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Costing methods and funding schemes for radioactive waste disposal programmes

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Introduction

A draft report to provide Member States guidance on:

- how to estimate the cost of a disposal programme
- how to establish funding schemes covering that cost

The report contains cost examples of different disposal programmes which can be useful as an indicator or to give an order of magnitude.

However, the goal is not to compare the cost of disposal programmes.

IAEA SERIES

Costing methods and funding schemes for radioactive waste disposal programmes

Introduction

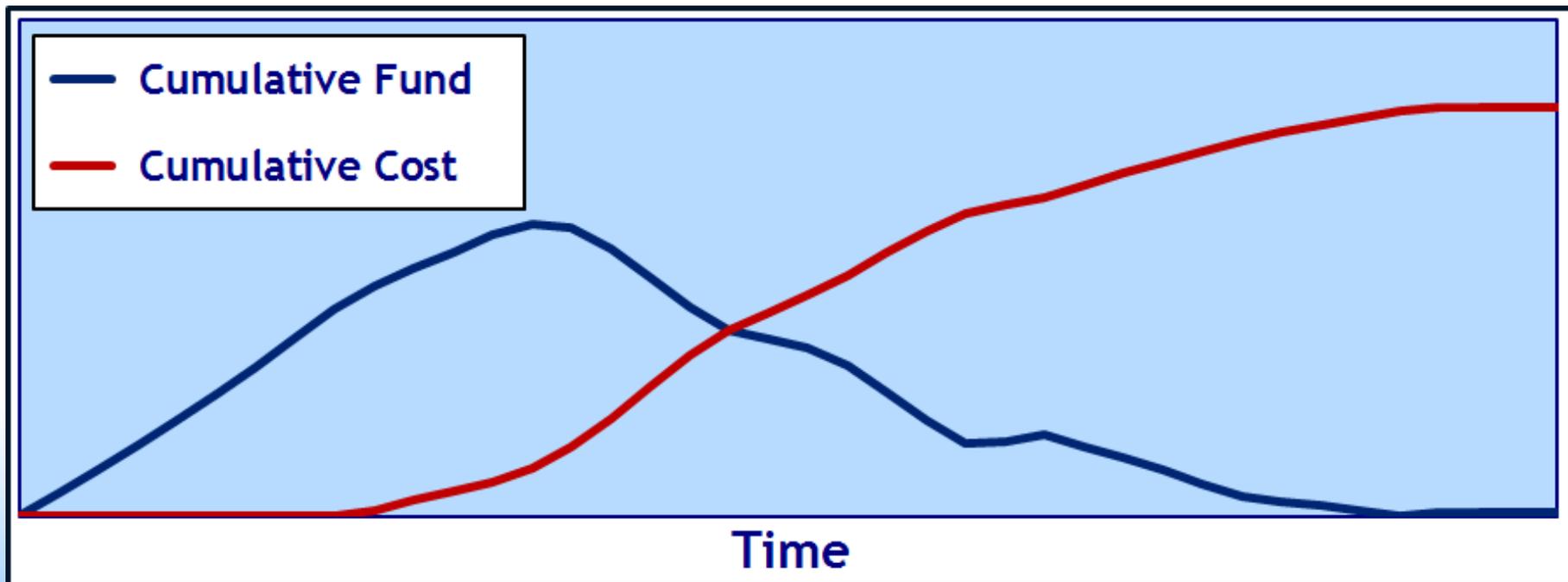
Establishing adequate costing and funding mechanisms is not straightforward

- complexity of the disposal program including many uncertainties and many stakeholders
- very long time periods over which disposal programs stretch
- offset in time between activities generating the wastes, and thus the funding, and the expenditures of the disposal costs

Introduction

Establishing adequate costing and funding mechanisms is not straightforward

- offset in time between activities generating the wastes, and thus the funding, and the expenditures of the disposal costs



5 steps to estimate programme cost

The methodology presented consists of the following steps:

