skb.se

SKB TR-25-02

ISSN 1404-0344

ID 2096317

November 2025

Plan 2025

Costs from and including 2027 for the radioactive residual products from nuclear power

Basis for fees and collaterals for the period 2027–2029

Svensk Kärnbränslehantering AB

This report is the English version of SKB Plan 2025. In the event of any discrepancy between the Swedish and English versions, the Swedish original will take precedence.

This report is published on www.skb.se

Foreword

According to current regulations, license holders of Swedish nuclear reactors must ensure the safe management and final disposal of spent nuclear fuel and other radioactive waste products. This responsibility also includes the decommissioning and dismantling of the nuclear power plants. The costs associated with these measures must be calculated and reported to the Swedish National Debt Office every three years, in accordance with the Act (2006:647) and the Ordinance (2017:1179) on the financing of nuclear waste products.

This report constitutes the 33rd planning submission since the initiation of Plan 82. It presents cost estimates both for the entire system—including certain waste from facilities not owned by the stakeholders—and in accordance with the limitations set by the financing regulations. The calculations are based on two scenarios: a reference scenario reflecting the current planning of the power plant owners, and a financing scenario based on the reactor lifetimes stipulated in the regulatory framework.

Since the previous planning report, government approval has been granted for the expansion of the Final Repository for Short-Lived Radioactive Waste (SFR) and for the construction of the final repository system for spent nuclear fuel (the KBS-3 system). The SFR is being expanded to accommodate operational and decommissioning waste from reactors undergoing shutdown, and initial above-ground work has commenced for the Final Repository for Spent Nuclear Fuel (SFK). In addition, decommissioning activities are underway for six nuclear reactors.

The nuclear waste management programme is thus entering a new phase, involving the construction and commissioning of new facilities. Existing facilities continue to operate while undergoing maintenance and development. This enables the final disposal of nuclear waste and spent nuclear fuel.

The methodology for preparing the cost basis has been further developed for Plan 2025. The objective is to ensure that fees and financial collateral are determined in a manner that is both sustainable over the long term and aligned with the legal responsibilities. Much of the development work has been based on the Swedish National Debt Office's review comments on Plan 2022. In several cases, these comments have led to changes, while in other areas further work or investigation is required before decisions can be made. SKB and the Swedish National Debt Office have shared their respective expectations for Plan 2025.

Solna, September 2025

Swedish Nuclear Fuel and Waste Management Company (SKB)

Stefan Engdahl, CEO

Summary

Companies licensed to operate nuclear reactors are responsible for implementing the necessary measures to safely manage and dispose of the resulting spent nuclear fuel and radioactive waste, as well as to decommission the reactors after their operational life ends. The most critical measures include the planning, construction, and operation of the required facilities and systems, along with conducting associated research and development. The financing of these measures is based on funds accumulated through fees paid by the license holders, primarily during the operational period of the reactors, but also afterward if necessary.

The financing is governed by the Financing Act (2006:647) and the associated Ordinance (2017:1179). Under this legislation, a reactor owner is defined as a license holder authorized to possess or operate one or more nuclear reactors that were not permanently shut down before January 1, 1975.

For reactor owners with one or more reactors in operation, the fee is specified in öre per kilowatt-hour of electricity delivered. This currently applies to Forsmark Kraftgrupp AB, OKG Aktiebolag, and Ringhals AB. For Barsebäck Kraft AB, whose two reactors have been permanently shut down, the fee is specified as an annual amount.

SKB has been jointly commissioned by its owners to calculate and compile the future costs of the required measures. According to the regulations, such cost reporting must be submitted to the Swedish National Debt Office (RGK) every three years.

The future cost estimates are based on SKB's and the reactor owners' current planning regarding the design and implementation timeline of the nuclear waste management system. The current design is referred to as the reference design, and the overall implementation plan is termed the reference scenario. This report is based on the planned activities presented in the RD&D Programme 2025 (SKB 2025). The reference scenario reflects the current planning of the nuclear power companies, which includes an expected operational lifetime of 60 years for the youngest reactors, while the oldest reactors have been permanently shut down.

This report includes, to some extent, cost estimates based on the reference scenario (Chapter 4). Although not required by regulation, SKB considers this inclusion to enhance transparency, as the reference scenario forms the basis for other calculations. The cost report prepared in accordance with the Financing Act and Ordinance is presented in Chapter 5.

To enable RGK to review the calculations in greater detail than what is presented in this report, SKB also submits a supplementary report. This includes, among other things, a breakdown of costs for the four reactor owners: Forsmark Kraftgrupp AB, OKG Aktiebolag, Ringhals AB, and Barsebäck Kraft AB.

The reference scenario includes the following facilities and systems currently in operation:

- Transport system for radioactive waste products.
- Central interim storage facility for spent nuclear fuel (Clab).
- Final repository for short-lived radioactive waste (SFR).
- Laboratories for the development of encapsulation and final repository technologies.

It also includes the following planned facilities or facility components:

- Extension of SFR to accommodate short-lived waste from reactor decommissioning and a small amount of operational waste.
- Final repository for long-lived waste (according to the SFL concept).
- Canister factory and encapsulation facility for spent nuclear fuel adjacent to Clab.
- Final repository for spent nuclear fuel (SFK).

The reference scenario also includes costs for supporting functions, feasibility studies, technology development, and post-closure safety analysis, as well as for SKB's central operations. Central SKB costs include general functions such as corporate management, operational support, communications,

environmental management, overarching safety issues, and safety reporting. Additionally, costs for reactor decommissioning and interim storage facilities at the power plant sites are reported.

The Financing Act and Ordinance impose several conditions that affect the scenario SKB uses to develop the cost basis for fees and financial collateral. Most notably, this includes the reactor operational lifetime used to estimate the quantity of spent nuclear fuel and radioactive waste, and the requirement to assess uncertainties related to future developments in various areas. To meet the latter requirement and report expected costs, SKB has chosen to apply a probability-based uncertainty analysis. Furthermore, the calculation must only include residual products, which—according to the definition in the Financing Act—excludes the management of operational radioactive waste from the reactors. As a result, costs for SFR in its current role as a repository for operational waste are excluded.

The quantity of spent nuclear fuel and radioactive waste to be managed is linked to the reactors' operational lifetimes. The fee-based operational lifetime is set at 50 years in the regulations. A minimum remaining operational time of six years must be applied unless there is reason to believe that operations will cease earlier. The fee calculation, performed by RGK, is then based on the expected electricity production during this period.

In addition to paying fees, a reactor owner must provide two types of financial collaterals. One collateral covers approved fees that have not yet been paid. The basis for this is referred to as the financing amount. Its calculation is similar to the fee basis but limited to the management of residual products existing at the time of the calculation—December 31, 2026, in this report. The second collateral supplements the financing amount to account for potential shortfalls. The basis for this is referred to as the supplementary amount. According to the Financing Ordinance, the supplementary amount is not included in the reactor owners' cost reporting.

The results of the cost calculation are as follows. The amounts refer to future costs from 2027 onward and are stated in January 2025 price levels:

Remaining base cost: SEK 151.0 billion

Basis for financing amount: SEK 145.8 billion

Contents

1 Introduction

This report presents calculations of the future costs required for the management and disposal of nuclear waste and spent nuclear fuel from Swedish nuclear reactors, as well as for their decommissioning. In accordance with Swedish legislation, these cost estimates must be submitted to the Swedish National Debt Office (RGK) every three years. The calculations have been prepared by the Swedish Nuclear Fuel and Waste Management Company (SKB) on behalf of its owners.

The report includes cost estimates for two scenarios:

- The current planning scenario, assuming a 60-year operational lifetime for the reactors (reference scenario).
- The scenario based on the current financing regulations, assuming a 50-year operational lifetime (financing scenario).

The operational lifetimes of the reactors are a key factor in planning the nuclear waste management programme. Based on the reactor owners' current planning assumptions, forecasts are made for the quantities of nuclear waste and spent fuel to be managed within the waste system, as well as the timing of needs for interim storage and final disposal.

The report is structured as follows:

Chapter 1 provides background information on the financing system and the applicable regulatory framework.

Chapter 2 describes the current design of the Swedish system for managing and disposing of nuclear waste and spent nuclear fuel, as well as the planning for implementation of the nuclear waste programme and decommissioning of nuclear facilities.

Chapter 3 outlines SKB's methodology for conducting the cost calculations.

Chapter 4 presents the underlying reference cost estimate, based on current plans for reactor operations and SKB's activities.

Chapter 5 contains the cost report prepared in accordance with the Financing Act, which constitutes the primary purpose of this report.

1.1 Conditions

1.1.1 Obligations under the Nuclear Activities Act

According to the Act (1984:3) on Nuclear Activities (the Nuclear Activities Act, KTL), any entity holding a license for nuclear activities is responsible for the safe management of nuclear waste or nuclear material generated in the operation that is not intended for reuse. This responsibility includes the planning, construction, and operation of the necessary facilities and systems, as well as conducting the research, development, and demonstration activities required. As a final step, it also encompasses the decommissioning and closure of the facilities.

Under the Nuclear Activities Act, the license holder is also obligated to bear the costs associated with the measures required for the management of nuclear waste and spent nuclear fuel, as well as for the decommissioning of the facilities. The license holders for the nuclear power plants in Forsmark, Oskarshamn, Ringhals, and Barsebäck are Forsmarks Kraftgrupp AB (FKA), OKG Aktiebolag (OKG), Ringhals AB (RAB), and Barsebäck Kraft AB (BKAB), respectively.

The Swedish Nuclear Fuel and Waste Management Company (SKB) is owned by Vattenfall AB, OKG Aktiebolag, Forsmarks Kraftgrupp AB, and Sydkraft Nuclear Power AB. On behalf of its owners, SKB is responsible for the management and final disposal of nuclear waste and spent nuclear fuel from the Swedish nuclear power plants.

1.1.2 The Financing System and Applicable Regulations

According to the Act (SFS 2006:647) on the Financial Measures for the Management of Residual Products from Nuclear Activities (the Financing Act) and the associated Ordinance (2017:1179), license holders of nuclear facilities are required to pay a fee to cover, among other things, future waste management and decommissioning costs.

License holders who are authorized to possess or operate one or more nuclear reactors that were not permanently shut down before January 1, 1975 are defined in the legislation as reactor owners. Consequently, all license holders for the nuclear power plants in Forsmark, Oskarshamn, Ringhals, and Barsebäck are also considered reactor owners under the regulatory framework.

The regulations distinguish between residual products from nuclear activities and radioactive operational waste. Residual products are defined as *"spent nuclear fuel or other nuclear material that will not be reused, and nuclear waste generated at a nuclear facility after the facility has been permanently shut down."* The fee is intended to cover the costs of managing and disposing of residual products, but not the costs associated with operational waste, which are financed directly by the reactor owner.

For reactor owners with one or more reactors in operation, the fee is specified in öre per kilowatt-hour of electricity delivered. This currently applies to FKA, OKG, and RAB. For BKAB, whose two reactors have been permanently shut down, the fee is specified as an annual amount.

In addition to paying fees, reactor owners are required to provide two types of collaterals: one to cover unpaid fees and another to account for unforeseen costs. These collaterals are intended to be activated if the reactor owner fails to meet its payment obligations and the funds in the Nuclear Waste Fund are deemed insufficient.

According to Section 8 of the Financing Ordinance, reactor owners must submit a cost estimate for the management of nuclear waste products to the Swedish National Debt Office (RGK). This estimate must be submitted no later than September every third year. SKB has been commissioned by its owners to prepare a joint cost estimate on behalf of the reactor owners.

Based on this information, RGK prepares proposals for nuclear waste fees and collateral amounts. The government then decides on the fees and collateral amounts for the following three calendar years. Fees and collateral amounts must be provided both during the operational period of the reactors and after permanent shutdown, until the nuclear power plants are fully decommissioned and all residual products have been managed.

The fees are paid into the state-managed Nuclear Waste Fund. The fund's assets are placed in interest-bearing accounts at the RGK, in government-issued debt instruments, or in securities issued under the Covered Bond Issuance Act (2003:1223). Since December 2017, the Nuclear Waste Fund has also been permitted to invest a portion of its assets in Swedish and global equities, corporate bonds, and derivative instruments to reduce risk and improve fund management efficiency. Reactor owners are entitled to withdraw funds to cover the majority of their responsibilities under the Nuclear Activities Act.

1.1.3 Amounts to Be Reported Under the Financing Act

The quantity of spent nuclear fuel and radioactive waste to be managed depends on the operational lifetimes of the reactors. In the cost calculation, each reactor that has not been permanently shut down must be assumed to have a total operational lifetime of 50 years, or a remaining operational lifetime of at least six years. If there are specific reasons to believe that operations may cease earlier, the expected operational lifetime should instead be based on that earlier date.

Section 5 of the Financing Act defines four cost categories:

Base Cost – the expected annual costs for the measures and activities referred to in Section 4, items 1–3 of the Financing Act, i.e., the license holders' costs for the safe management and final disposal of residual products, the safe decommissioning and dismantling of nuclear facilities, and the necessary research and development activities.

Additional Cost – the expected annual costs for activities referred to in Section 4, items 4–9 of the Financing Act, such as the state's costs for R&D, fund management, licensing, supervision, monitoring, and control, as well as public information efforts

Financing Amount – an amount for each license holder corresponding to the difference between, on the one hand, the remaining base and additional costs for the residual products existing at the time of calculation, and on the other hand, the license holder's share in the Nuclear Waste Fund.

Supplementary Amount – an amount that supplements the financing amount to account for the possibility that it may prove insufficient.

SKB reports to RGK the total and remaining base cost and the portion of this cost that should form the basis for the financing amount. The additional cost and the supplementary amount are calculated by RGK. The supplementary amount must take into account uncertainties on both the asset and liability sides.

2 The Nuclear Waste Programme

On behalf of its owners, SKB is responsible for the management and final disposal of nuclear waste and spent nuclear fuel from Swedish nuclear power plants.

The waste management system and its implementation plan are described in the RD&D Programme 2025 (SKB 2025). Selected parts of that information are presented below to provide context for the cost estimates discussed in subsequent chapters.

The planned operational lifetimes of the reactors are a key factor in the planning of the nuclear waste management programme. Based on these lifetimes, forecasts are made regarding the quantities of nuclear waste and spent nuclear fuel to be managed, as well as the timing of interim storage and final disposal.

The planning of the nuclear waste management system is based on the current planning assumptions of the reactor owners. The two reactors at the Barsebäck nuclear power plant were shut down in 1999 and 2005, respectively. At the Oskarshamn nuclear power plant, two of three reactors were shut down in 2015 and 2017, and at the Ringhals nuclear power plant, two of four reactors were shut down in 2019 and 2020. All of the reactors that have now been shut down were commissioned during the 1970s.

For the six reactors currently in operation (commissioned during the 1980s), the planned operational lifetime is 60 years. This applies to Forsmark 1, Forsmark 2, Forsmark 3, Oskarshamn 3, Ringhals 3, and Ringhals 4. The youngest reactors, Forsmark 3 and Oskarshamn 3, are therefore expected to remain in operation until 2045, according to the current planning of the reactor owners.

2.1 Description of the Waste Management System

The system for managing all nuclear waste and spent nuclear fuel from reactor operators consists of two main components: the system for low- and intermediate-level waste, and the system for spent nuclear fuel (the KBS-3 system), along with a shared transportation system. Figure 2-1 presents both existing and planned facilities within these systems, as well as the transport flows.

The system for low- and intermediate-level waste includes facilities for treatment, interim storage, and final disposal. Currently, the SFR (Final Repository for Short-Lived Radioactive Waste) is in operation, along with facilities for processing and interim storage, as well as near-surface disposal located adjacent to nuclear facilities. To ensure the final disposal of all nuclear waste generated during the operation and decommissioning of nuclear reactors and other nuclear facilities, existing facilities will be extended, and new ones will be constructed.

The KBS-3 system encompasses facilities for the management of spent nuclear fuel. At present, the Clab interim storage facility is operational. Planned additions to the system include Clink, which comprises the existing Clab facility and a new encapsulation plant for spent nuclear fuel, and SFK, the final repository for spent nuclear fuel.

The transportation system currently includes ports, a dedicated vessel, transport containers, and terminal vehicles for short-distance land transport. It will be supplemented to accommodate the transport needs of the new facilities.

