



RADIOACTIVE WASTE
from 100 to 100,000 years
in 10 minutes

Jan Boelen

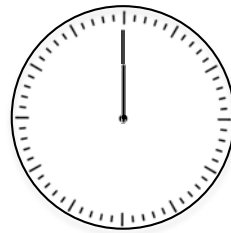
COVRA_{nv}

08-03-17, WM Panel #111, Phoenix USA

TIME

Time renders
radioactive waste
harmless

Radioactive Waste
Management is
Time Management



RADIOACTIVE WASTE



- 2 nuclear power plants
 - 1 operating (500 MWE)
 - 1 shut down (GKN 1997)
- 2 research centers
- U-enrichment plant
- Mo-production
- 1300 licences for working with radioactive substances
 - industry
 - medicine
 - research

RADIOACTIVE WASTE



- HLW: 100 m³
- LILW: 11.000 m³
- NORM: 20.000 m³

Wat to do with the radioactive waste?



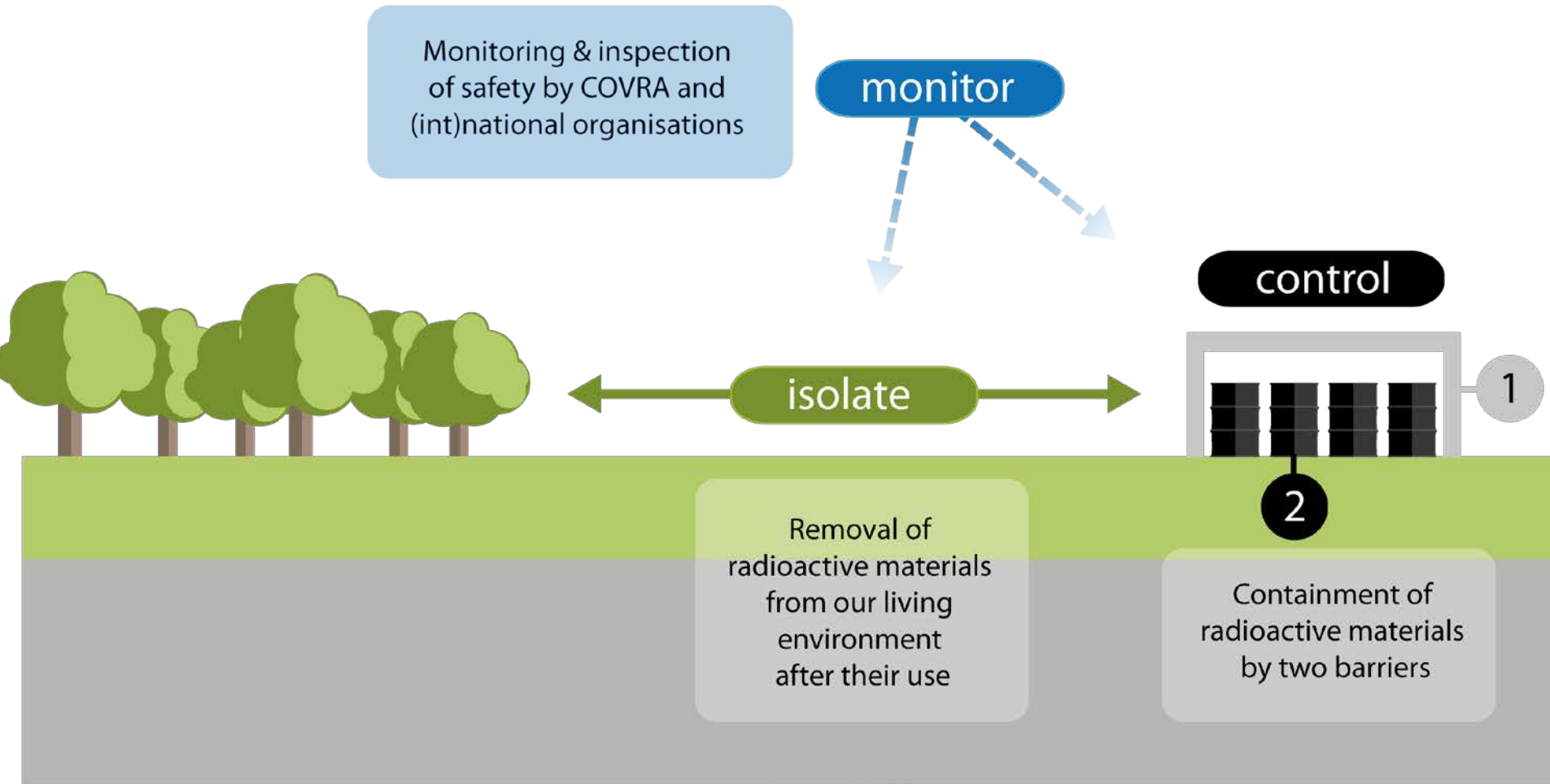
SOLUTIONS FOR THE NETHERLANDS



- small amount of waste
- high ground water table
- high population density
- high environmental awareness
- advanced spatial planning