1. define the reference disposal programme
2. develop a work breakdown structure (WBS) decomposing the programme into more specific items
3. estimate the overnight cost of the WBS items
4. take account of uncertainties and risks in the cost estimate
5. establish a mechanism to provide the funding covering the disposal programme's cost

Proposed methodology

Step 1: Define the reference disposal programme

- Early on, there are always a lot of unknowns
 - level of detail depends on the development stage of the disposal programme
 - **in that case, assumptions need to be made about those unknowns**
 - it is crucial to clearly document any assumptions and include a justification for each assumption
 - those assumptions will be addressed later in the chapter on risks and uncertainties

Basis to inform a reference programme: Notable progress to licensing stage

SSM to Government (2018):
Recommend to permit construction

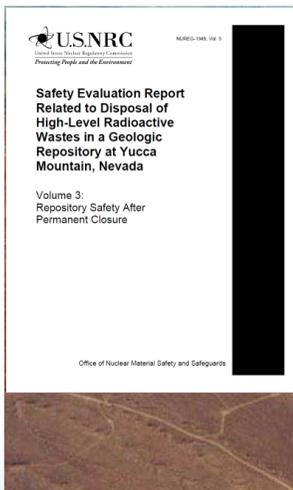


Spent Fuel Repository at Forsmark
(Courtesy of SKB)

ASN (2018) on *Options de sûreté*:
Satisfactory technological maturity



HLW & IL-LLW Cigeo Project
(Courtesy of Andra)



Yucca Mountain Project
(Courtesy of SNL)



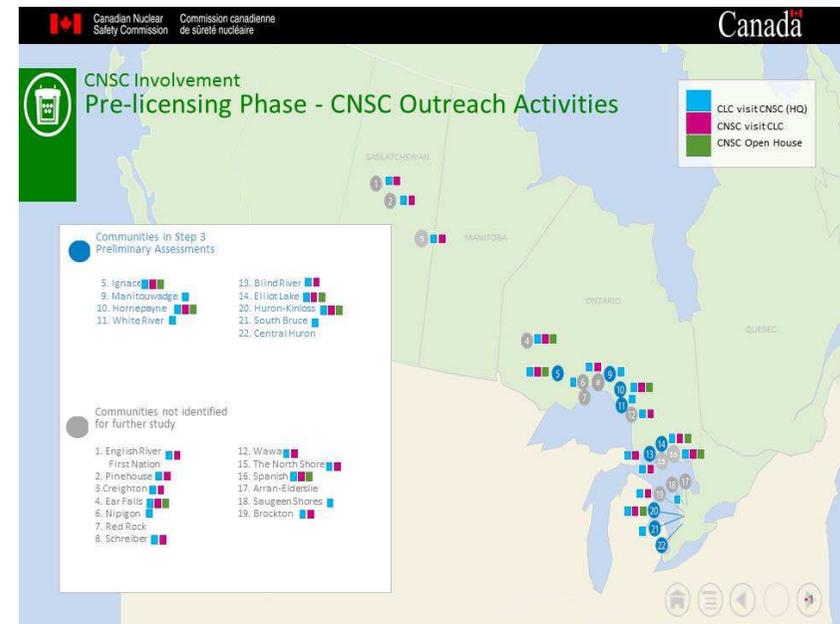
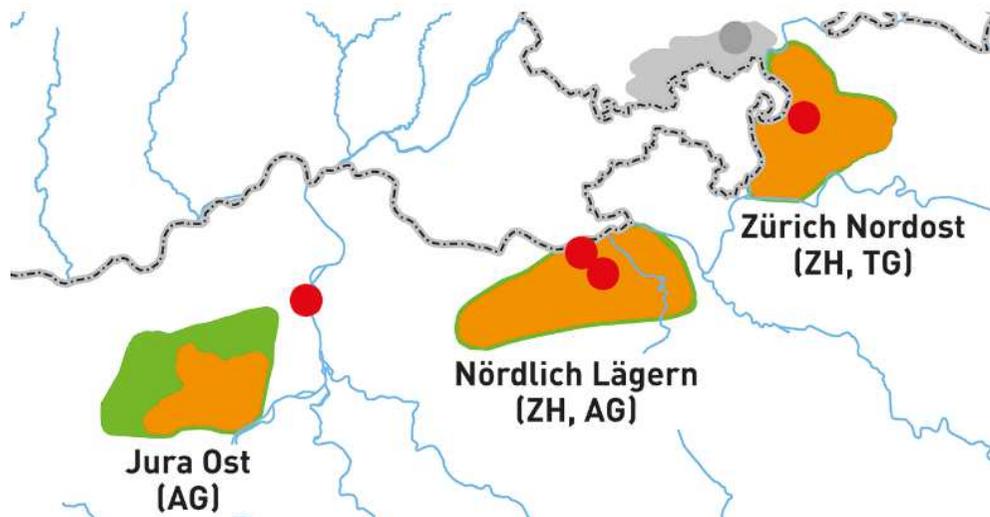
STUK (2015):
Nuclear waste
facility can be
built to be safe