Once completed, the three systems will be designed to manage all spent nuclear fuel and nuclear waste from reactor operators and SKB's nuclear facilities.

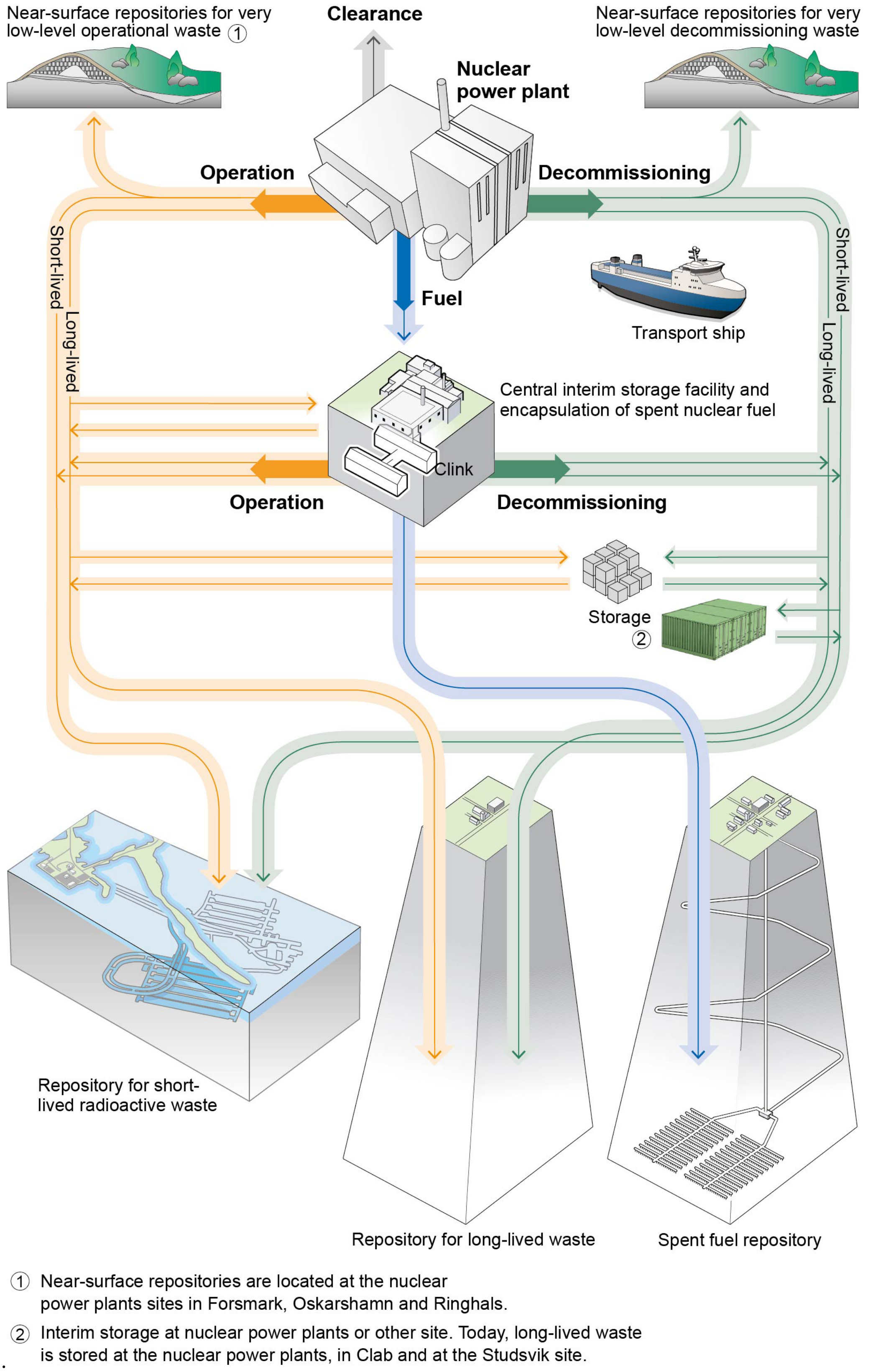

Figure 2-1. *The system for the management of spent nuclear fuel and radioactive waste. The arrows represent transport flows to existing or planned facilities.*

2.2 Facilities within the Low- and Intermediate-Level Waste System

The system for low- and intermediate-level radioactive waste comprises facilities for handling, treatment, interim storage, and disposal. These facilities, along with the waste handling and treatment processes, are adapted to accommodate different categories of waste. Within the system, there are facilities operated both by the Swedish Nuclear Fuel and Waste Management Company (SKB) and by reactor operators. Additionally, facilities located at the Studsvik Tech Park are used, when necessary, for handling or interim storage of waste from nuclear power plants and the Clab interim storage facility.

To ensure the safe management and final disposal of all nuclear waste generated during the operation and decommissioning of Sweden's nuclear reactors and SKB's nuclear facilities, the current infrastructure will be expanded and supplemented with new facilities.

Facilities for Short-Lived Waste

Final disposal of short-lived radioactive waste depends on the content of radioactive substances. Waste containing radionuclides with short half-lives and low surface dose rates may be disposed of in near-surface repositories. Other short-lived waste is placed in the SFR (Final Repository for Short-Lived Radioactive Waste).

Waste Treatment

Treatment facilities for short-lived waste are located at the nuclear power plants, at the Studsvik Tech Park, and at Clab. These facilities process the waste to meet requirements for clearance or for disposal in either the SFR or near-surface repositories. The purpose of treatment may include volume reduction, activity concentration, solidification, or conditioning of the material. The waste is then placed in containers that meet the specifications for each waste category.

Interim Storage

Interim storage facilities for both short-lived and long-lived waste are located at the nuclear power plants. These facilities store waste awaiting treatment and/or packaging, as well as completed waste packages. Decommissioning of six reactors began before the extension of the SFR was completed, meaning that waste from decommissioning must be temporarily stored, either at the nuclear power plants or at alternative locations.

Near-Surface Repositories

Some low-level waste has very low activity. Waste with a surface dose rate below 0.5 mSv/h and predominantly containing short-lived radionuclides (with half-lives shorter than approximately 30 years) may be disposed of in near-surface repositories. Such repositories are located within the industrial areas of the Forsmark, Oskarshamn, and Ringhals nuclear power plants. The repository adjacent to the Oskarshamn plant is also licensed for waste from the decommissioning of the Barsebäck plant. Current practice requires that near-surface repositories be monitored for approximately 30 years after the final waste has been deposited.

Final Repository for Short-Lived Radioactive Waste (SFR)

The SFR in Forsmark has been operational since 1988. It consists of an above-ground section and an underground section, connected by two access tunnels (see Figure 2-2). Final disposal of radioactive waste takes place in rock caverns located 60–140 meters beneath the seabed. Post-closure safety of the SFR is based on limiting the quantity of long-lived radionuclides in the repository and on the ability of engineered and natural barriers to delay radionuclide migration. Each cavern is designed according to the activity level and material characteristics of the waste deposited therein. As of the end of 2024, approximately 42,000 cubic meters of waste had been disposed of in the SFR.

To accommodate the final disposal of waste from the remaining operation and decommissioning of Sweden's nuclear power plants, SKB has received permission to extend the SFR. The underground extension will be constructed at a depth of 120–140 meters below the seabed (see Figure 2-2). The extended facility will include ten rock vaults and one silo, all designed with barriers tailored to different waste types. Upon completion, the total disposal capacity will be approximately 180,000 cubic meters.

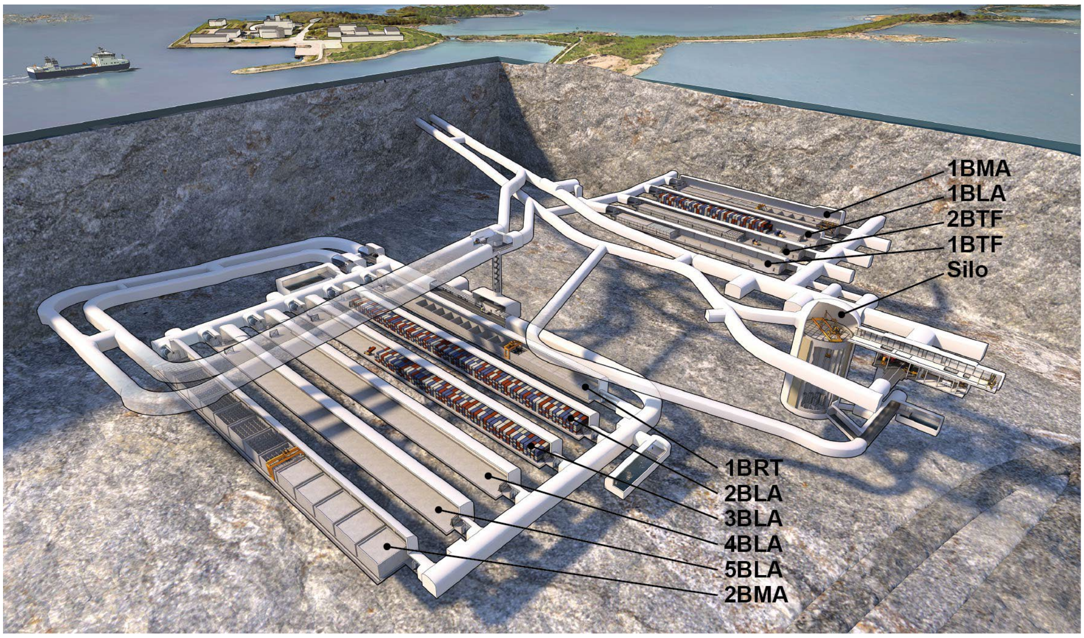

Figure 2-2. *Fully extended SFR with six additional rock vaults: Four vaults for low-level waste (2–5BLA), one vault for intermediate-level waste (2BMA), and one vault for segmented reactor pressure vessels (1BRT).*

2.2.1 Facilities for Long-Lived Waste

Waste Treatment

At the nuclear power plants, there is currently the capability to segment certain spent core components and subsequently place them in containers for interim storage. This process was previously carried out in connection with reactor upgrades but is now primarily conducted as part of decommissioning projects.

2.2.2 Interim Storage

Long-lived radioactive waste is stored in interim facilities until a final repository for such waste is commissioned. Currently, this waste is stored at yjr nuclear power plant sites, at Clab, and at the Studsvik Tech Park. Clab is primarily intended for the interim storage of spent nuclear fuel, but certain long-lived operational waste—such as control rods from boiling water reactors (BWRs) and other core components—is also stored in its storage pools.

Long-lived waste generated during reactor decommissioning is stored either at the site where it is produced or at alternative locations. Forsmarks Kraftgrupp AB (FKA) operates an interim storage facility within a building at the nuclear power plant site for both short- and long-lived waste generated during maintenance outages and power uprates. OKG AB has an interim storage facility in a dedicated rock cavern on the Simpevarp peninsula (BFA), where long-lived waste is stored. Although the operating license is held by OKG, BFA is licensed for interim storage of core components from all Swedish nuclear power plants. Currently, waste from the Oskarshamn nuclear power plant and Clab is stored at BFA, which is considered to have sufficient capacity for the long-lived waste generated during the decommissioning of Oskarshamn 1 and Oskarshamn 2 (O1 and O2).

Ringhals AB (RAB) operates an interim storage facility in a building that is deemed to have adequate capacity for the long-lived waste generated during the decommissioning of Ringhals 1 and Ringhals 2 (R1 and R2). For the remaining reactors at Forsmark, Oskarshamn, and Ringhals, it is assessed that sufficient interim storage capacity can be established at the respective nuclear power plants.

Barsebäck Kraft AB (BKAB) has an interim storage facility within a building at the site, where long-lived waste from Barsebäck 1 and Barsebäck 2 (B1 and B2) is stored. This waste consists of segmented internal components placed in steel containers. According to current plans, these steel containers will be transported to another interim storage facility to allow for the clearance of the BKAB site prior to the commissioning of a final repository for long-lived waste.

At the Studsvik Tech Park, AB Svafo operates an interim storage facility where long-lived waste from several reactor operators is stored.

Final Repository for Long-Lived Waste

SKB plans to dispose of long-lived radioactive waste at a relatively great depth to prevent intrusion into the repository and to avoid freezing of the engineered barriers during colder climatic conditions. The final repository for long-lived waste will be the last facility within the waste management system to be commissioned. According to current plans, construction is expected to begin in the mid-2040s, with commissioning occurring approximately a decade later. The facility is then projected to operate for ten years. The location of the repository has not yet been determined.

The disposal volume will be small in comparison to SKB's other final repositories. Development of the repository is still in an early phase. Post-closure safety is planned to rely on the delay of radionuclide migration through both engineered and natural barriers.

SKB has developed a repository concept (SKB TR-19-01) that includes two disposal sections: one for metallic waste, primarily reactor core components, and one for legacy waste. This proposed repository concept, referred to as SFL, forms the basis for Plan 2025. The concept is illustrated in Figure 2-3.

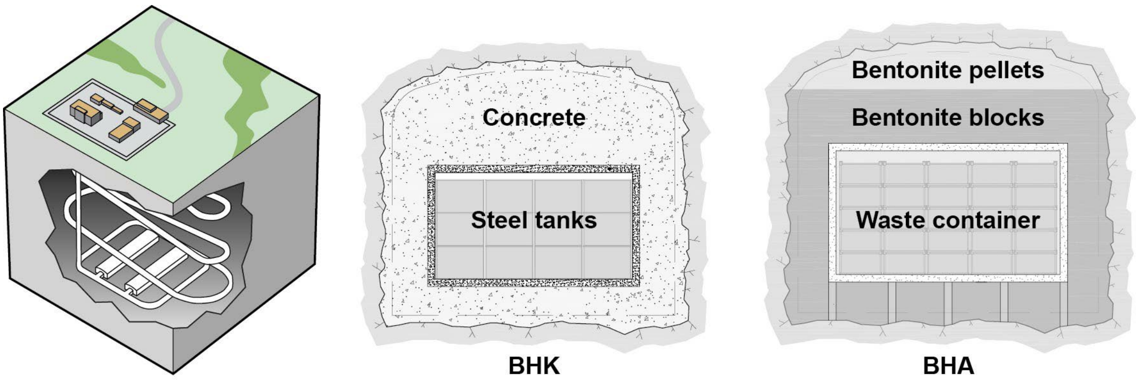

Figure 2-3. *Preliminary layout (left) and repository concept with one waste vault for core components and segmented PWR reactor pressure vessels (BHK), and one waste vault for historical waste (BHA).*

2.3 Facilities within the KBS-3 System for Spent Nuclear Fuel

The KBS-3 system comprises the facilities required for implementing the KBS-3 method. Spent nuclear fuel from Swedish nuclear power plants is currently stored at the Clab interim storage facility in Oskarshamn Municipality. A new encapsulation facility will be constructed adjacent to Clab. This encapsulation facility will be operated as an integrated unit with the interim storage, and the combined facility is referred to as **Clink**.

At Clink, the spent nuclear fuel will be placed into copper canisters, which will then be sealed. The sealed canisters will be transported by ship in specially designed canister transport casks (KTB) to the **SFK** facility in Forsmark, located in Östhammar Municipality. SFK is being constructed to accommodate the final disposal of spent nuclear fuel from Sweden's existing nuclear power programme.

The canisters will be deposited at a depth of approximately 500 meters in deposition holes surrounded by a buffer of swelling bentonite clay. Once all canisters have been deposited, the repository will be backfilled and permanently sealed.

Central Interim Storage Facility for Spent Nuclear Fuel

Spent nuclear fuel is stored at the Clab interim storage facility, as illustrated in Figure 2-4. Operational since 1985, Clab consists of a receiving section at ground level and a storage section located in bedrock approximately 30 meters below the surface. A fuel elevator connects the receiving and storage sections. The storage section comprises two rock caverns, each containing four storage pools and one reserve pool. The ground-level reception section includes pools and handling equipment for transport casks and spent nuclear fuel.

The spent fuel is stored under approximately eight meters of water in specially designed cassettes, which are placed in designated positions within the storage pools. There are two types of cassettes for spent nuclear fuel: standard storage canisters and compact storage canisters. Both types have identical external dimensions, but compact canisters accommodate a greater number of fuel elements.

