved, especially the requirements for the development and production of the various technologies required.
Construction preparations and project design solution	5	The required increase is based on the need to prepare detailed project design solutions and documentation for all the phases of the construction of the deep geological repository as an underground complex and nuclear facility, including the EIA documentation, and the need to commence the underground mining exploration work and certain parts of the surface area shortly after 2030.
Bukov underground research facility	5	These workers will serve to enhance the potential for the maximum utilisation of the Bukov underground research facility taking into account the necessity for developing the relevant in-situ technologies and adopting the relevant procedures for the underground exploration work at the final site.

5.4 Communication

From the point of view of communication, SÚRAO should continue to present its currently operational repositories to the public with an emphasis on their safety and the regular monitoring of the surroundings. Moreover, activities such as presentations for schools, open days and the summer school, etc., which contribute to increasing the awareness of the issue of the radioactive waste generated in the Czech Republic, should continue and be expanded. These activities should also focus on the candidate sites for the deep geological repository via the regular presentation and explanation of the various stages involved in the deep geological repository development process. However, this will require the expansion of the personnel in SÚRAO's communications department. A further essential condition concerns the creation of in-house communication bodies/the allocation of the personnel capacity of other institutions

involved in the process so as to ensure cooperation between the various organisations concerned and the application of a uniform coordinated public relations approach. In this regard, support might also be sought from inter-disciplinary committees made up of representatives of public and scientific institutions such as the Commission for Energy of the Academy of Sciences of the Czech Republic, etc.

From the technical point of view, it is necessary to compile the appropriate strategic studies including the relevant schedules that describe the links between the various administrative processes and the set milestones of the deep geological repository development project. Furthermore, it is necessary to initiate the development of other strategic studies that address the organisation of work, changes in the deep geological repository development programme from the R&D phase via the licensing procedure phase to the construction and operation phase in terms of organisational, capacity and financial considerations.

6 Conclusion

While the Czech Republic welcomes the fact that nuclear energy is included in the Taxonomy for activities with sustainable financing under defined conditions, so that the operation of existing and future/new nuclear sources fulfils the sustainability conditions set by the Commission, the text is considered to represent a rather fragile compromise. The proposed criteria in their full form do not take into account the conditions advocated by the Czech Republic in bilateral negotiations; nevertheless, the Czech Republic did not raise any objections in the context of discussions on the Delegated Act. Sustainability status is proposed by the Commission for all new nuclear sources that obtain a permit by 2045 and for existing nuclear sources that obtain a permit/notification of modifications to extend operation by 2040. The criteria that follow from the notification of investment plans under Article 41 Euratom require a plan for the start of operation of a deep geological repository in 2050 including details of the various stages involved and the technical design solutions, which will require the modification of the Radioactive Waste and Spent Nuclear Fuel Management Concept in the Czech Republic based, *inter alia*, on the findings of this study.

This study addresses the assessment of the conditions of the impact of the Delegated Act on the activities of SÚRAO, which has fundamental implications concerning, in particular, the development of the deep geological repository and the operation of the Dukovany repository. Concerning the latter, it is advisable that a strategic study be compiled on its future development in connection with the preparation of plans for the commissioning of new nuclear sources. In the case of the deep geological repository, the main condition concerns the commissioning thereof in 2050. This milestone can be achieved by optimising the schedule for the selection of the final site for the facility and accelerating the related research and development activities. In order to achieve this milestone, it will also be necessary to make specific decisions at the RAW disposal process policy level (e.g. the updating of the Radioactive Waste and Spent Nuclear Fuel Management Concept). At the same time, it is recommended that the settings and implementation of the technical criteria and the requirements of the Taxonomy be monitored and assessed on a continuous basis, including with respect to the regular revision thereof and, consequently, the impacts on the settings and implementation of the Radioactive Waste and Spent Nuclear Fuel Management Concept.

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Annex no. 1 Estimation of the amount of waste to be disposed of in the deep geological repository in 2050

The deep geological repository in the Czech Republic will feature two independent underground sections. One section will be used for the disposal of spent fuel and the other for the disposal of high- and intermediate-level radioactive waste. The two sections must be sufficiently far apart from each other so that no mutual influence is possible on the safety and reliability of the disposal system as a whole. The surface complex of the repository will serve both underground sections.

1. Inventory of spent fuel

Spent fuel is stored for several years in pools in the main production units of the respective NPPs after being removed from the reactor. The fuel is stored in this way for the time necessary to reduce the residual heat output of the fuel to a level that allows for its transfer to the dry spent fuel storage facility.