Spent Fuel Repository at Olkiluoto
(Courtesy of Posiva)

Basis to inform a generic reference programme: Notable progress in siting

Switzerland (Nagra):
“Ready for stage 3” (22.11.2018)



Canada (NWMO):

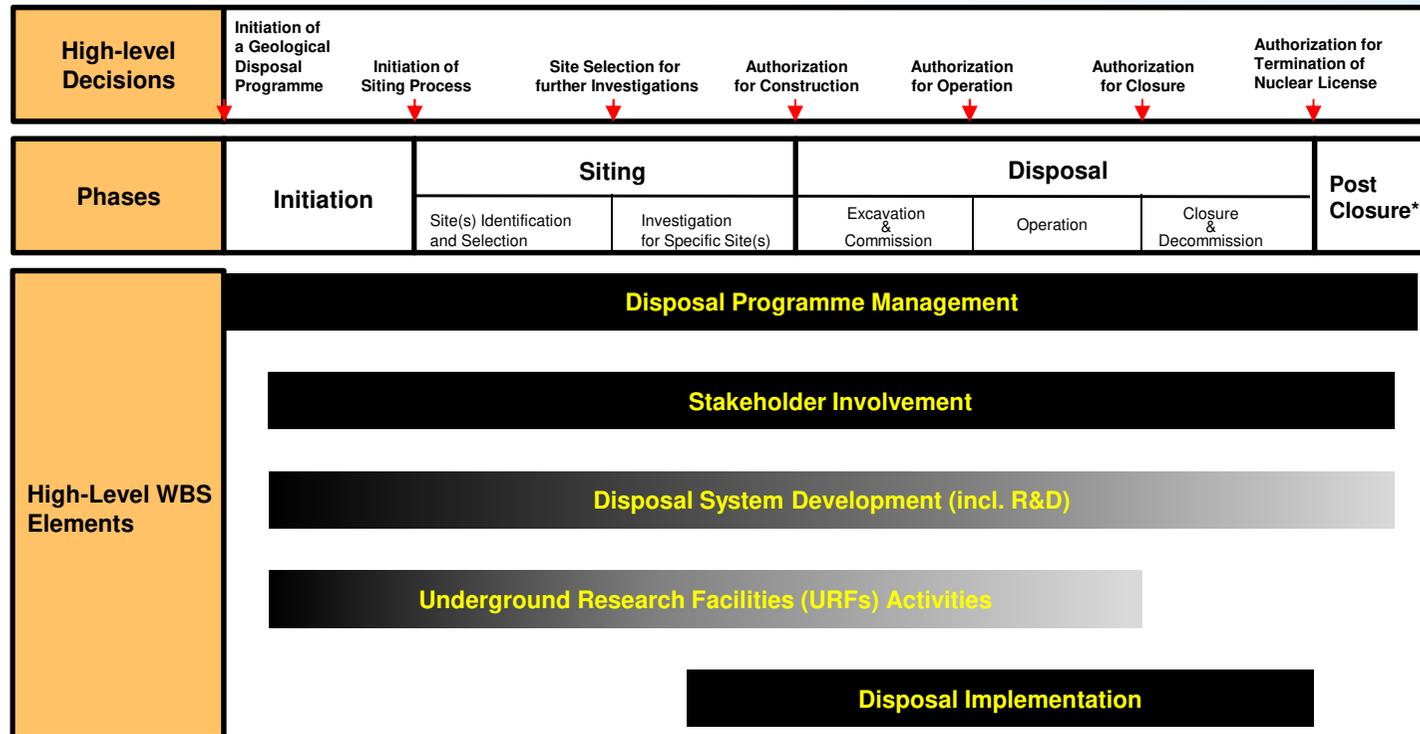
The process is collaborative. Over time, further studies will show which areas have strong potential to safely host the project.