The Swedish Government has granted SKB permission under the Nuclear Activities Act (KTL) and the Environmental Code (MB) to increase the maximum allowable quantity of spent nuclear fuel stored at Clab from 8,000 tonnes to 11,000 tonnes, calculated as the original amount of uranium. The existing facility has sufficient capacity to accommodate this increase. As of the end of 2024, approximately 8,000 tonnes of spent nuclear fuel were stored at Clab.

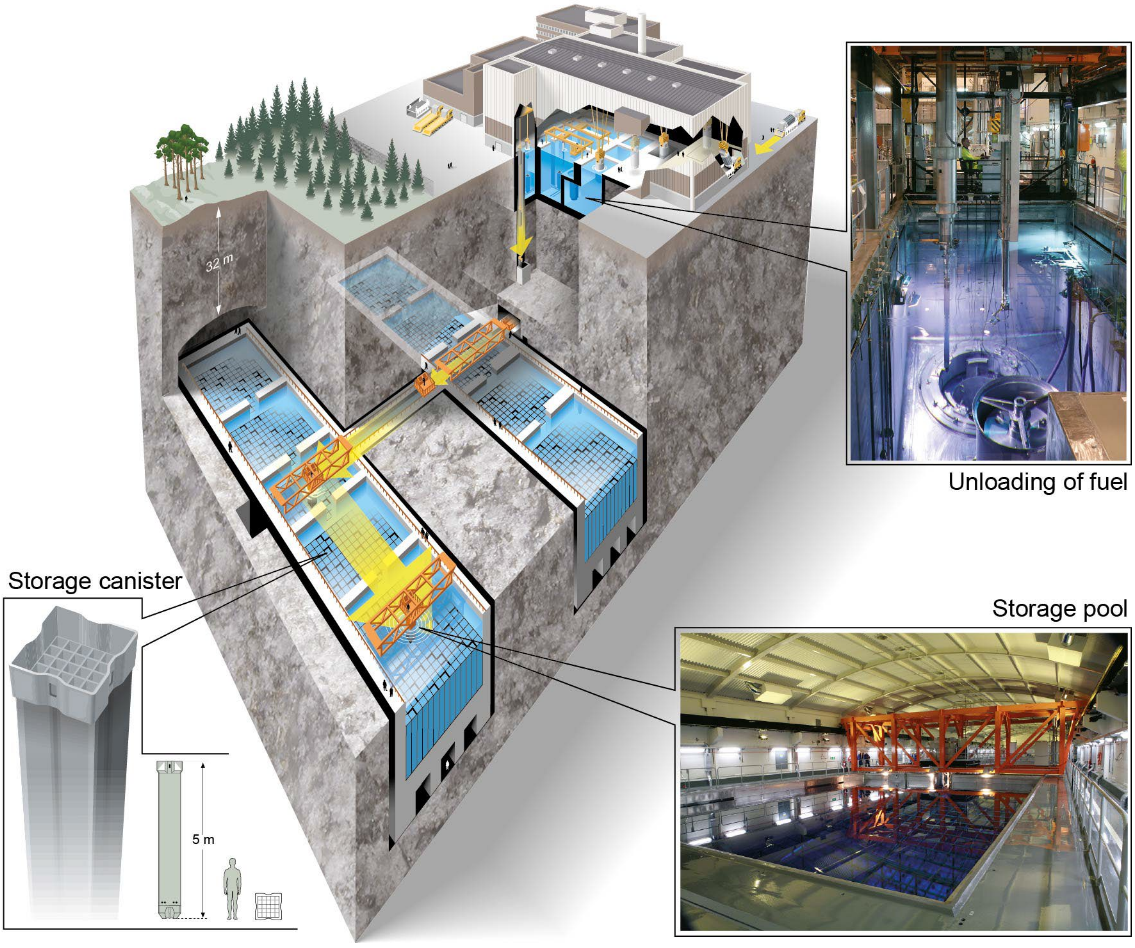

Figure 2-4. *The central interim storage facility for spent nuclear fuel, Clab.*

Central Facility for Interim Storage and Encapsulation of Spent Nuclear Fuel

Before the spent nuclear fuel is deposited in the SFK repository, it is encapsulated in copper canisters. This process will take place in a new facility adjacent to Clab. The two facility sections will be operated as an integrated unit, referred to as Clink.

During encapsulation, fuel assemblies are transferred from their positions in interim storage to the encapsulation section, where they are dried and placed into the canister. For each canister, fuel is selected to ensure that the total residual heat output remains within acceptable limits. The canister is then sealed, and inspections of the canister surface and the sealing weld are conducted. The sealed canister is placed in a canister transport cask (KTB) for shipment to the SFK repository.

The canister consists of a copper shell and an internal insert (see Figure 2-6). The copper shell provides corrosion protection in the repository environment, while the insert offers mechanical stability to withstand potential loads. Inserts are specifically designed to accommodate fuel from either boiling water reactors (BWR) or pressurized water reactors (PWR).

Figure 2-5. *Clink, including the receiving section, storage section in two rock caverns for spent nuclear fuel, and the encapsulation section.*

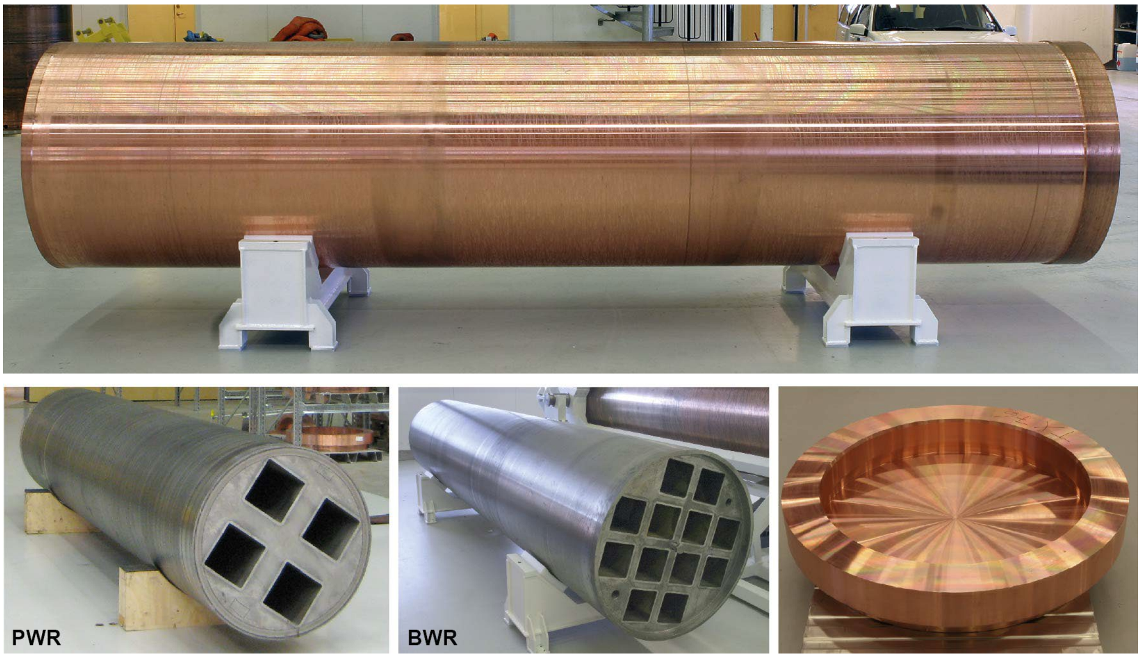

Figure 2-6. *Copper canister with two types of inserts: one accommodating twelve fuel assemblies from BWR reactors, and one accommodating four fuel assemblies from PWR reactors.*

Final Repository for Spent Nuclear Fuel

The SFK repository will be located in Forsmark, within Östhammar Municipality. It will serve as the final disposal site for all spent nuclear fuel from Sweden's existing nuclear power programme.

SKB has developed and selected the KBS-3 method for the final disposal of spent nuclear fuel. The method, whose development began in the late 1970s, is based on a system of passive, interacting protective barriers. These barriers are designed to contain the spent fuel and prevent the release of radioactive elements to humans and the environment over a time horizon of 100,000 years.

The facility will consist of an above-ground section and an underground section (see Figure 2-7). The above-ground section includes an operational area with a main building where nuclear activities will be conducted, and an adjacent industrial area for handling and storing excavated rock and for water treatment.

The connection between the above-ground and underground sections consists of a ramp for vehicle transport and shafts for elevators and ventilation.

The underground section comprises a central area and multiple deposition areas, which together form the repository area. Each deposition area contains several deposition tunnels with deposition holes drilled into the tunnel floors. The placement of the deposition tunnels and the spacing between deposition holes are determined based on the geological properties of the bedrock. Key factors include the location of major deformation zones, the presence of large or highly water-conducting fractures, and the thermal conductivity of the rock.

The repository will be located at a depth of approximately 450–500 meters below the surface.

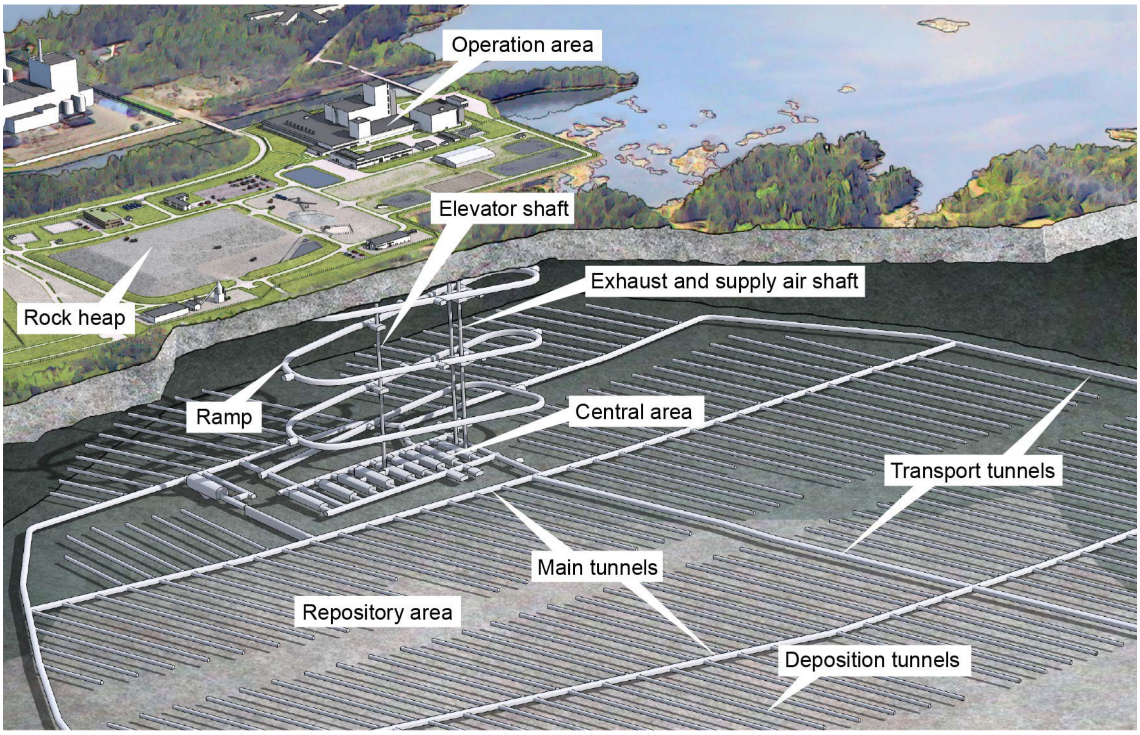

Figure 2-7. *Southern view showing SFK's above-ground and underground facilities, including the central area, repository area, and the ramp and shafts connecting the underground section with the surface facilities.*

The canisters are transported by a dedicated vehicle down the ramp to the central area of the underground facility. From there, they are transferred to a deposition machine and either placed in a canister buffer storage area pending deposition or transported directly to the deposition area.

In the deposition area, the canisters are placed into deposition holes, where they are surrounded by bentonite clay. Once all canisters in a deposition tunnel have been emplaced, the tunnel is backfilled with clay, which will swell upon contact with water. The tunnel is then sealed with a concrete plug.

Construction of the underground facility will proceed progressively during the operational phase. This means that excavation, buffer installation, canister deposition, backfilling, and tunnel sealing will occur in parallel. After all spent nuclear fuel canisters have been deposited, the remaining spaces will be backfilled, and the above-ground facilities will be decommissioned.

2.4 The Transport System

The transport system consists of a dedicated vessel, terminal vehicles, and various types of transport containers for nuclear fuel and radioactive waste (see Figure 2-8).

The vessel *m/s Sigrid*, commissioned in 2014, is used for transporting radioactive waste and spent nuclear fuel. It is constructed with a double hull and double bottom, providing protection for the cargo in the event of grounding or collision. The vessel typically makes between 30 and 40 trips per year between the nuclear power plants, the Studsvik Tech Park, the SFR repository, and Clab.

Short-lived low- and intermediate-level waste is transported from the nuclear power plants and Clab to SFR. Low-level waste, which does not require radiation shielding, is transported in ISO containers. Intermediate-level waste requires shielding and is mostly solidified in concrete or bitumen at the nuclear power plants. This waste is transported in waste transport casks (ATB) with steel walls ranging from 7 to 20 centimetres in thickness, depending on the level of radioactivity.

Currently, some long-lived waste—such as control rods from boiling water reactors (BWRs)—is transported from the nuclear power plants to Clab. This waste is shipped in transport casks with steel walls approximately 30 centimetres thick to shield gamma radiation. Spent nuclear fuel is also transported from the nuclear power plants to Clab in similar casks. Since the fuel emits both neutron radiation and heat, these containers are equipped with a plastic layer for neutron shielding and cooling fins for thermal dissipation.

Figure 2-8. *SKB's transport system currently consists of a ship (m/s Sigrid), terminal vehicles, and transport casks for short-lived radioactive waste (ATB), core components (TK), and spent nuclear fuel (TB).*

Work is underway to renovate and upgrade existing waste transport casks (ATBs) to enable the transport of a broader range of radioactive waste types. Additionally, new transport containers are being developed for larger reactor core components housed in steel containers.

A new type of transport cask is also being developed for the transport of spent nuclear fuel (see Figure 2-9), designed to meet updated safety requirements. The design of this new cask differs from that of current transport casks, necessitating adaptations at both the nuclear power plants and Clab to accommodate its handling. Delivery and testing of these new casks are scheduled to begin in 2025.

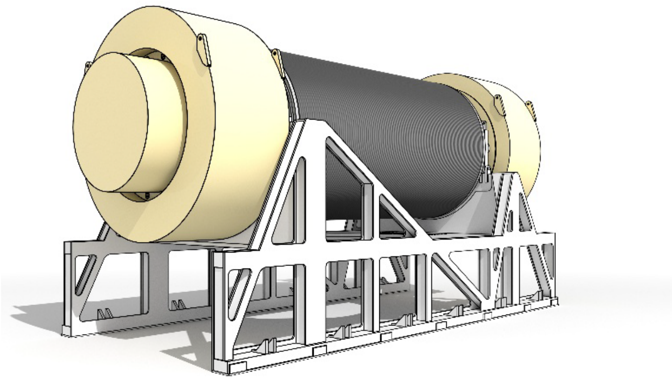

Figure 2-9. Illustration of new transport cask for spent nuclear fuel.

In the future, encapsulated spent nuclear fuel will also be transported from Clink to the SFK repository. To enable this, the transport system will be supplemented with canister transport casks (KTBs). Preparatory work is currently underway to design, license, and manufacture these casks.

2.5 Implementation Plan

This section outlines the planning for the construction and commissioning of new and extended facilities. It also describes the action plans of reactor operators and SKB regarding the decommissioning of nuclear facilities. The chapter begins with an overview of the implementation plans for the nuclear waste management programme.

SKB presents its implementation plan in the RD&D Programme (SKB 2025), which forms the basis for long-term strategic planning and annually updated five-year operational plans. The planning encompasses all facilities through to their eventual decommissioning. Activities are adapted and plans revised in response to external developments, such as decisions by reactor owners or regulatory authorities.