no shallow disposal,
only geological disposal

IMC approach



POLICY

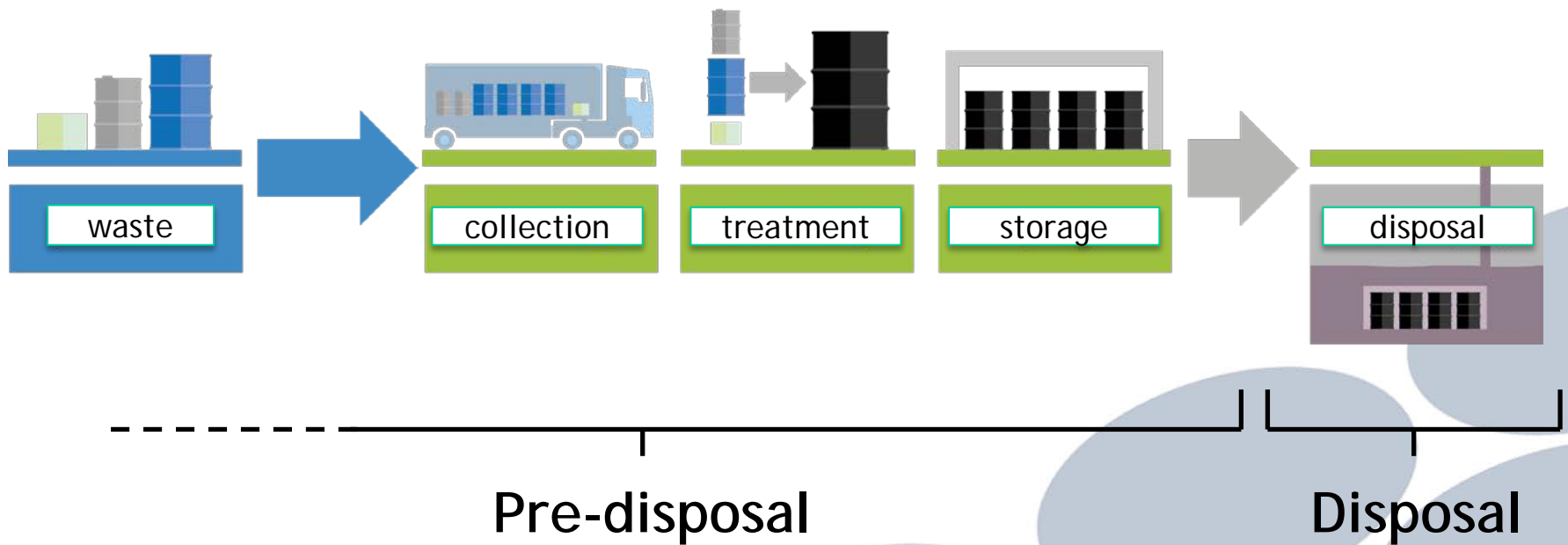
- all waste managed and owned by COVRA
- all waste at one industrial site
- at least 100 years storage, in buildings
- disposal after 100 years either in national or international context (dual track)
- research

stable policy since 1984

STORAGE FOR MORE THAN 100 YEARS?



RADIOACTIVE WASTE MANAGEMENT



MONEY

- polluter pays
- costs covered by fees
- cost effective

- no retrospective adjustment of fees paid
- COVRA takes over full title
- future costs to be paid from funds
- capital growth fund

SPACE



CONFIDENCE

37



COMMUNICATION

Colour orange is repainted very 20 years in a lighter shade to illustrate the decay of radioactive waste inside



COMMUNICATION

New building for depleted uranium:
Largest SOLAR DIAL of Europe



MUSEUM DEPOT



MUSEUM DEPOT





**RADIOACTIEVE
STOFFEN**

MARIE CURIE



Een speciale vitrine
Deze vitrinekast is gemaakt van afschermend lood en loodglas. De straling van het radium kan hierdoor echter niet volledig worden tegengehouden. Hoewel de stralingsdosis buiten de vitrine minimaal is, wordt voor een optimale veiligheid enige afstand tot de vitrinekast in acht genomen.