Expression of Interest: 2012 – 21 communities

Top: 2016 – 9 maintain interest and viability

Today: 5 sites still under further study

Generic reference for a Geological Disposal Programme



Governance must inform and prepare high-level decisions.

All stakeholders contribute to and can influence the decisions according to their agreed rights and responsibilities.

- **Timeline to inform a sequence of needed decisions**
- **Work Breakdown Structure to summarize generic tasks to be accomplished, and associated deliverables**

Proposed methodology

Step 2: Develop a WBS

- A WBS decomposes the disposal programme into a series of smaller and more specific components
- A generic WBS can be used to start
- The high-level components of this WBS are



Managing the disposal programme



Stakeholder engagement



Developing the disposal programme



Implementing the disposal programme

Proposed methodology

Step 3: Estimate the overnight cost of the WBS items

- The report collected cost figures to illustrate following components' cost of different disposal programmes:
 - annual budgets of waste management organisations
 - annual communication budgets
 - stakeholder involvement and community benefits
 - R&D budgets (including costs for constructing and operating a URF)
 - estimated costs of surface and geological disposal facilities
- These examples can be useful as a cost indicator or to give an order of magnitude. The goal is not to compare the cost of disposal programmes.

Risks and uncertainties

The overnight cost estimate contains a lot of uncertainties

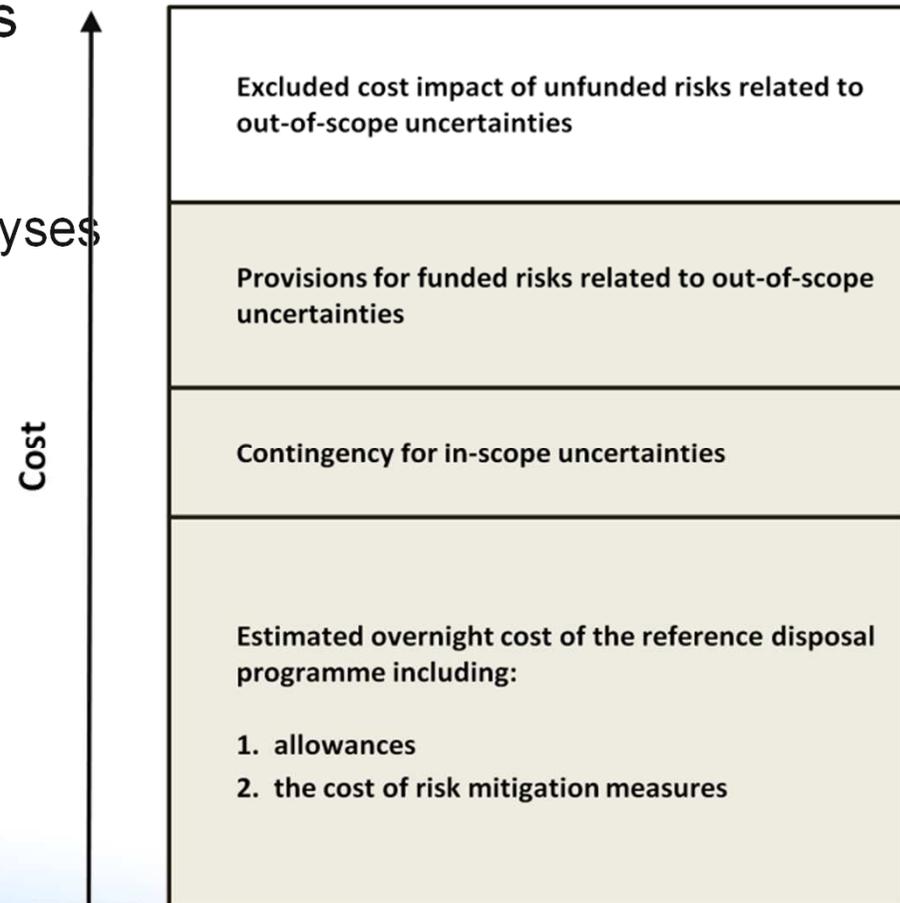
- an estimate is only a forecast and is inherently uncertain
- the defined reference disposal programme can contain a lot of assumptions which might prove to be wrong
- waste disposal programmes can stretch over very long timespans and conditions (scientific, technological, economic and societal) can be expected to change over those long timespans
- usually many stakeholders are involved in disposal programmes and past experiences suggest they may impact on how the programme is further implemented