During the current RD&D period, SKB has received several key decisions. In addition to fundamental government approvals, the Land and Environment Court (MMD) has issued conditions under the Environmental Code (MB) for both the extension of the SFR repository and the KBS-3 system. Furthermore, the Swedish Radiation Safety Authority (SSM) has approved the Preliminary Safety Assessment Report (PSAR) for SFR, and construction of the extension is underway. In January 2025, SKB submitted an application to SSM for approval of the PSAR for SFK, and the review process is ongoing. Initial above-ground work at the Forsmark site for SFK has commenced, enabled by the MMD ruling granting SKB enforcement authorization.

Methods for the final disposal of long-lived low- and intermediate-level waste remain under development. During the current RD&D period, efforts have primarily focused on inventory analysis and preliminary acceptance criteria. Once the necessary data on inventory are available, they will form the basis for repository design and post-closure safety analysis. In addition to continued work on inventory, the previously conducted safety assessment (SKB TR-19-01) serves as a foundation for ongoing research and technological development. The results will provide the necessary conditions for submitting applications for licensing and approval of the final repository.

2.5.1 Implementation Plan for the Nuclear Waste Programme

SKB's planning for the extension and construction of new facilities is based on the various permits and approvals required under a stepwise process, where each step represents a milestone.

The operational phase for the final repositories and Clink begins with a commissioning phase, during which radioactive waste is handled and deposited—albeit at a lower rate than during subsequent routine operations. The underground section of SFK will be progressively constructed during routine operations. Decommissioning of the facilities and final closure of the repository will follow during the decommissioning phase. Each phase requires review and approval of updated safety assessments by the Swedish Radiation Safety Authority (SSM). Final closure also requires government authorization.

Figure 2-10 presents the overall activity and milestone plan for the nuclear waste management programme. The figure also illustrates waste flows and their temporal distribution.

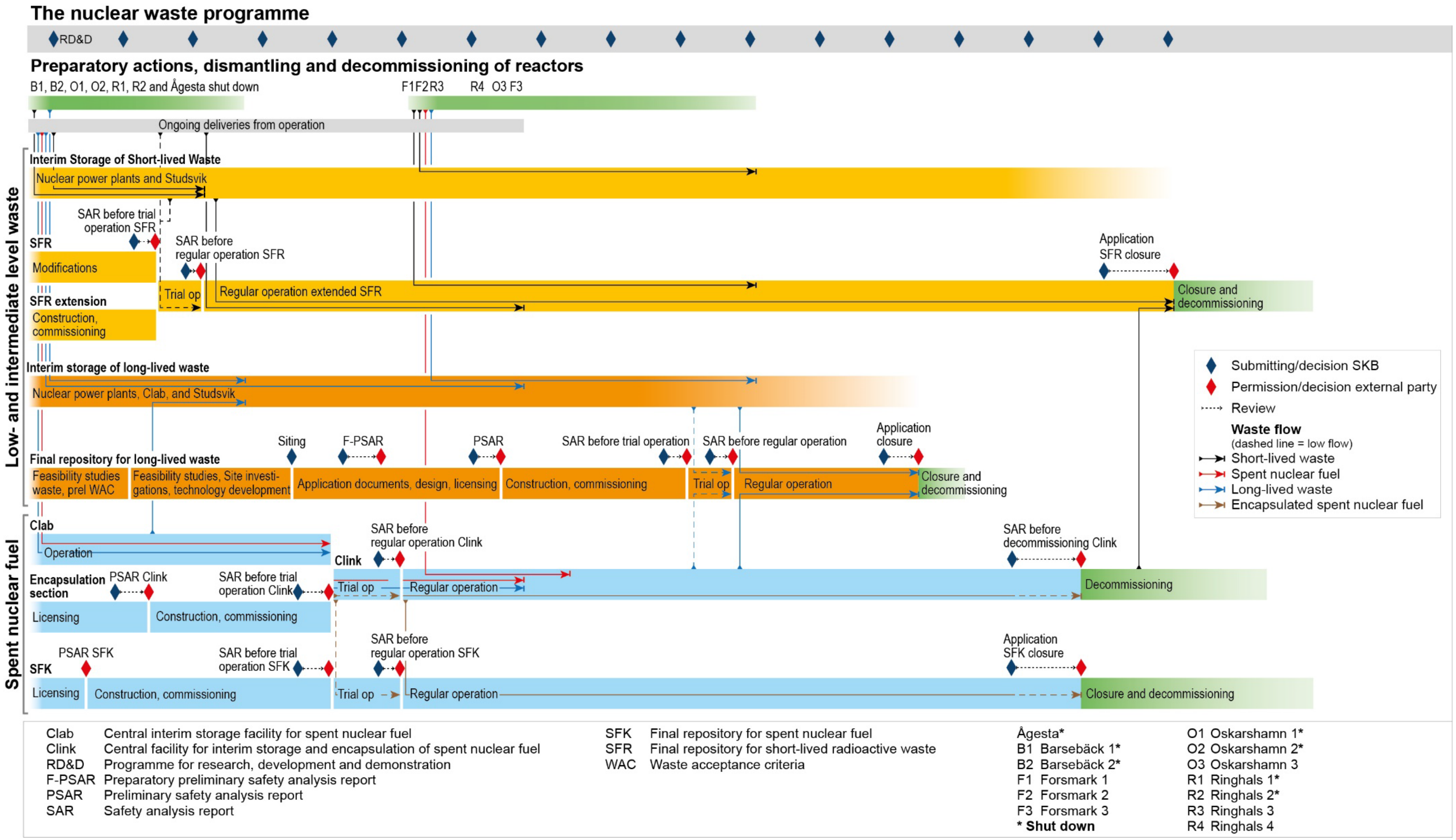

Figure 2-10. *Activity and milestone plan for SKB's nuclear waste programme and reactor decommissioning plans. The figure also shows waste flows and their timeline.*

2.5.2 Planning for Low- and Intermediate-Level Waste

SKB's plans for the final disposal of low- and intermediate-level radioactive waste include the ongoing extension of the SFR repository and future, yet-to-be-licensed activities for the disposal of long-lived low- and intermediate-level waste.

Short-Lived Waste

Decommissioning and dismantling of the first reactors has begun, and in some cases completed, before the extended SFR is ready to receive decommissioning waste. As a result, BKAB, OKG, and RAB will temporarily store short-lived decommissioning waste primarily at the respective plant sites, although other locations may also be considered.

There will also be a need to temporarily store operational waste during the SFR extension period, as waste deposition at the facility will be suspended during construction.

SKB initiated the extension of SFR in December 2024, following receipt of all necessary permits, conditions, and approvals from the Government, the Land and Environment Court (MMD), and the Swedish Radiation Safety Authority (SSM). The extension is expected to be completed and the integrated facility ready for commissioning in the early 2030s.

In parallel with the extension, the existing SFR facility will be upgraded, partly due to the extended operational period compared to the original plan. SKB intends to submit a revised Safety Assessment Report (SAR) prior to commissioning in the late 2020s, followed by a supplementary SAR ahead of routine operations.

Long-Lived Waste

SKB plans to begin final disposal of long-lived waste during the 2050s. Since some reactors will be decommissioned earlier, the long-lived waste generated during their dismantling will need to be temporarily stored.

Interim storage facilities for long-lived waste will be used until transport to a final repository becomes feasible. To enable these transports, a new type of licensed waste transport container will be required.

Several key milestones must be achieved before final disposal of long-lived waste can begin, including site selection and site investigations, post-closure safety analysis, completion of the licensing process, and construction of the repository. Planning is based on a scenario in which disposal takes place at one of the previously studied sites known to SKB. According to current plans, the disposal phase will span approximately ten years.

2.5.3 Planning for Spent Nuclear Fuel

The only facility currently in operation within the KBS-3 system is Clab. The remaining facilities to be constructed include an encapsulation plant adjacent to Clab—which will be operated as an integrated unit and referred to as Clink—and the SFK repository, where the spent nuclear fuel will be permanently disposed of.

The establishment of facilities within the KBS-3 system is divided into the main phases of *licensing*, *construction and commissioning*, *trial operation*, *regular operation*, and *decommissioning and closure*.

In addition to Clink, a conventional industrial facility for canister manufacturing is planned to be constructed nearby, intended for the processing and assembly of canister components.

Interim Storage

According to current plans, trial operation of SFK and Clink will begin in the second half of the 2030s, at which point the unloading of spent nuclear fuel from interim storage can commence. In order for Clab to continue receiving spent nuclear fuel until that time, measures must be taken to free up storage capacity.

This will be achieved by transferring spent fuel currently stored in standard storage canisters into compact storage cassettes. While both storage canisters have the same external dimensions, compact canisters can accommodate a greater number of fuel assemblies. An additional measure involves the removal of reactor core components for interim storage at another location.

Encapsulation

Construction work is ongoing for the encapsulation section of Clink, and the results will form the basis for continued efforts during the construction phase. Documentation is currently being prepared to support SKB's application to the Swedish Radiation Safety Authority (SSM) for approval of the Preliminary Safety Assessment Report (PSAR) for Clink.

Operations at Clab will continue throughout the construction of the encapsulation facility; however, the reception of spent nuclear fuel may need to be temporarily limited during certain periods.

Once the trial operation of Clink has been evaluated and SSM has approved the application for regular operation, full-scale operation may commence. The operation of Clink will encompass both the current activities at Clab and the various processes within the encapsulation facility, including the selection of spent nuclear fuel for encapsulation, inspection and encapsulation of the fuel, and inspection of the sealed canisters.

In addition to the optimization and design of canister components, technological development is primarily focused on processes for controlling and ensuring quality during the manufacturing of canister components, welding of the copper base, sealing, and the development of inspection and testing methods for components and welds.

Final Disposal

SKB has received all necessary approvals to begin site preparation work at Forsmark. Preparations for the construction of the underground facility of SFK are underway and will commence once the Swedish Radiation Safety Authority (SSM) approves the Preliminary Safety Assessment Report (PSAR).

The SFK design phase includes technical construction preparations and geological investigations. Additional site surveys are being conducted to support the placement of buildings and the design of foundations. Bedrock investigations will focus primarily on the planned location of the ramp. Local infrastructure at Forsmark is being adapted, largely in collaboration with Forsmarks Kraftgrupp AB (FKA), to meet the needs of both SFK and the SFR extension.

In parallel with the licensing process, detailed design work has been carried out for the facility components to be constructed early in the project. These include establishment areas, site offices, access routes to the repository—namely the ramp, shafts, and central area—as well as above-ground structures.

The construction phase may begin once the PSAR has been approved by SSM. Initial activities will include filling parts of the operational area, preparing handling surfaces, and establishing temporary construction facilities.

Construction of the underground repository will be divided into three stages:

1. Excavation of access routes (ramp and shafts) down to the repository level.
2. Construction of the central area's rock caverns and installation of technical systems.
3. Establishment of the first deposition area and initiation of trial operation.

The technological development required to complete the deposition system includes buffer installation, backfilling, plugging, and the development of methods and machinery for these installations.

As with Clink, an integrated system test will be conducted for the repository facility. This will involve executing all operational steps, including the deposition of a number of canisters without spent nuclear fuel, to test system functionality and organizational readiness.

Regular operation of SFK will include the progressive construction and completion of site-specific deposition tunnels with deposition holes, as well as the transport and deposition of canisters, installation of buffer material, backfilling, and plugging of deposition tunnels.

2.5.4 Planning for Very Low-Level Waste

Currently, the necessary facilities are in place for handling the very low-level radioactive waste generated during reactor operation. However, during the decommissioning of nuclear reactors, the volume of waste requiring management is expected to increase significantly.

To manage the large volumes of very low-level waste generated during the dismantling of nuclear reactors, reactor operators foresee a need for near-surface disposal facilities.

2.5.5 Planning for Decommissioning of Nuclear Facilities

The planning for the decommissioning of the nuclear power plants at Barsebäck, Forsmark, Oskarshamn, and Ringhals, along with SKB's nuclear facilities, is presented below.

The decommissioning plans of the reactor owners and SKB outline the intended implementation with a focus on radiation safety and strategic considerations. Estimated waste volumes from the decommissioning are reported in the respective decommissioning and waste management plans. Waste volumes by type and activity category are continuously updated during the dismantling and demolition phase based on results from radiological surveys.

The purpose of decommissioning a nuclear facility is to release the site from regulatory control with as few restrictions as reasonably possible. Buildings and infrastructure that are useful for continued operations and can be released from regulatory control are retained, while other installations are dismantled. Conventional demolition of buildings is carried out to approximately one meter below ground level, and remaining cavities are backfilled with demolition debris. The topsoil is restored to the condition required for continued site use. For the underground parts of final disposal facilities, decommissioning involves backfilling tunnels and sealing the repository. Above-ground structures are decommissioned according to the same principles as other nuclear facilities.

Decommissioning a reactor generates several waste streams. Spent nuclear fuel is transported to Clab or later to Clink, and subsequently to the SFK for final disposal, while other waste is sorted. Short-lived waste that cannot be released from regulatory control is sorted based on activity content and deposited in near-surface repositories or in the SFR. Long-lived waste is planned to be disposed of in a repository for long-lived waste. Reactor pressure vessels and internal components are segmented; for example, segmented components from BWR reactors are deposited in the SFR, while those from PWR reactors are also deposited in a repository for long-lived waste.

The reactor owners plan to initiate dismantling and demolition as soon as possible after permanent shutdown. Necessary permits must be in place prior to decommissioning. Once a reactor is permanently shut down, defueling operations begin and all spent nuclear fuel is removed for interim storage. If needed, a service operation phase follows until dismantling and demolition begins. After regulatory release, building demolition can proceed and the site can be restored.

In addition to transporting spent nuclear fuel, systems are shut down and operational waste is managed during defueling operations. Preparatory activities for dismantling and demolition are also planned, such as decontamination of the primary system, aimed at making subsequent work as safe and efficient as possible by reducing dose rates within the facility. The timing of dismantling and demolition is optimized to ensure decommissioning begins without delay after shutdown. Dismantling and demolition work is divided into a suitable number of defined packages or phases. The planning of work tasks and their sequence will be continuously optimized throughout the decommissioning process based on ALARA (As Low As Reasonably Achievable) and BAT (Best Available Technique) principles to minimize radiation doses and maximize efficiency.

It is estimated that conventional waste streams constitute approximately 95% of the total waste volume, with the majority consisting of demolition debris from buildings. To minimize post-treatment requirements, buildings are decontaminated prior to demolition. Demolition debris is crushed and reused for construction purposes as needed. Non-mineral waste fractions and surplus materials are disposed of through recycling or landfill.

The reactor owners and SKB collaborate to select a safe handling solution that meets regulatory requirements and is optimized for the entire waste management chain—from dismantling through characterization, packaging, interim storage, and transport to final disposal for various types of decommissioning waste.

Figure 2-11 illustrates the overall activity and milestone plan for the decommissioning of nuclear and conventional facilities.