Based on thermo-technical calculations for a reference site, the average value of the thermal output of one waste disposal package for the Dukovany SF was determined at 655 W, for the Temelín SF 1,125 W and for new nuclear sources 1,221 W (Vokál et al. 2020). The thermal output value and the waste disposal package loading scheme were determined for the highest conservative values of the initial temperature at the disposal level of the reference site and for the lowest coefficient of thermal conductivity of the selected rock environment; the SF cooling period was considered to be 65 years. It can be assumed that the initial temperature and the thermal conductivity coefficient values will be more favourable for the final and back-up sites and, when calculating the temperature distribution in the deep geological repository, it is likely that it will be possible to consider a higher SF residual heat value and, thus, to shorten the storage time required for cooling.

1.1 VVER 440 reactor fuel

Part of the SF from the Dukovany NPP will meet the thermal performance condition requirement by 2050. The waste disposal package for SF from the VVER 440 reactor is designed to hold 7 fuel sets. Based on real data obtained from the EDU nuclear database (ČEZ database) and on thermal calculations (Kobylka et al. 2019), it follows that for the unprofiled fuel sets (with a burn-up of less than 40 MWd/kg_{mass}) that were used in the reactor in the initial years of operation of the Dukovany NPP, the thermal output condition will be met for those fuel sets stored in CASTOR 440/84 waste disposal packages up to 1998, i.e. a total of 14 waste disposal packages. Each CASTOR 440/84 waste disposal package contains 84 fuel sets. By 2050, enough SF to fill 168 waste disposal packages will meet the residual heat output condition for disposal. Fully-filled waste disposal packages containing Gd1 and Gd2M fuel with a burn-up of higher than 54 MWd/kg_{mass} will not meet the thermal performance condition even after 65 years of storage (Kobylka et al. 2019). For such fuel, a waste disposal package loading scheme has been proposed applying combinations of a 4:3 ratio of Gd2M to unprofiled fuel or a 5:2 ratio of Gd1 to unprofiled fuel. Concerning the SF handling process, it will be necessary to design a new loading scheme because the SF will have a higher residual heat output due to the earlier disposal date.

1.2 VVER 1000 reactor fuel

The VVER 1000 reactor waste disposal package is designed to contain 3 fuel sets. It is possible to deduce from the thermal output condition per one waste disposal package that the average thermal output value of 1 fuel set must be lower than 375 W. Based on the ETE database (ČEZ database) and on thermal calculations (Kobylka et al. 2019) it follows that the type 1000/TVSAT fuel set (approx. 2,420 fuel sets) will have a thermal output of 406.6 W even 65 years following its removal from the reactor. In order to meet the condition for the thermal output limit value for this type of fuel, a loading scheme at a ratio of 2:1 has been proposed (TVSAT:1000/VVANTAGE). Concerning earlier disposal, the loading scheme will have to be verified in order to fulfil the thermal output condition for all the waste disposal packages, and not just for the SF that was used in the initial years of the operation of the Temelín NPP. SF is stored in CASTOR 1000/19, OS ŠKODA 1000/19 and ŠKODA 1000/19M waste disposal packages.

2. HLW and intermediate-level radioactive waste intended for disposal in the deep geological repository

Since high-level radioactive waste generates heat, it must be disposed of in the future deep geological repository. Intermediate-level waste that contains a significant amount of long-lived radionuclides and which cannot be disposed of in currently operational repositories must also be disposed of in the deep geological repository.

A separate section has been designated in the deep geological repository for the disposal of high-level and intermediate-level RAW. This section will also be used for the disposal of other classes of RAW that are unacceptable for disposal in existing repositories and for the disposal of RAW from the decommissioning of nuclear facilities, especially the Dukovany and Temelín power plants, and new nuclear sources (see the Concept). RAW from the decommissioning of the LVR-15 nuclear research reactor will also be disposed of in the repository (Touš, 2017).

2.1 Decommissioning

Two decommissioning options are being considered for the decommissioning of the nuclear power plants:

- Immediate decommissioning, wherein the decontamination and dismantling activities will commence immediately after the fuel is removed from the reactor, followed by the processing and treatment of the RAW.
- Gradual decommissioning, wherein following the removal of fuel from the reactor, the technological components will be “mothballed” and the decommissioning activities postponed by 40-50 years.