Proposed methodology

Step 4: Take account of uncertainties and risks in the cost estimate

The approach to deal with uncertainties and risks presented in the report consists of following elements

1. Identify the risks and uncertainties
2. Perform sensitivity and scenario analyses
3. Develop a risk management plan
4. Include contingencies and/or put aside provisions
 - allowances
 - contingencies
 - provisions for funded risks



Risks and uncertainties

The approach to deal with uncertainties and risks presented in the report consists of following elements

1. Identify the risks and uncertainties
2. Perform sensitivity and scenario analyses

Japan calculated the cost of 11 scenarios (different host rock types and different disposal concepts)



Proposed methodology

Step 5: Establish the funding mechanism

1. identify funding sources and mechanisms
2. determine how much funding is required
3. manage the fund

Funding mechanism

1. Source of funding



**Nuclear power
plant operators**



**Users of nuclear
applications**

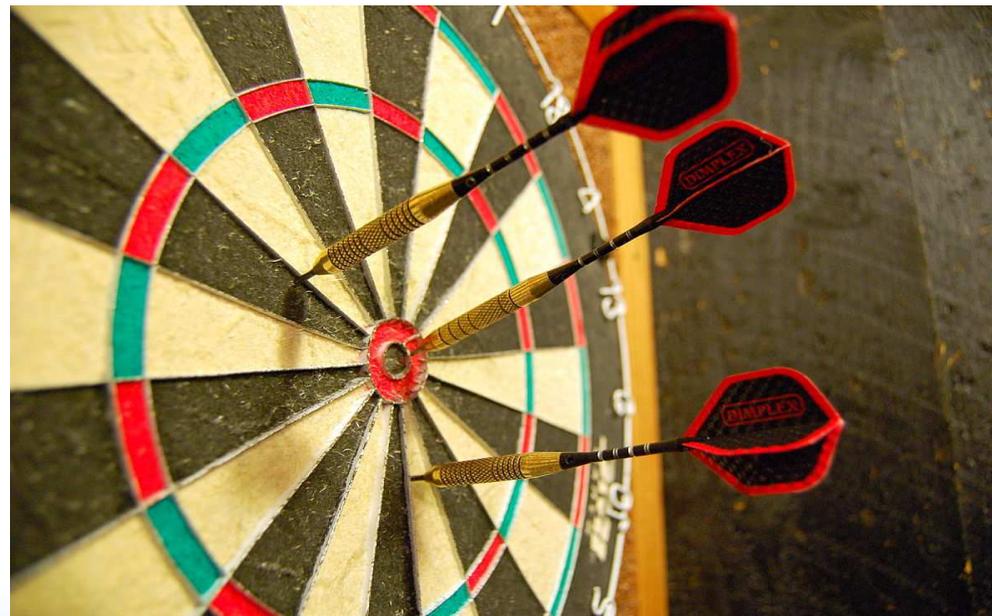


The State

Funding mechanism

2. Determine how much funding is required: discounting

What will be the future cost escalation rates and returns on your investment?