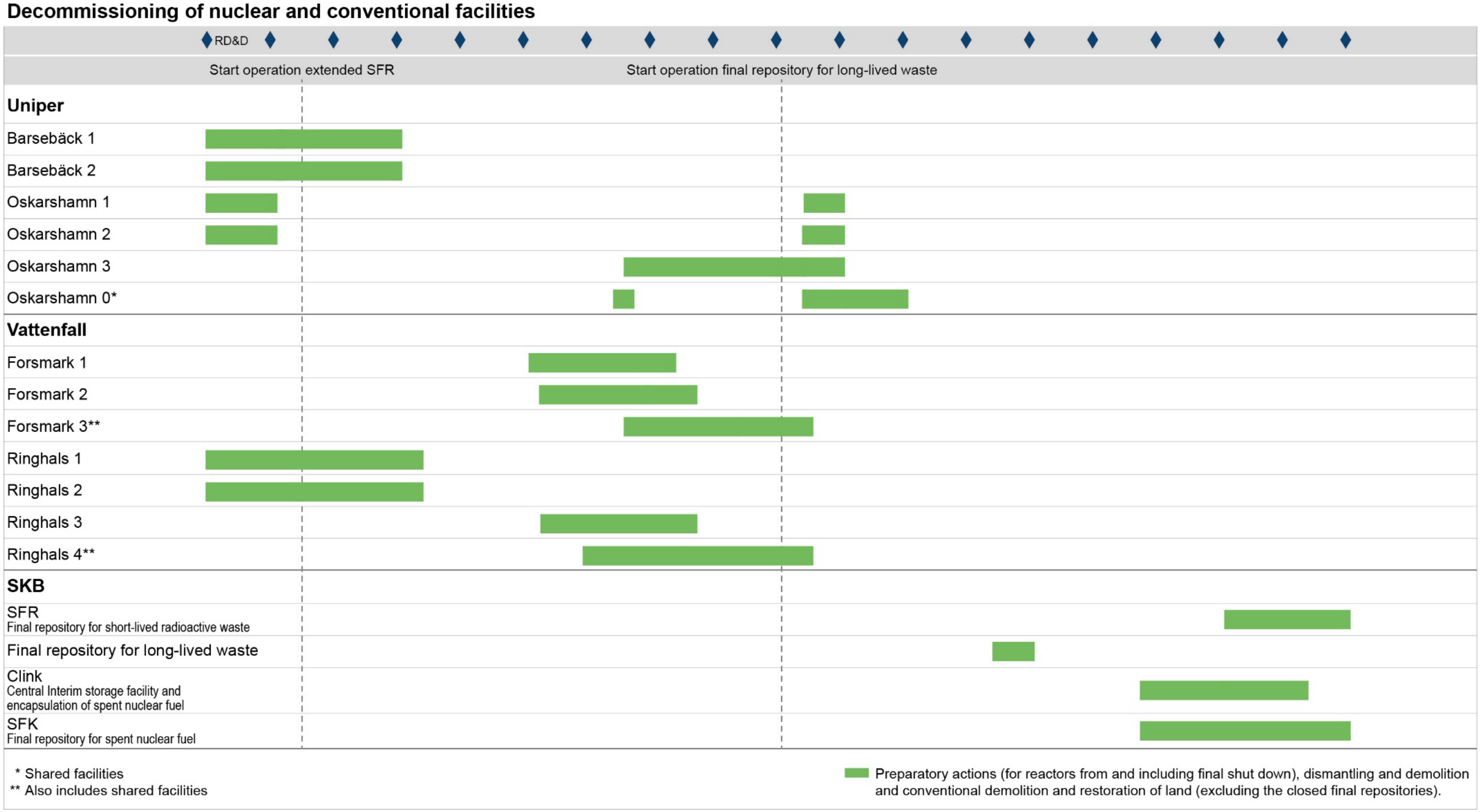

Figure 2-11. *Activity and Milestone plan for the decommissioning of nuclear and conventional facilities.*

Decommissioning within Uniper

Uniper is the majority owner of OKG and BKAB. In 2017, Uniper decided to initiate the dismantling and demolition of reactors B1, B2, O1, and O2 within a unified programme. Since 2022, Uniper's subsidiary, Sydkraft Nuclear Services AB, has served as the contractor for this work under the name Swedish Uniper Decommissioning and Dismantling (SUDD). SUDD's detailed planning and procurement for each phase are based on the use of proven technologies and established methods to minimize technical and safety-related risks. BKAB and OKG act as client organizations in relation to SUDD.

Uniper will evaluate and preserve the lessons learned from the ongoing decommissioning programme to support the planning and execution of future decommissioning activities for O0 (shared facilities) and O3.

Figure 2-12 presents the overarching plans for the decommissioning of Uniper's nuclear facilities in Sweden.

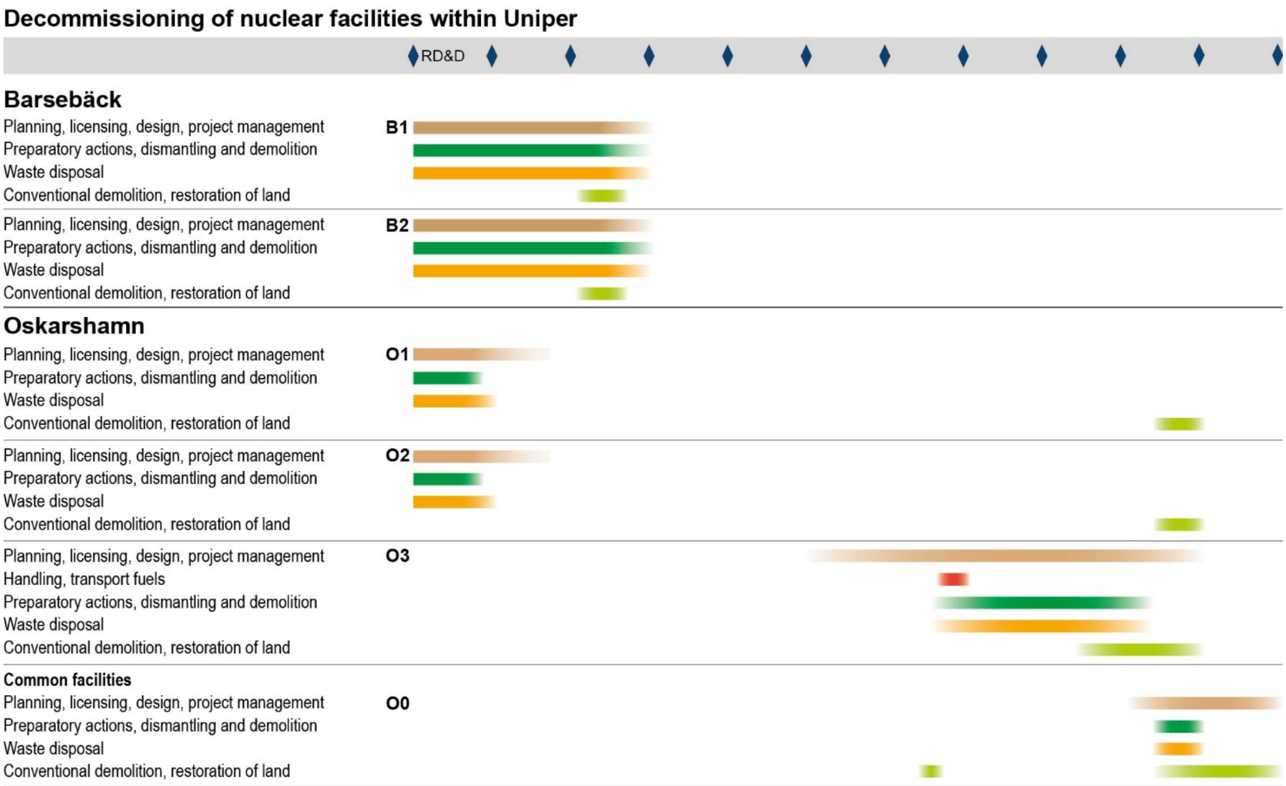

Figure 2-12. *Overview of the decommissioning plans of Barsebäck Kraft AB and OKG Aktiebolag.*

The Barsebäck Nuclear Power Plant is owned and managed by BKAB. Reactor B1 has been permanently shut down since 1999, and reactor B2 since 2005. The site (property) is owned by Sydkraft Nuclear Power AB.

Dismantling and demolition began in 2020. The buildings within the power plant area are planned to be eligible for regulatory release for demolition by 2028 and, following approval, will be dismantled according to the current schedule. The power plant area is expected to be restored for regulatory release in the early 2030s.

Once the interim storage facilities for low- and intermediate-level radioactive waste in the harbour area have been emptied of nuclear waste, these facilities and the surrounding area can be prepared for regulatory release.

BKAB has established local procedures for the regulatory release of materials. If necessary, certain materials may undergo decontamination prior to release. In addition, BKAB utilizes external treatment for the release of metallic materials.

BKAB can dispose of very low-level radioactive waste at OKG's new near-surface repository MLA3 or, following a specific release decision, at the hazardous waste landfill outside Kumla.

Since the decommissioning of the Barsebäck plant is being carried out before the extended SFR (Final Repository for Short-Lived Radioactive Waste) is operational, BKAB has constructed a new interim storage facility for low-level waste. Intermediate-level waste is also stored temporarily within the harbour area pending final disposal. To enable regulatory release of the harbour area before a repository for long-lived waste is available, external interim storage solutions are being investigated.

OKG owns the nuclear reactors O1, O2, and O3, all of which are of the BWR (Boiling Water Reactor) type, as well as the shared facilities designated O0. The site (property) is owned by OKG.

Reactor O1 has been permanently shut down since 2017, and reactor O2 since 2015. Dismantling and demolition of these two units began in 2020. The buildings within the so-called decommissioning area—primarily O1, O2, and a shared waste facility (0AVF)—are planned to be eligible for regulatory release by 2028. Conventional demolition is scheduled to occur in conjunction with the demolition of O3.

Reactor O3 is expected to remain in operation until the mid-2040s. Shared facilities will be decommissioned once they are no longer required for the operation or decommissioning of O3. Planning for the decommissioning of O3 and O0 will continue during the operational phase in accordance with standard procedures, incorporating lessons learned from Uniper's decommissioning programme.

Demolition of O3 and the remaining buildings on the site is planned to begin in the mid-2050s. The site will then be prepared for clearance.

OKG has established local procedures for the regulatory release of materials. Where necessary, materials may undergo decontamination prior to release. Additionally, metallic materials are released following off site treatment.

Very low-level radioactive waste can be disposed of in OKG's new near-surface repository, MLA3.

Since the dismantling of O1 and O2 is being carried out before the extended SFR (Final Repository for Short-Lived Radioactive Waste) is operational, OKG has constructed a new interim storage facility for low-level waste. Intermediate-level waste is temporarily stored in BFA pending final disposal.

Decommissioning within Vattenfall

Vattenfall is the majority owner of RAB and FKA. The decommissioning of reactors R1 and R2 is currently underway.

Figure 2-13 presents the overarching plans for the decommissioning of Vattenfall's nuclear facilities in Sweden.

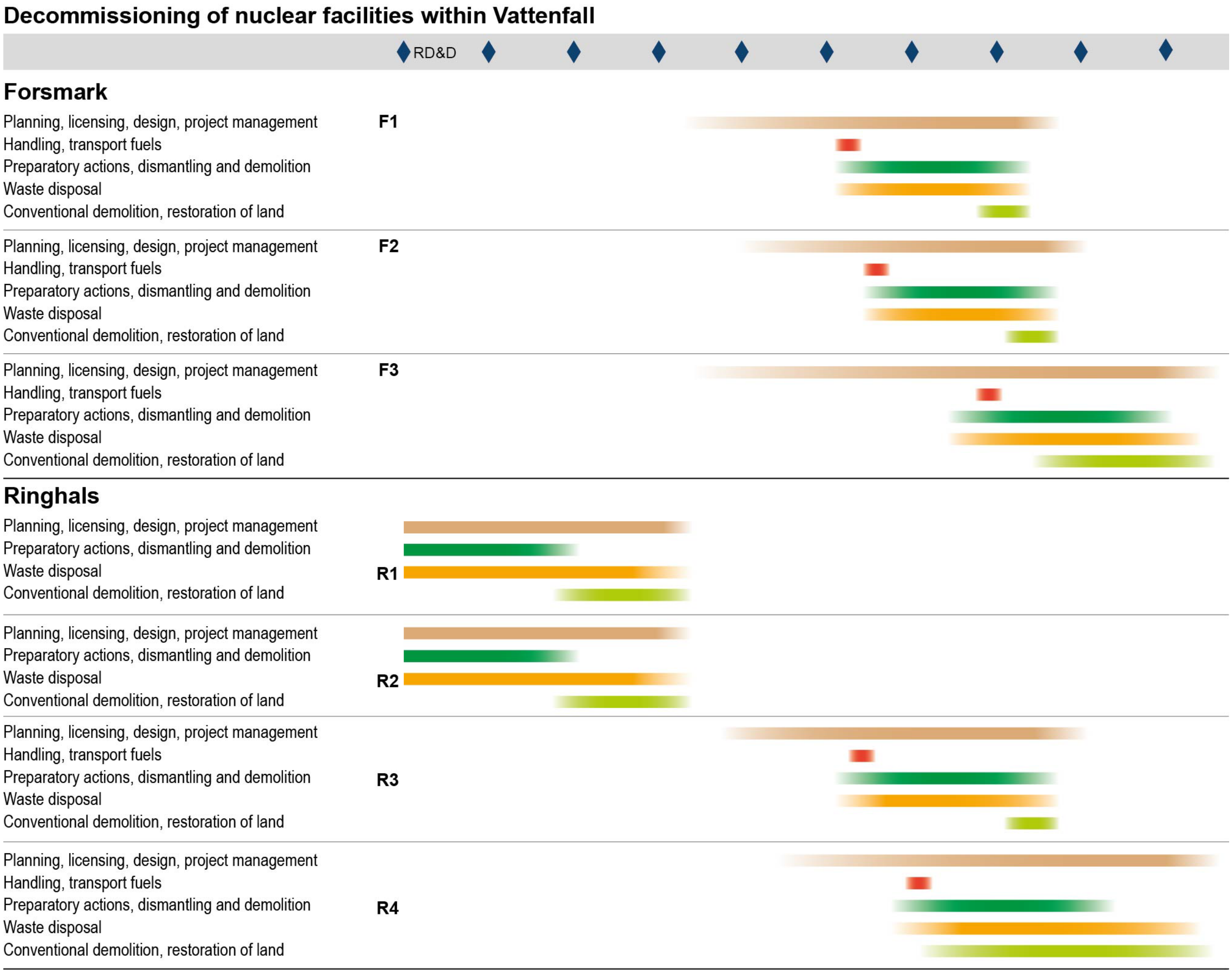

Figure 2-13. *Overview of the decommissioning plans of Forsmarks kraftgrupp AB and Ringhals AB.*

The Ringhals Nuclear Power Plant consists of four reactors: R1 is of the BWR (Boiling Water Reactor) type, while R2, R3, and R4 are PWR (Pressurized Water Reactor) units, arranged in two reactor pairs.

Reactors R1 and R2 are defueled, and dismantling and demolition has commenced, with completion expected in the early 2030s. Reactors R3 and R4 are planned to remain in operation until 2041 and 2043, respectively.

The layout of the reactors allows for separation between the reactor pairs, enabling parallel operation and decommissioning within distinct operational zones. The decommissioning of R1 and R2 is logistically facilitated by the proximity of the existing waste management facility to R1.

The decommissioning of the Ringhals reactors is described in two separate plans: one for R1 and R2, and another for R3 and R4. The plan for R4 also includes shared facilities, such as the waste management facility and interim storage. R1 and R2 entered the dismantling and demolition phase in 2024. All activities related to the decommissioning are coordinated within a unified programme, which outlines the tasks being analysed or executed during each programme phase.

Since the final shutdown of R1 and R2 occurred before the extended SFR (Final Repository for Short-Lived Radioactive Waste) became operational, the resulting nuclear waste must be stored temporarily. This interim storage can be managed locally at the Ringhals site and, to some extent, externally. Local interim storage reduces external dependencies and is therefore the preferred option for most waste streams. Storage will take place in refurbished existing facilities for intermediate-level waste and in a newly constructed interim storage facility for low-level waste within the current waste management area.

The Forsmark Nuclear Power Plant comprises three BWR-type reactors: F1, F2, and F3. All reactors operated by FKA are planned for a 60-year lifespan, which corresponds to decommissioning around 2040, 2041, and 2045 for F1, F2, and F3, respectively.

The decommissioning of F1, F2, and F3 is outlined in a dedicated decommissioning plan. The dismantling and demolition for F1 and F2 is expected to be executed in a manner that maximizes synergies and minimizes the need for facility separation or service operation. During the decommissioning projects for F1 and F2, F3 will enter a defueled operational phase, allowing continuous decommissioning activities on-site from the start of the first project until the final dismantling of the last reactor.

The baseline planning assumes that the extended SFR will be operational at the time of dismantling and demolition for the Forsmark units, which would limit the need for interim storage to long-lived waste only. Short-lived waste will be sent to SFR after packaging.

When dismantling and demolition begins for FKA's reactors, a repository for long-lived waste will not yet be operational. As a result, interim storage and final conditioning of long-lived waste will continue after the completion of dismantling and demolition for the reactors.

Decommissioning of SKB's Facilities

SKB's facilities are among the last nuclear installations scheduled for decommissioning, with dismantling expected to begin approximately 50 years from now. As such, the decommissioning planning is presented in general terms, with references to existing decommissioning plans for more detailed information.