The RAW from the decommissioning process will consist of:

- The activated components of the structural parts of the reactor (the cylindrical part of the pressure vessel, the active zone removable basket, the reactor shaft and the thermal shielding).
- Activated concrete and backfill from around the reactor shaft.
- Operational activated components (thermo-couples, inserted rods, witness sample cassettes, absorbers).

2.1.1 Option of the immediate decommissioning of the Dukovany NPP

Radioactive waste balance sheets have been compiled assuming the end of operation of the Dukovany NPP after 2035. Preparations for decommissioning (SF disposal, decontamination) will take place up to 2045. The first block will be dismantled after 2049, and the dismantling of the fourth block will be completed in 2060. Tab. 5 shows the mass balances of the activated parts for one reactor and the number of waste disposal packages that will be required for the disposal of this waste. It is planned that the decommissioning process will take 28 years.

Tab. 5 Mass balance of the activated technological components from one reactor of the Dukovany nuclear power plant considered for disposal in the DGR and the corresponding number of waste disposal packages (4.34 m^3); immediate decommissioning variant (Touš et al. 2017)

Component	DGR (kg)	Waste disposal packages
Pressure vessel	101 000	101
Reactor shaft	53 000	53
Active zone removable basket incl. the bottom	22 000	22
Pipe protection block	18 000	18
Pressure vessel thermal insulation	14 000	14
Serpentinite concrete internal cladding	4 000	4
Inlet pipe up to 1 m from the pressure vessel	4 000	4
Inlet pipe from 1 m from the pressure vessel	4 000	4
Serpentinite concrete	77 000	77
Activated construction concrete	200 000	200
TOTAL - 1 reactor	497 000	497
TOTAL - 4 reactors	**1 988 000**	**1 988**

2.1.2 Option of the immediate decommissioning of the Temelín NPP

Radioactive waste balance sheets have been prepared assuming the 60-year operation of the Temelín NPP. Operation will be terminated after 2060 and the decommissioning phase will take 5 years from this date. 1 year is planned for the preparation of the disassembly of the components. Certain parts of the primary circuit will be dismantled first, followed by the dismantling of the reactor blocks. Tab. 6 shows the mass balances of the activated parts of one reactor and the number of waste disposal packages that will be required for the disposal of this waste. It is planned that the Temelín NPP decommissioning process will take 18 years.

Tab. 6 Mass balance of the activated technological components from one reactor of the Temelín nuclear power plant considered for disposal in the DGR and the corresponding number of waste disposal packages (4.34 m^3); immediate decommissioning variant (Touš et al. 2017)

Component	DGR (kg)	Waste disposal packages
Pressure vessel	226 680	35
Reactor shaft	58 000	13
Active zone removable basket incl. the bottom	35 000	79
Fuel set steel supports	10 230	14
Pipe protection block	17 130	10
Pressure vessel thermal insulation	20 500	27
Serpentinite concrete	54 600	10
Ionisation chamber channels with counterweights	5 250	4
Support Ring	11 390	2
Construction concrete	1 360	1
TOTAL - 1 reactor	440 995	195
TOTAL - 2 reactors	**881 990**	**390**

2.1.3 The gradual decommissioning variant

Concerning the gradual decommissioning option, no waste from the decommissioning of the two nuclear power plants will be prepared for disposal in the deep geological repository by 2050.

2.1.4 Decommissioning of the LVR-15 nuclear research reactor

The radioactive waste from the decommissioning of the LVR 15 research reactor will be ready for disposal in the deep geological repository by 2050. The waste will consist of the reactor vessel, the active zone basket, horizontal channels, the thermal column, absorption rods and beryllium blocks. The total mass of the steel components is estimated at 10 tonnes, while the mass of other materials such as aluminium alloys, boron carbide alloys and beryllium oxides is estimated at around 11 tonnes. The fragmented reactor vessel parts will fill 10 waste disposal packages and the other components will fill a further 11 waste disposal packages (Touš, 2017).

2.2 RAW from the industrial, research, medical and agricultural sectors considered for disposal in the deep geological repository

A further group of RAW considered for disposal in the deep geological repository comprises radioactive waste that is currently stored in the Richard underground repository. This consists of RAW that does not meet the acceptability conditions for disposal in currently operational repositories and which, therefore, is being stored at the Richard facility until the commissioning of the deep geological repository; the waste mainly consists of used radionuclide emitters. Based on information provided in a report on the disposal of RAW at the Richard repository

(SÚRAO-2022-03) issued on 31 December 2021, 206 waste disposal packages containing RAW consisting of 113 used radionuclide emitters are currently under storage. The total volume of this waste is 41 m^3 with a weight of 72 tonnes (Máčelová et al. 2022).