Funding mechanism

3. Manage the fund



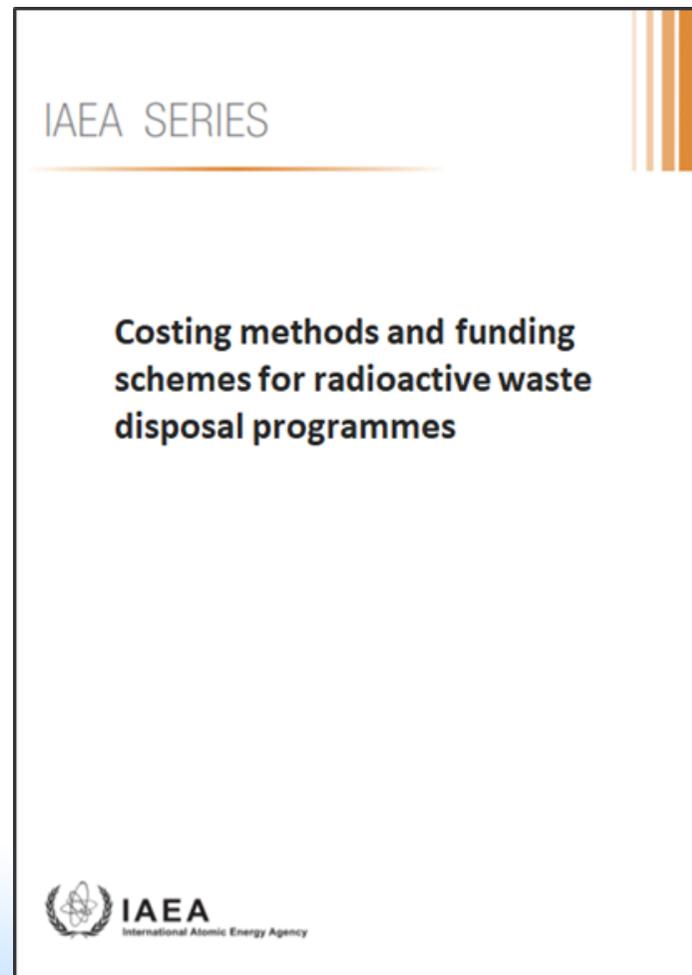
low risk
low return



high risk
high return

Report publication in process

For further details, cf. the report submitted for publication in 2019



Applicability of the method for a multinational project

The report methodology is applicable to any disposal project, national or multinational.

The programme, and the underlying assumptions, need to be clearly documented as a basis for cost estimation.

Note: Providing required information to decision makers = deliverables = cost

Cost drivers, that may be influenced by a multinational context:

- More stakeholders (across borders) may imply greater information needs
- Additional decision steps (e.g. early on in the programme) imply cost
- Time to reach decisions/consensus drives cost
- ...
- Basis for siting and license decisions for only one, not several programmes

Applicability of the method for a multinational project

The following aspects of the methodology may require particular consideration for a multinational disposal project:

- Societal and political uncertainties and/or risks and how they can be mitigated/incorporated in the cost estimate
- Any associated international obligations, and associated costs
- Additional RWM steps related e.g. to more diverse inventory, potential additional conditioning, transport...
- Establishing funding mechanisms that fairly allocate costs “across borders”
- ...
- Economy of scales for infrastructure investment for only one programme
- Larger inventory, longer operational times and associated costs



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Thank you