Decommissioning of Clink and SFK can begin only after all spent nuclear fuel has been disposed of. The decommissioning of SFR can commence once the waste from Clink's decommissioning has been deposited. In contrast, a repository for long-lived waste can be decommissioned once the long-lived waste from the final reactor has been managed. This planning assumes that the waste from Clink's decommissioning does not contain long-lived waste and that the long-lived waste currently stored by AB Svafo has been properly handled.

A decommissioning plan has been developed for the existing Clab facility. This plan was updated in 2020 to clarify how dismantling and demolition is intended to be carried out for the underground sections of the facility.

SKB holds the license for SFR, and the decommissioning plan for the existing facility was updated in 2018 as part of SKB's periodic safety review.

During the most recent Fud (Research, Development and Demonstration) period, the decommissioning plan for the extended SFR was also updated. This update was conducted in parallel with the development of the Preliminary Safety Analysis Report (PSAR).

The timeline for decommissioning the SFR (Final Repository for Short-Lived Radioactive Waste) is linked to the dismantling of the last nuclear power plants and other SKB nuclear facilities, and the final disposal of radioactive waste. Once these conditions are met, decommissioning of the SFR can begin, with completion planned within five years. Waste from facility components that may be subject to dismantling during decommissioning (e.g., above-ground structures) will be managed as conventional waste, as they do not contain radioactive material. A radiological survey of the facility will be conducted to rule out contamination of structural components that may have come into contact with waste containers during operation, such as the terminal building.

The design of a future repository for long-lived waste is currently at the conceptual stage. A decommissioning plan will be developed in conjunction with the license application for construction of the facility. Decommissioning will begin in connection with the closure of the repository.

During the most recent Fud (Research, Development and Demonstration) period, the decommissioning plan for SFK (Final Repository for Spent Nuclear Fuel) was updated. This update was carried out in parallel with the development of the Preliminary Safety Analysis Report (PSAR) for the facility and is included as part of the application for PSAR approval.

Decommissioning of SFK will commence after the main operational phase has ended—that is, once all spent nuclear fuel has been disposed of, the deposition tunnels have been backfilled, and plugs have been installed. The sealing of the underground sections is part of the repository's barrier functions and is critical for post-closure safety.

At the start of SFK's decommissioning, no contamination will be present in the above-ground facility. Therefore, dismantling will be carried out as for a conventional facility.

2.5.6 Transport Planning

All transports are carried out by sea, except for those from the Forsmark Nuclear Power Plant to the SFR and from the Oskarshamn Nuclear Power Plant to Clab, which are conducted by land.

General Planning

Transport system utilization is expected to increase starting in the 2030s, as encapsulated spent nuclear fuel will be transported from Clink to SFK in parallel with the transport of decommissioning waste to SFR.

An increased need for transporting operational waste to SFR is also anticipated once the extension work is complete and the facility can receive waste again. After the final reactors have been decommissioned, transport volumes will decrease, and shipments will primarily consist of encapsulated spent fuel to SFK.

Neither the vessel capacity nor other components of the transport system are expected to be limiting factors for the implementation of the nuclear waste management programme, as the current transport system has excess capacity.

Transport of Low- and Intermediate-Level Waste

Transport of long-lived waste, in the form of BWR control rods to interim storage, will continue as long as BWR reactors remain in operation. These shipments use transport casks designed for core components.

Short-lived low- and intermediate-level waste is transported from nuclear power plants, Clab, and the Studsvik Tech Park to SFR for final disposal. Low-level waste is transported in ISO containers, while intermediate-level waste is transported in ATB casks. These transports will be conducted in campaigns.

Before a repository for long-lived waste becomes operational, waste will be transported from the Barsebäck Nuclear Power Plant to interim storage. During the operational phase of the repository, both previously stored waste and newly generated waste will be transported to the facility.

The transport system will be supplemented with a new type of transport cask for long-lived intermediate-level waste.

Transport of Spent Nuclear Fuel

Current shipments of spent nuclear fuel from nuclear power plants to Clab will continue in the same manner to Clink for as long as reactors remain in operation.

Once the KBS-3 system becomes operational, spent nuclear fuel will be transported from Clink to SFK. At that point, the transport system will be supplemented with a KTB (transport cask for encapsulated fuel).

To meet licensing requirements and SKB's internal standards, the design of the KTB is being developed through an iterative process in collaboration with the supplier. The container's design and safety-related features are documented in a safety report, which serves as the basis for licensing by the competent authority in the country where the KTB is manufactured. Before the container can be used in Sweden, the license must be validated by the Swedish Radiation Safety Authority (SSM). The estimated time required for design and licensing is at least seven years.

The first KTB is scheduled for delivery ahead of individual system testing. These initial system-level tests are planned to take place one year prior to the integrated system testing of each facility. The remaining containers will be manufactured and delivered successively thereafter.

2.5.7 Continued Research and Development

For the licensed facilities—SFR, SFK, and Clink within the KBS-3 system—ongoing research is being conducted to further develop and strengthen the analyses ahead of the next steps in the stepwise review process under the Nuclear Activities Act (KTL). The application for approval of the Preliminary Safety Analysis Report (PSAR) for SFK includes plans outlining continued research and development activities. Research and technological development are also being carried out to reduce conservatism in the analyses and to support optimization of the final repository and its technical barriers.

Operational experience from the existing SFR facility will be utilized to refine descriptions of waste-related processes where necessary, revise inventory predictions, and identify needs for new or improved waste and waste transport containers. Development efforts are ongoing to improve methods for determining the inventory of low- and intermediate-level radioactive waste.

For a repository for long-lived waste, further work is required before applications for permissibility and licensing under the Environmental Code (MB) and the Nuclear Activities Act (KTL) can be completed. Much of the research and technological development conducted and planned for SFR is also relevant to the disposal of long-lived waste. The safety evaluation presented in 2019 (SKB TR-19-01) has served as a foundation for continued research and development efforts. It also provides a basis for site selection criteria and the process of identifying a suitable location for the repository.

The research and technological development required for near-surface disposal and the management of very low-level radioactive waste are considered to be minimal.

Licensed Facilities

SKB and the nuclear power plant owners base their planning of research and technological development efforts for the final repositories and Clink on the action plans that have been presented. Applications and safety assessments determine when knowledge and technological maturity must reach the level required for SKB to initiate construction or operation of the facilities.

Part of the preparations for start of construction includes planning for procurement of contractors and establishing an organizational structure that enables effective knowledge transfer between the various construction projects. The development of investigation programmes with associated method descriptions is also an important preparatory activity.

A key foundation for the RD&D (research, development and demonstration) programme for SFK is the set of plans and programmes included in SKB’s application for approval of the Preliminary Safety Analysis Report (PSAR) for SFK. Since government approval for SFK has been granted, the focus has shifted from detailed descriptions in the R&D programme to outlining plans and programmes within the framework of the continued stepwise licensing process. As a result, the current RD&D programme (SKB 2025) presents results and plans in a more concise manner than previous versions.

Following the government’s approval of the SFR extension, the reporting has been adjusted in a similar way as for SFK. The prioritization of activities related to SFR is based on operational experience, feedback from regulatory reviews, results from post-closure safety analyses, and previous research and development.

An essential part of the development work is to demonstrate how proposed solutions function in practice. After the conclusion of field experiments at the Äspö Hard Rock Laboratory, demonstration trials will be conducted near the repository as part of the testing and verification of selected solutions.

As part of the research and development efforts, the potential for optimizing the technical design—while maintaining or enhancing safety—is being investigated. To date, development has primarily focused on individual systems. Therefore, the conditions for technical optimization are considered particularly favourable in terms of the interaction between the production lines for the various barriers, as well as for the development of technical systems within each production line.

Non-Licensed Facilities

The proposed repository concept for long-lived waste, which formed the basis of the safety evaluation conducted in 2019 (SKB TR-19-01), needs to be further refined as knowledge of the waste inventory increases through ongoing waste characterization efforts. Once the waste has been sufficiently characterized—meaning the material composition and radionuclide content have been detailed to an adequate extent—it will be possible to assess whether the existing safety evaluation requires updating. Enhanced understanding of the waste is expected to reduce uncertainties and/or the need for conservative assumptions in the safety assessment, thereby providing improved conditions for the continued development of technical barriers and acceptance criteria for the waste.

The ongoing extension of the SFR facility and the construction of SFK will provide valuable experience, particularly regarding barrier design. Knowledge gained from completed and ongoing research related to SFR and SFK will also be beneficial for the development of a repository for long-lived waste.

3 Cost Estimation Methodology

During the cost estimation process, several calculations are prepared. Some of these serve as the basis for the amounts requested in accordance with the Financing Ordinance, while others are developed to support SKB's ongoing operations and reporting to its owners.

The facilities operated or planned by SKB are intended for the management of spent nuclear fuel and radioactive waste from Swedish nuclear power plants. In these facilities, SKB will also, for a fee, accept small quantities of radioactive waste from industrial facilities, research institutions, and other organisations (such as those within the healthcare sector). The costs associated with managing this type of waste are not included in SKB's cost estimates.

3.1 Development of the Reference Estimate

The quantity of spent nuclear fuel and radioactive waste to be managed depends on the operational lifetime of the reactors. SKB's cost projections are based on the current plans of the reactor owners regarding operational duration and waste volumes. These planning assumptions also form the foundation for the design and implementation of the nuclear waste management system (see Chapter 2).

The reference scenario reflects the reactor owners' current plans and the strategic direction presented in the 2025 R&D Programme (SKB 2025). In addition to costs for the management of radioactive waste and spent nuclear fuel, the reference scenario also includes costs for the decommissioning and dismantling of the nuclear power plants.

The reference cost is calculated using a traditional deterministic method, meaning that the assumptions are fixed and predefined. The calculation is based on, among other things, functional descriptions for each facility, layout drawings, equipment lists, and staffing forecasts.

Cost estimates for future facilities are based on the data available at the time of calculation. During the construction of future facilities, building and installation costs are divided into three categories: *quantity-based costs*, *non-quantity-based costs*, and *secondary costs*.

Quantity-based costs are derived using assumed unit prices, for example for concrete casting, rock excavation, and operational staff. Quantities and unit prices are partly based on previous extensions of nuclear facilities such as Clab and SFR.

Non-quantity-based costs are relevant in early project stages when all details are not yet specified or included in the design documentation. In such cases, experience from similar projects may be used in the form of percentage mark-ups or so-called allowances for unspecified items[1].

Secondary costs refer to expenses for administration, design, procurement, and quality control, as well as costs for temporary buildings, machinery, accommodation, offices, and similar items. These costs are also relatively well known on a percentage basis.

[1] This should not be confused with the allowance for unforeseen items, which is not included in the reference calculation. Unforeseen items are assumed to form part of the overall uncertainty, which is addressed in the uncertainty analysis.

SKB's planning occasionally includes multiple proposed solutions. However, in the reference scenario, it is always assumed that a specific solution will be implemented. This is a necessary condition for producing unambiguous cost estimates. The selected alternatives should not be interpreted as a formal position by SKB or the reactor owners, but rather as a methodological approach to include cost calculations based on the solutions currently considered most feasible. For Plan 2025, the following assumptions have been made in the cost estimates:

- SKB has not yet made a final decision regarding the location of the repository for long-lived waste. The assumption in both the reference and financing scenarios is that the repository will be co-located with the existing SFR facility in Forsmark, based on the developed concept (SFL). Using the existing construction and transport tunnels at SFR as a starting point, the facility is assumed to be situated several hundred metres deeper into the bedrock. As a consequence of this co-location assumption, SFL is decommissioned at the same time as SFR.
- The assumption in both the reference and financing scenarios is that all PWR reactor pressure vessels will be segmented.
- According to current plans, SFK and Clink are scheduled to begin operation in 2037. During the initial years, the deposition rate is expected to gradually increase to 180 canisters per year. Thereafter, a deposition rate of 180 canisters per year is assumed for the entire operational period. This applies to both *the Financing scenario* and the *Reference scenario*.

3.2 Development of Cost Estimates According to the Financing Act

The cost estimation process is carried out in several stages (see Figure 3-1). Under the financing regulations (Act and Ordinance), SKB is required to report two separate amounts:

- the remaining base cost, and
- the portion of the base cost that should form the basis for the financing amount.

The cost calculations begin with a reference scenario, which assumes that the currently operating reactors will remain in operation for 60 years (blue box). However, since the Financing Ordinance stipulates that reactors are to be assumed to operate for 50 years or, alternatively, for a remaining operational period of at least six years[2], the reference scenario must be scaled down accordingly (green box). A shorter operational period results in a reduced volume of spent nuclear fuel and radioactive waste.

According to the Financing Act, the cost calculation must also exclude operational waste generated during the normal operation of the reactors.

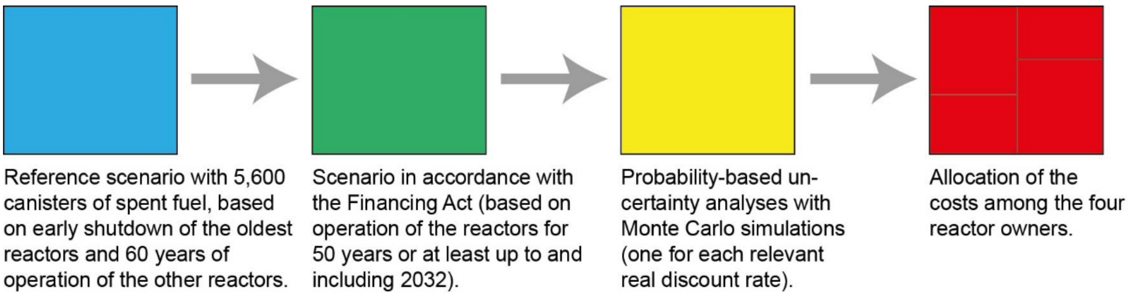

Figure 3-1. *Stepwise process for calculations.*

[2] If there are specific reasons to believe that operations may cease at an earlier date, the operational lifetime shall be determined based on that earlier point in time.

SKB takes into account future real price changes in the cost estimates prepared in accordance with the Financing Act. Real price changes refer to developments in prices and productivity within the project that deviate from general societal trends, as measured by the Consumer Price Index (KPI).

The Financing Act stipulates that cost reporting must reflect expected costs. As a result, an uncertainty analysis based on probabilistic calculations is included (yellow box).

The Financing Ordinance requires that each reactor owner's share of the base cost be specified. This information is necessary for allocating costs among the licence holders (red box).

3.2.1 Costs Excluded in the Financing Scenario

The Financing Act distinguishes between residual products and operational waste arising from nuclear activities. The nuclear waste fee and associated financial collaterals are intended to cover the costs of managing and disposing of residual products, whereas the costs for handling and disposing of operational waste are to be financed directly by the reactor owners. This means, among other things, that the cost of the current repository for short-lived radioactive waste is excluded from the financing scenario.

In addition to licences for operating the nuclear power plants, each nuclear power company holds, or plans to obtain, separate licences for smaller facilities located within the respective power plant sites. These include interim storage and near-surface disposal facilities for very low-level operational waste.

The costs for constructing and operating these smaller facilities are considered part of the ongoing operational expenses of the nuclear power plants and are therefore not included in the cost estimates under the Financing Act. However, the future costs for decommissioning these facilities must be included in the estimates, as they are both temporally and functionally linked to the decommissioning and dismantling of the nuclear power plants.

3.2.2 Adjustment for Real Cost Changes

In the cost estimates prepared under the Financing Act, SKB accounts for future real cost changes using a set of conversion factors referred to as External Economic Factors (EEFs). These factors reflect cost developments—including productivity trends—for labour, input materials, and machinery. The selected EEFs influencing the calculations consist of a limited number of observable macroeconomic variables. The wide range of variables typically present in a project of this nature is reduced to a few selected factors, resulting in a relatively high level of aggregation.

The following EEFs are used in the Plan calculations:

- **EEF 1**: Real labour cost in the service sector
- **EEF 2**: Real labour cost in the construction sector
- **EEF 3**: Real price of machinery
- **EEF 4**: Real price of construction materials
- **EEF 5**: Real price of copper
- **EEF 6**: Real price of bentonite
- **EEF 7**: Real energy price
- **EEF 8**: Real exchange rate SEK/USD

Each cost item in the Plan calculation is linked to one of the first seven EEFs. EEF 8 is used to convert copper and bentonite prices quoted in USD.