The vitrified material created via the reprocessing of highly-enriched SF from the operation of the LVR-15 nuclear research reactor at ÚJV Řež will be ready for disposal in the deep geological repository by 2050 (Touš, 2017). This SF was transported to the Russian Federation for reprocessing in two stages, i.e. in 2007 and 2013. It is expected that the vitrified material will be returned to the Czech Republic in the period 2028-2033. The waste will be stored in specially-constructed waste disposal packages at ÚJV Řež up to the time of disposal. The total volume of vitrified waste is 0.58 m^3 with a weight of 1.5 tonnes.

Annex no. 2 Detailed schedule of the various technical and licensing stages

(for reasons of clarity, presented in a separate file in pdf and xls)

Annex no. 3 Executive summary

Some of the requirements of the technical criteria set out in the Taxonomy, i.e. Commission Regulation (EU) 2022/1214, which supplements Annex No. 1 of Commission Delegated Regulation (EU) 2021/2139, specifically points 4.26, 4.27, 4.28, 4.29, 4.30 and 4.31, affect the activities of SÚRAO. They cover the following technical screening criteria for existing and new nuclear facilities as described in the Radioactive Waste and Spent Nuclear Fuel Management Concept:

The project is located in an EU member state and meets the following requirements:

e) the Member State has operational final disposal facilities for all very low-, low- and intermediate-level radioactive waste, notified to the Commission under Article 41 of the Euratom Treaty or under Article 1(4) of Council Regulation 2587/1999 and included in the national programme updated under Council Directive 2011/70/Euratom;

f) the Member State has a documented plan with detailed steps to have in operation, by 2050, a disposal facility for high-level radioactive waste describing all of the following:

i) concepts or plans and technical solutions for spent fuel and radioactive waste management from generation to disposal;

ii) concepts or plans for the post-closure period of a disposal facility's lifetime, including the period during which appropriate controls are retained and the means to be employed to preserve knowledge of that facility in the longer term;

iii) the responsibilities for the plan implementation and the key performance indicators to monitor its progress;

iv) cost assessments and financing schemes.

For the purposes of point (f), Member States may use the plans drawn up as part of the national programme required by Articles 11 and 12 of Directive 2011/70/Euratom.

Fulfilment of the conditions described in Commission Delegated Regulation (EU) 2022/1214 for the Czech radioactive waste disposal programme in terms of SÚRAO's activities will be possible under the following assumptions:

Management of low- and intermediate-level RAW (condition e)

The regular evaluation of the expected production of low-level waste from the operation of nuclear power plants and, if necessary, a timely decision on the expansion of the Dukovany repository according to the expected nuclear energy development scenario (e.g. according to the Radioactive Waste and Spent Nuclear Fuel Management Concept). Furthermore, the compilation of a study on the management of very-low-level waste. This issue is conditional on the compilation of a strategic study.

Management of SF and HLW (condition f)

Based on the evaluation of the influence of the identified conditions (points 4.27 and 4.28), the following prerequisites must be met in order to fulfil condition f (the compilation of a plan and

the subsequent implementation thereof in order to introduce the deep geological repository into operation in 2050):

Technical conditions

- Preparation of a reporting system for the requirements of the Taxonomy.
- Updating of the conditions, schedules and milestones in the Radioactive Waste and Spent Nuclear Fuel Management Concept and the modification of Government Resolution No. 1350/2020.
- Updating and assessment of the whole of the SÚRAO Research and Development Plan (Vokál et al. 2020) and the definition of the various stages of the development of the project from the point of view of the development of technology for the start of operation of the deep geological repository in 2050.
- Optimisation of the current schedule for the development of the deep geological repository from the point of view of the related administrative processes; detailed assessment of the impacts of upcoming legislation (including amendments thereto) and the incorporation thereof into the SÚRAO S.36 internal document.
- Shortening of the period, and changes to the methodology, for selecting the final and back-up sites.
- Commencement of the implementation of geological characterisation work, especially in the geological research mode. A geological survey focusing on deep borehole drilling and the excavation of the underground workings (for the final deep geological repository site).
- Initiation of the EIA process following the selection of the final and back-up sites.
- The commencement of the excavation of the underground exploration workings and, simultaneously, the initiation of the nuclear facility siting process as soon as possible at the final site chosen for the deep geological repository.
- The optimisation of plans for the operational phase of the deep geological repository in terms of the amount of disposed of radioactive waste and the feasibility of operation.
- The preparation of technical studies for the closure and institutional control periods and preservation of knowledge on the deep geological repository.
- The compilation of detailed schedules for the development, production and emplacement of the engineered barriers and the other repository components in terms of the requirements of the Atomic Act.
- The detailed definition of the processes included in the pre-operation phase of the repository.
- The definition of clear personnel competences and communication channels with regard to the affected municipalities.

Organisational conditions

The conditions necessary for the successful achievement of the afore-mentioned objectives are as follows:

- **personnel provision**

  One of the essential conditions for the successful achievement of these aims comprises the engagement of specialists in all the various components of the process. In the case of SÚRAO, the main areas in this respect concern the geological characterisation of the site, the preparation of the project, safety, preparations for construction, and the development of the engineered components and the management and support processes. All the emerging needs in terms of personnel and salaries will be ensured in line with the set number of positions and the funds provided for salaries from the Ministry of Industry and Trade.

- **the involvement of all the relevant ministries and state administration authorities** (in addition to the Ministry of Industry and Trade, the Ministry of the Environment, Ministry of Finance, the Ministry for Regional Development, the Mining Office and the SÚJB) in the deep geological repository development programme and communication with the affected municipalities.

- **a critical review of existing strategic documents** (the Radioactive Waste and Spent Nuclear Fuel Management Concept, Site Selection Requirements and Indicators, etc.) and the modification/amendment of the relevant legislative regulations and norms.

From the point of view of research and development, it can be stated that bringing forward the date of the commencement of operation of the deep geological repository to 2050 significantly reduces the time available for the design, development, production and verification of the safety of the various components of the repository. It is probable that the priorities of the R&D plan will have to be adjusted so as to meet the 2050 commencement of operation date and to focus to a greater extent on adopting the results of R&D that has already been conducted on the various repository components/technologies in countries that are on the verge of opening their deep geological repositories (Sweden, Finland, France and Switzerland). However, due to differences between the geological environments of these countries and the Czech Republic, it will not be possible to simply adopt all of the results of their R&D programmes. In many areas, the R&D plan will remain unchanged; however, the priorities in other areas will change significantly. One of the biggest changes will concern a change in the project management approach via the introduction of a systemised, project-based approach to the deep geological repository project. This approach will require, in particular, the updating of the management of both the human and financial resources available. Personnel support will also be needed for the efficient management of the tendering process, which will be crucial in terms of the timing of the deep geological repository project. Ensuring a high-quality selection process in terms of the expertise required, project management and the contractual and financial conditions will be fundamental to the successful completion of the deep geological repository. It will also be necessary to update existing SÚRAO guidelines concerning the project and to introduce a management system based on legislative requirements and a data and information management system. The research and development work will need to be organised so that those items that are critical to achieving the required milestones are prioritised. Major decisions regarding the safety and technical concept of the repository will need to be made as soon as possible.

Communication

In terms of communication, it will be necessary to devote attention to the following activities:

- Presentation to the public of the repositories that are currently in operation with an emphasis on their safety and the regular monitoring of their surroundings.
- The continuation and expansion of e.g. presentations for schools, open days and the summer school, etc., which contribute to increasing the overall awareness of the issue of the radioactive waste generated in the Czech Republic.
- The focusing of communication and presentation activities on the affected sites, at which the steps that will lead to the construction of the deep geological repository should be presented and explained on a regular basis.
- The creation of communication bodies/platforms and the allocation of the personnel capacity of other institutions involved in the process so as to ensure cooperation between the various organisations concerned and the application of a uniform coordinated public relations approach. In this regard, support might also be sought from inter-disciplinary committees made up of representatives of public and scientific institutions such as the Commission for Energy of the Academy of Sciences of the Czech Republic, etc.
- The gradual strengthening of the personnel capacity of SÚRAO's communication department so as to fulfil the afore-mentioned aims.

From the point of view of the technical conditions of the design solution, it will be necessary to compile the appropriate strategic studies, including project schedules, that describe the links between the various administrative processes and the project preparation stages. Furthermore, it will be necessary to initiate other strategic studies concerning the organisation of the work involved and changes to the deep geological repository development programme from the R&D phase through the licensing procedures phase to the construction and operation phases from the organisation, capacity and finance viewpoints.

It will also be necessary to continuously monitor and evaluate the settings and implementation of the technical criteria and the requirements of the Taxonomy, including with regard to the regular revision thereof, as well as their impacts on the settings and implementation of the RAW and SF Management Concept.

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