For each EEF, a forecast is developed for future real trends. These forecasts are based on established modelling techniques, statistical analyses, and expert judgement. Based on these forecasts, cost items are adjusted to reflect the real cost development from the time the calculation is made until the cost is incurred.

3.2.3 Probabilistic Uncertainty Analysis

To produce the cost estimates required under the financing regulations, SKB applies a probabilistic calculation method known as the successive principle (Lichtenberg, 2000). This well-established method is used to identify, analyse, and evaluate uncertainties in projects. The final results of the uncertainty analysis are expressed as probabilities for different cost outcomes.

The uncertainties—also referred to as variations—are assessed individually by members of three separate analysis groups. In Plan 2025, the work was divided such that an external analysis group evaluated general variations affecting multiple cost items, while two internal groups assessed object-specific variations related to SKB's own costs and the decommissioning costs of the nuclear power plants, respectively.

In assessing uncertainties, participants in the analysis groups provided upper and lower bounds that, with 90% confidence, are not expected to be exceeded or undercut relative to a planning reference. Assumptions that were predefined as fixed were excluded from the uncertainty analysis.

Once the analysis groups completed their assessments, the calculation phase commenced. This was carried out using a Monte Carlo simulation, in which the probability distribution is calculated based on the current cost data and the values provided by the analysis groups. The simulations are based on unique random numbers and 5,000 realisations. All outcomes are stored, and the result is presented as a probability distribution derived from the aggregate of all realisations.

3.2.4 Cost Allocation

The fee-based funds paid into the Nuclear Waste Fund by each reactor owner are intended to cover that owner's future financial needs for the management and disposal of nuclear waste and spent fuel. Some costs are directly attributable to the individual reactor owner's obligations, while others relate to activities carried out jointly with other licence holders—effectively within SKB's area of responsibility. These shared costs are apportioned among the licence holders based on various agreements established between them.

4 Costs According to the Reference Scenario

4.1 Reactor Operating Scenarios and Quantity of Residual Products

The reference scenario is based on the nuclear power companies' current plans for reactor operation. It is likely that production data for individual reactors will change over the remaining operational period. However, the reference scenario does not account for such changes; instead, it is based on historical data and the current situation, which is projected forward and assumed to remain constant throughout the calculation period. Any future changes will be incorporated once decisions have been made and any necessary permits have been obtained.

Table 4-1 provides a summary of historical operational data for the reactors, along with assumptions regarding future electricity production and the quantity of spent nuclear fuel. The amount of fuel is expressed in tonnes of uranium[3].

The current forecasts from the nuclear power companies indicate approximately 5,600 canisters, which also forms the basis of the reference calculation. At present, each company is exploring the possibility of revising its planning assumptions by extending reactor lifetimes.

The number of spent fuel canisters is shown in Table 4-2. The table also includes the volumes of radioactive operational and decommissioning waste planned for disposal in the final repository under the reference scenario. These volumes refer to waste containers that are ready for final disposal. The table does not include waste volumes intended for near-surface disposal at the power plant sites.

Table 4-1. Operational Data, Electricity Production, and Fuel Quantities Based on Planned Operation According to the Reference Scenario.

			Up to and Including 2025			Total for Reference Scenario			
Commercial Operation Start			Thermal / Net Output	Electricity Production to 2026	Spent Nuclear Fuel to 2025	Planned Operation al Lifetime	Operation Until	Electricity Production	Total Spent Nuclear Fuel
			(MW)	(TWh)	(Tonnes of U)	(Years)		(TWh)	(Tonnes of U)
F1	(BWR)	1980-12-10	3,200[4] / 1,098	320	1,068	60.0	2040-12-08	442	1,388
F2	(BWR)	1981-07-07	3,253 / 1,120	323	1,046	60.0	2041-07-06	455	1,380
F3	(BWR)	1985-08-22	3,300 / 1,167	352	1,069	60.0	2045-08-21	533	1,490
O1	(BWR)	1972-02-06	1,375 / 473	109	370		2017-06-30	109	370
O2	(BWR)	1974-12-15	1,800 / 638	154	537		2015-12-31	154	537
O3	(BWR)	1985-08-15	3,900 / 1,400	347	1,063	60.0	2045-08-14	561	1,552
R1	(BWR)	1976-01-01	2,540 / 881	220	736		2020-12-31	220	736
R2	(PWR)	1975-05-01	2,500 / 807	221	649		2019-12-30	221	649
R3	(PWR)	1981-09-09	3,135 / 1,063	294	863	60.0	2041-09-08	426	1,148
R4	(PWR)	1983-11-21	3,300 / 1,118	284	843	60.0	2043-11-20	437	1,172
B1	(BWR)	1975-07-01	1,800 / 600	93	419		1999-11-30	93	419
B2	(BWR)	1977-07-01	1,800 / 600	108	424		2005-05-31	108	424
BWR Total			22,968 / 7,977	2 028	6,732			2,676	8,295
PWR Total			8,935 / 2,988	800	2,355			1,084	2,968
All Reactors Total			31,903 / 10,965	2 828	9,087			3,760	11,263

[3] The actual weight of the fuel in the form of complete fuel assemblies is significantly greater. A BWR assembly weighs approximately 300 kg, of which around 180 kg consists of uranium. After burn-up, the uranium weight has decreased slightly. For a PWR assembly, the corresponding weights are approximately 560 kg and 460 kg, respectively.

[4] For the years 2023 and 2024, the figures are 3,075/1,040 and 3,200/1,098, respectively.

Table 4-2. Encapsulated Spent Fuel and Radioactive Waste for Disposal According to the Reference Scenario.

	Quantity for Final Disposal	Final Repository
Spent BWR Fuel	5,600 canisters	SFK
Spent PWR Fuel		
Other Spent Nuclear Fuel (MOX, Ågesta, Studsvik)		
Operational Waste from Nuclear Power Plants	153,300 m^3	SFR
Decommissioning Waste from Nuclear Power Plants		
Operational and Decommissioning Waste from Nuclear Power Plants (Core-related Components)		
Operational Waste from Clab and the Encapsulation Facility		
Decommissioning Waste from Clab and the Encapsulation Facility		
Operational Waste from Svafo and Studsvik	16,400 m^3	Final Repository for Long-Lived Waste (SFL concept)
Operational and Decommissioning Waste from Nuclear Power Plants (Core-related Components)		
Waste from Svafo and Studsvik		

4.2 Cost Reporting

The following section presents the reactor owners' estimated future costs for the reference scenario from 2027 onwards, as well as the incurred and budgeted costs up to and including 2026. The distribution of the total cost of the nuclear waste management programme—covering both incurred and future costs—is illustrated in Figure 4-1. The distribution is based on the January 2025 price level, with previously incurred costs adjusted using the Consumer Price Index (KPI).

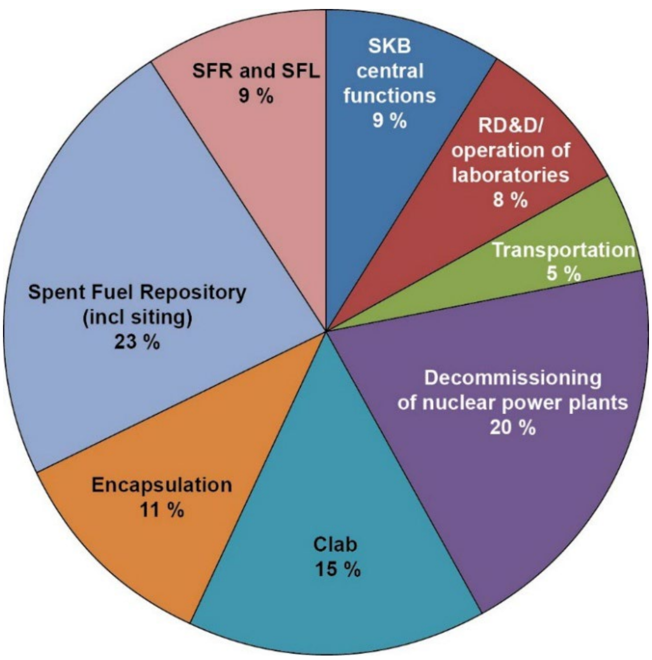

Figure 4-1. *Distribution of the Total Cost (Incurred and Future) for the Reference scenario, price level as of: January 2025.*

4.2.1 Future Costs

The reactor owners' projected future costs for various facilities and activities under the reference scenario are presented in Table 4-3. For each facility or activity, the costs are categorised as *"feasibility studies, technology development and safety analysis", "investment", "operation and maintenance", "backfilling" and "decommissioning and closure*".

The reference scenario also includes costs for supporting functions and central support. Supporting functions cover expenses for portfolio management, requirements management, project and design support, and administrative services. These costs are allocated to each facility. Costs for SKB central functions include corporate management, operational support, communications, environmental management, overarching safety issues, and safety reporting. Central support costs are reported separately in Table 4-3.

Investment costs generally refer only to expenses incurred before a facility or part of a facility enters operation. However, for SFK, where the extension of deposition tunnels will continue during the operational phase, these costs are included under investment. The cost estimates in Table 4-3 are based on the current reference scenario data and do not include allowances for uncertainty and risk or adjustments for real price changes (EEF adjustments).

The reference cost amounts to a total of SEK 126.1 billion. Of this, SEK 98.6 billion falls within SKB's area of responsibility and is therefore shared among the licence holders (joint costs). The remainder represents costs for activities where each reactor owner bears individual responsibility (separate costs).

Figure 4-2 illustrates the distribution of the reference cost over time. A simplified timeline for the various facilities is shown to indicate their impact on the cost flow. The two cost peaks in the diagram are attributable to investment in SFK and the encapsulation section of Clink, and to the decommissioning of the nuclear power plants.

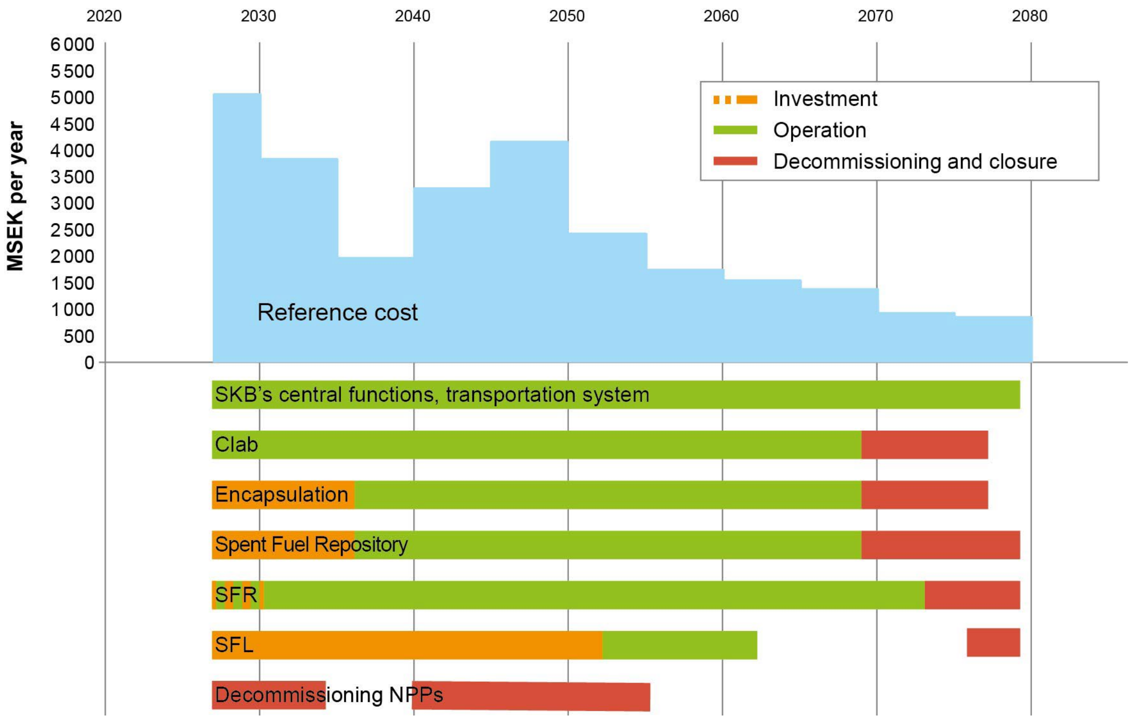

***Figure 4-2.** Temporal distribution of future costs for the Reference scenario and overview timelines for the facilities, price level as of January 2025.*

Table 4-3. Summary of Licence Holders' Future Costs for the Reference Scenario from 2027 Onwards.

		Cost per Cost Category (SEK million)	Cost per Facility (SEK million)
SKB Central Functions		8,500	**8,500**
Transport	Investment	1,850	**4,450**
	Operation and Maintenance	2,600	
Clab	Operation and Maintenance	8,840	**12,380**
	Reinvestments	2,430	
	Decommissioning	1,110	
Encapsulation	Investment	4,600	**21,220**
	Operation, Maintenance and reinvestments	16,290	
	Decommissioning	330	
SFK			
- Above ground	Preliminary Studies, Technology Development and Safety Analysis	1,160	**40,030**
	Investment and Decommissioning	10,430	
	Operation and Maintenance (entire facility)	7,840	
	Reinvestments (entire facility)	3,020	
- Other Rock Caverns	Investment	3,680	
	Decommissioning and Closure	1,820	
- Main and Deposition Tunnels	Investment	7,610	
	Decommissioning, Backfilling and Closure	4,470	
Final Repository for Long-Lived Waste (SFL Concept)	Preliminary Studies, Technology Development and Safety Analysis	610	**3,020**
	Investment	1,410	
	Operation, Maintenance & Reinvestments	540	
	Decommissioning and Closure	470	
Interim Storage and Near Surface Repositories at Nuclear Power Plants	Investment, Operation and Decommissioning	130	**130**
SFR (Operational waste)	Operation, Maintenance & Reinvestments	1,500	**1,500**
SFR (Decommissioning waster)	Preliminary Studies, Technology Development and Safety Analysis	370	**7,350**
	Investment	3,550	
	Operation, Maintenance & Reinvestments	2,510	
	Decommissioning and Closure	920	
Decommissioning of Nuclear Power Plants		27,510	**27,510**
Total Reference Cost			**126,100**
(excluding adjustments for EEF and allowances for contingencies and risk)			

Rounding differences may occur.

4.2.2 Incurred and Budgeted Costs

Table 4-4 presents the incurred costs (at current price levels) up to and including 2024, along with the forecast for cost outcomes for 2025 and 2026. Costs related to reprocessing activities that occurred in the early stages are not included in the table.

Table 4-4. Previously Incurred Costs at Current Price Levels

	Incurred up to 2024	Forecast 2025	Forecast 2026	Total up to 2026
SKB Central	7,810	400	390	8,590
RD&D (Fud)	8,770	0	0	8,770
Transport	3,370	310	90	3,770
Clab	11,490	430	600	12,510
Encapsulation	1,700	100	240	2,040
Spent Fuel Repository	9,020	640	840	10,500
SFR and SFL	6,310	580	780	7,670
Decommissioning of Nuclear Power Plants	14,730	2,530	2,550	19,800
Total	**63,190**	**4,980**	**5,470**	**73,640**

Rounding differences may occur.

5 Costs According to the Financing Scenario

This section presents the calculation that will form the basis for fees and financial collateral for the years 2027–2029. The regulatory framework stipulates, among other things, that for reactors in operation, the calculation shall be based on an operational lifetime of 50 years or a remaining operational period of at least six years. If there are specific reasons to assume that operations may cease earlier, the expected operational lifetime shall instead be determined based on that earlier point in time.

5.1 Operational Scenarios for the Reactors and Quantity of Residual Products

Figure 5-1 depicts the projected future operational lifespan as stipulated by the Financing Act and the current plans of the nuclear power companies.

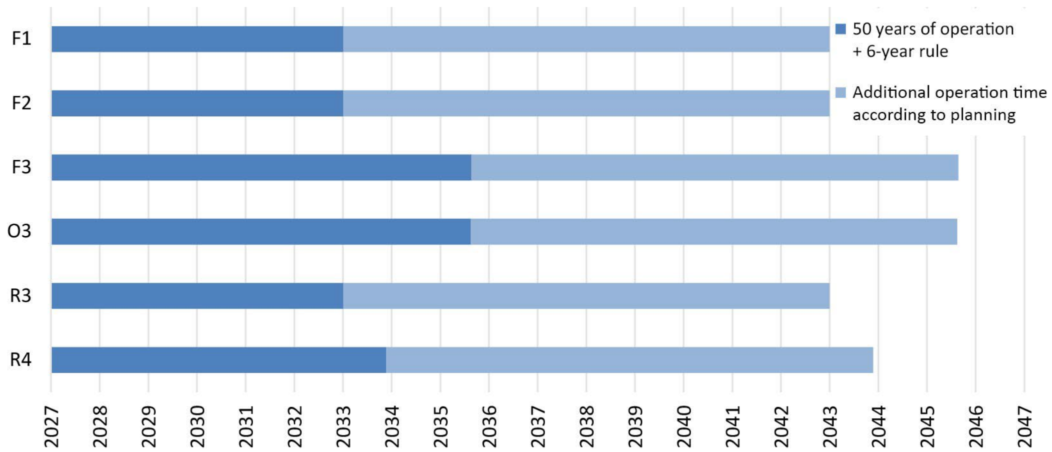

Figure 5-1. *Assumptions regarding future operational periods in accordance with the Financing Act and the planned operating lifetimes of the reactors.*

Table 5-1 presents operational data and fuel quantities for the scenario in accordance with the Financing Act (50 + 6 years). Table 5-2 provides more detailed information, including a comparison with the quantities in the reference scenario.

The cost reporting is relatively detailed for the scenario based on the Financing Act (50 + 6 years); see Section 5.3.1. For the basis of the financing amount, of 31 December 2023, only the total amount is provided (Section 5.3.2).

Table 5-1. Operational Data, Electricity Production and Fuel Quantities Based on the Financing Scenario (50 + 6 Years)

Commercial Operation Start			Total for Base Cost			
			Operational Period According to Financing Act (years)	Operation Until	Electricity Production (TWh)	Spent Fuel (Tonnes of U)
F1	(BWR)	1980-12-10	50.0	2032-12-31	378	1,222
F2	(BWR)	1981-07-07	50.0	2032-12-31	383	1,213
F3	(BWR)	1985-08-22	50.0	2035-08-22	441	1,287
O1	(BWR)	1972-02-06		2017-06-30	109	370
O2	(BWR)	1974-12-15		2015-12-31	154	537
O3	(BWR)	1985-08-15	50.0	2035-08-15	450	1,314
R1	(BWR)	1976-01-01		2020-12-30	220	736
R2	(PWR)	1975-05-01		2019-12-30	221	649
R3	(PWR)	1981-09-09	50.0	2032-12-31	352	997
R4	(PWR)	1983-11-21	50.0	2033-11-20	352	997
B1	(BWR)	1975-07-01		1999-11-30	93	419
B2	(BWR)	1977-07-01		2005-05-31	108	424
Total BWR					2,337	7,523
Total PWR					925	2,642
All Reactors Total					3,262	10,164

Table 5-2. Encapsulated Spent Nuclear Fuel and Radioactive Waste for Disposal According to the Financing Scenario (50 Years of Operation).

	Quantity for Final Disposal		Repository
	50 years operation	Reference	
Spent BWR Fuel Spent PWR Fuel Other Spent Nuclear Fuel (MOX, Ågesta, Studsvik)	5,000 canisters	(5,600)	SFK
Operational Waste from Nuclear Power Plants Decommissioning Waste from Nuclear Power Plants Operational Waste from Clab and the Encapsulation Facility Decommissioning Waste from Clab and the Encapsulation Facility Operational Waste from Svafo and Studsvik	148,500 m^3	(153,300)	SFR
Decommissioning Waste from Svafo and Studsvik Operational and Decommissioning Waste from Nuclear Power Plants (Core-related Components) Waste from Svafo and Studsvik	16,400 m^3	(16,400)	Final Repository for Long-Lived Waste (SFL Concept)

5.2 Changes Compared to the Reference Scenario

This section addresses changes relative to the description of the reference scenario in Chapter 4.

The primary differences concern assumptions about reactor operating lifetimes, which affect the quantities of spent nuclear fuel and radioactive waste. The assumed operational period also influences the rate of disposal of the canisters containing spent nuclear fuel.

A summary of the key changes in the operational scenarios compared to the reference scenario is as follows:

- **The number of canisters containing spent nuclear fuel is reduced** from the 5,600 included in the reference scenario. The calculation of the remaining base cost assumes 5,000 canisters. For the financing amount calculation, the assumption is that 4,541 canisters will be disposed of.
- **The total operational period for SFK and Clink is shortened.** In the calculation of the remaining base cost, a reduction of 3.3 years in operating time is applied compared to the reference scenario. For the financing amount calculation, the reduction is just under six years. This shorter timeline also affects cost estimates for other facilities, primarily SFR (decommissioning waste).
- **Costs for operational waste managed during ongoing reactor operation are excluded from the calculation** (as they do not fall under the definition of residual products). This primarily means that costs for final disposal of operational waste in SFR are not included. Additionally, transport costs to SFR are excluded, along with a proportional share of costs for SKB's central functions.
- **Costs for space in SKB's facilities occupied by radioactive waste from parties other than the licensees** (e.g. AB Svafo and others) are not included in the calculation. These costs are financed through other means.
- **Decommissioning begins once a reactor is permanently shut down.** Decommissioning work continues until the remaining parts of the facility are radiologically cleared. At that point, the remaining activities are no longer regulated by the Nuclear Technology Act, and conventional demolition can proceed under the same conditions as other industrial operations. The extent of demolition for remaining facility components varies between power plants, depending on future plans for the site. In Plan 2025, as in previous reports, a standard deduction of 10% has been applied to the costs of conventional demolition included in the reference scenario. An exception is Barsebäck, where the full cost is included. This standard deduction may be reviewed in future reports.

5.3 Cost Reporting

5.3.1 Remaining Base Cost

Table 5-3 provides a summary of the licensees' projected future costs attributable to the remaining base cost, which forms the basis for the calculation of fees. The costs presented in the table for the individual facilities do not include any allowances for contingencies or risk. These allowances, along with the impact of future real price and cost developments (EEF), are shown at the bottom of the table.

The estimated costs for various facilities are presented under the categories: "*preliminary studies, technology development and safety analysis*", "*investment*", "*operation and maintenance*", "*backfilling*", and "*dismantling and closure*" (backfilling refers solely to the backfilling of deposition tunnels). Investment typically includes only those costs incurred prior to the commissioning of a facility or part thereof. In the case of SFK, where the extension of deposition tunnels will continue during the operational phase, these costs are also included under investment.

The scenario in accordance with the Financing Act also includes costs for supporting functions and central support. Supporting functions comprise costs for portfolio management, requirements management, project and design support, and administrative support. These costs are included and allocated to the respective facilities.

Costs for SKB central functions include corporate management, operational support, communications, environmental management, overarching safety issues, and safety reporting. Central support is presented separately in Table 5-3.

The total remaining base cost amounts to SEK 151.0 billion. Of this, SEK 6.5 billion represents an adjustment for real price and cost development (EEF), and SEK 26.4 billion is an allowance for uncertainty and risk.

Figure 5-2 illustrates the temporal distribution of the costs presented in Table 5-3. The figure also includes a simplified timeline for the various facilities to provide an indication of their impact on the cost flow. The two cost peaks in the diagram stem from the investment in the encapsulation section of Clink, SFK, and the expansion of SFR, as well as from the decommissioning of the nuclear power plants.

Figure 5-3 shows the present value of the remaining base cost for discount rates ranging from 0 to 4 percent. The diagram reflects total amounts, meaning that the allowance for contingencies and risk also includes an adjustment for EEF. The underlying data for the diagram were generated through a series of separate Monte Carlo simulations using constant discount rates over time. This illustrates the sensitivity of the remaining base cost to the discount rate. To obtain an accurate allowance for contingencies and risk—both for the remaining base cost and the financing amount—a Monte Carlo simulation should be performed using the same discount rate curve applied in the fee and finical collateral calculations.

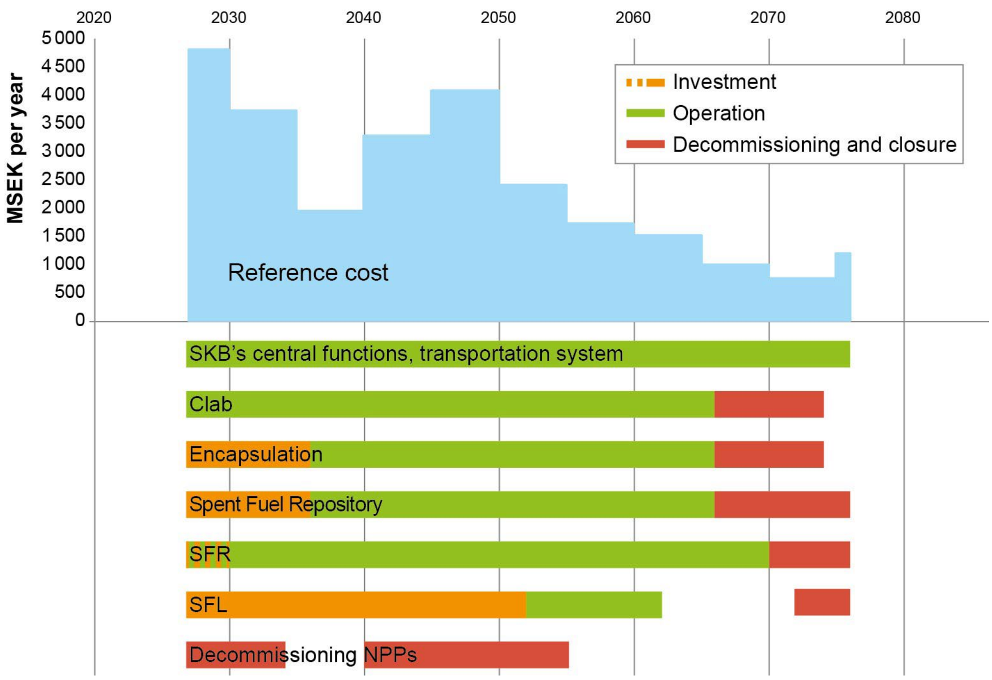

Figure 5-2. *Temporal distribution of future costs, excluding allowances for contingencies and risk, for the Financing scenario and overview timelines for the facilities, price level as of January 2025.*

Table 5-3. Remaining Base Costs from 2027 Onwards, Price Level: January 2025

		Cost per Cost Category (SEK million)	Cost per Facility (SEK million)
SKB Central Functions		7,870	**7,870**
Transport	Investment	1,810	**4,180**
	Operation and Maintenance	2,360	
Clab	Operation and Maintenance	8,220	**11,650**
	Reinvestments	2,310	
	Decommissioning	1,110	
Encapsulation	Investment	4,590	**19,490**
	Operation, Maintenance and reinvestments	14,560	
	Decommissioning	330	
SFK			
- Above ground	Preliminary Studies, Technology Development and Safety Analysis	1,130	**37,580**
	Investment and Decommissioning	10,350	
	Operation and Maintenance (entire facility)	7,280	
	Reinvestments (entire facility)	2,690	
- Other Rock Caverns	Investment	3,540	
	Decommissioning and Closure	1,720	
- Main and Deposition Tunnels	Investment	6,870	
	Decommissioning, Backfilling and Closure	4,000	
Final Repository for Long-Lived Waste (SFL Concept)	Preliminary Studies, Technology Development and Safety Analysis	610	**3,020**
	Investment	1,410	
	Operation, Maintenance & Reinvestments	540	
	Decommissioning and Closure	470	
Interim Storage and Near Surface Repositories at Nuclear Power Plants	Investment, Operation and Decommissioning	-	-
SFR (Operational waste)	Operation, Maintenance & Reinvestments	-	-
SFR (Decommissioning waster)	Preliminary Studies, Technology Development and Safety Analysis	350	**7,330**
	Investment	3,520	
	Operation, Maintenance & Reinvestments	2,550	
	Decommissioning and Closure	920	
Decommissioning of Nuclear Power Plants		27,000	**27,000**
Total Base Estimate		**118,110**	
Adjustment for EEF		**6,480**	
Allowance for Contingencies and Risk		**26,370**	
Total Remaining Base Cost		**150,960**	

Rounding differences may occur.

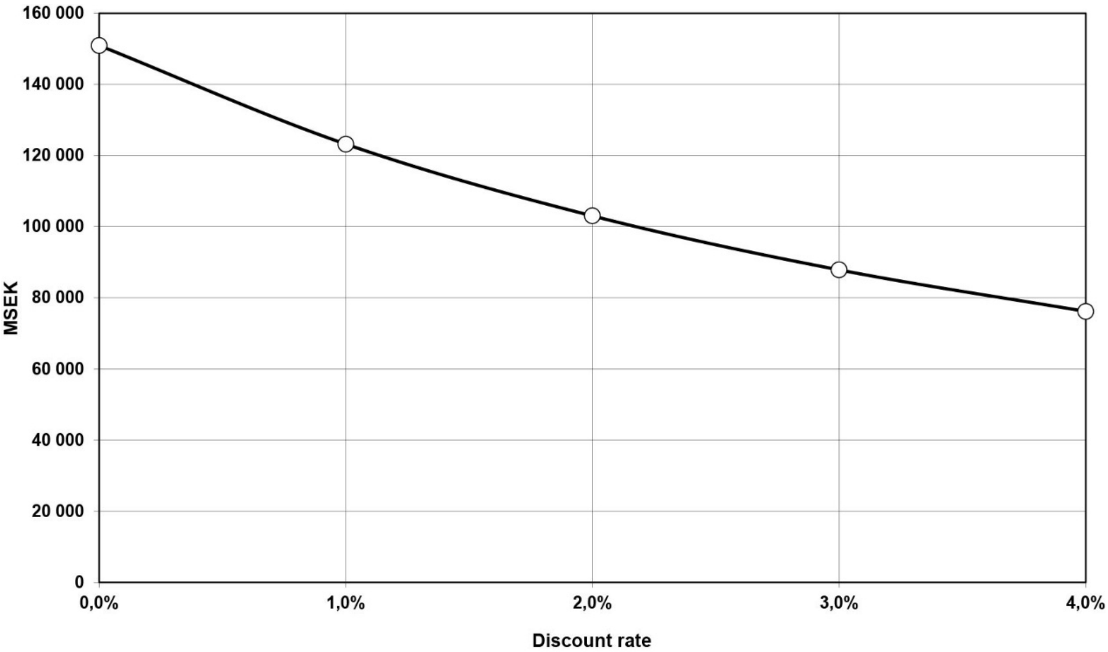

Figure 5-3. *Present value of the remaining base cost as a function of the discount rate, Price level as of January 2025*

5.3.2 Basis for the Financing Amount

The financing amount serves as the basis for one of the collaterals that licensees must provide in addition to fee payments. The cost basis for the financing amount is composed of the data submitted by SKB (this report) and additional costs calculated by the Swedish National Debt Office (Riksgälden). SKB calculates its portion of the amount using the same method as for the remaining base cost, but the calculation only includes the quantities of residual products present at the time the calculation begins. For Plan 2025, this refers to the residual products present as of 31 December 2026. As a result, the number of canisters is reduced to 4,541 compared to the 5,000 used in the calculation of the remaining base cost.

The portion of the financing amount based on SKB's calculations amounts to SEK 145.8 billion, which is SEK 5.2 billion lower than the remaining base cost.

References

SKB's (Svensk Kärnbränslehantering AB) publications can be found at www.skb.com/publications.

Lichtenberg S, 2000. Proactive management of uncertainty using the successive principle: a practical way to manage opportunities and risks. Copenhagen: Polyteknisk Press.

SKB, 2025. Fud-program 2025. Program för forskning, utveckling och demonstration av metoder för hantering och slutförvaring av kärnavfall. Svensk Kärnbränslehantering AB. (In Swedish.)

SKB TR-19-01. SKB 2019. Post-closure safety for a proposed repository concept for SFL. Main report for the safety evaluation SE-SFL. Svensk Kärnbränslehantering AB.