This showcase is made of protective lead and film glass, which however, cannot entirely stop the radiation. Although the amount of radiation outside the case is minimal, an appropriate distance is advised to ensure optimal safety.

Radium
In 1896 ontdekte Henri Becquerel dat uraniumzout een onbekend soort straling uitzendt. De Pools-Franse natuurwetenschapper Marie Curie bedacht er de naam radioactiviteit voor. Geholpen door haar echtgenoot Pierre wist ze twee andere radioactieve stoffen te identificeren, die ze radium en polonium noemde. Voor deze ontdekking voer Curie in 1911 de Nobelprijs voor scheikunde, nadat ze acht jaar eerder al samen met haar man en met Becquerel die voor natuurkunde had gekregen. Curie toog met dit radiumpreparaat naar Leiden in de (vergeefse) hoop dat het gedrag van radium bij extreem lage temperaturen meer duidelijk zou maken over de nog onbekende oorzaak van radioactieve straling.

In 1896 Henri Becquerel discovered that uranium salt emitted an unknown type of radiation, for which the Polish-French scientist Marie Curie coined the phrase radioactivity. With the help of her husband Pierre, she managed to identify two other radioactive elements, which she called radium and polonium. Curie was also being already awarded the Nobel Prize in physics in 1911, before both her husband and Becquerel, which this preparation of will address most of radioactive radiation by studying the influence of radium on normally live organisms, though the attempt proved unsuccessful.



HLW STORAGE



HLW

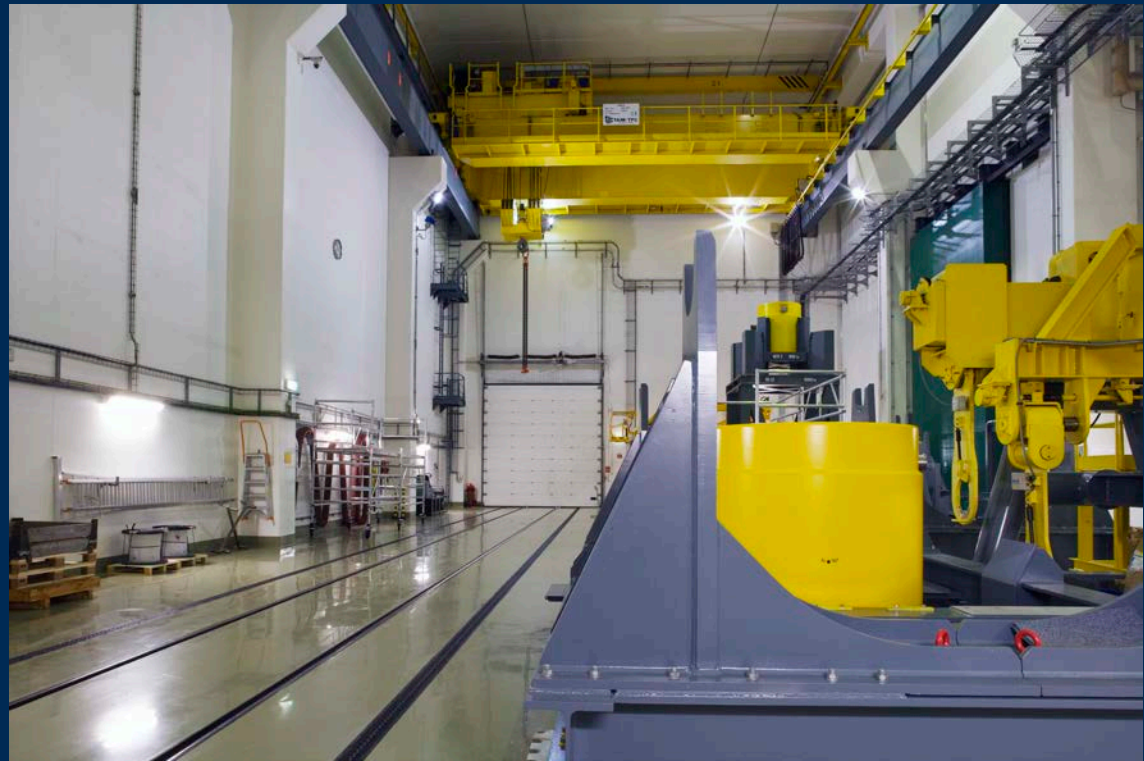
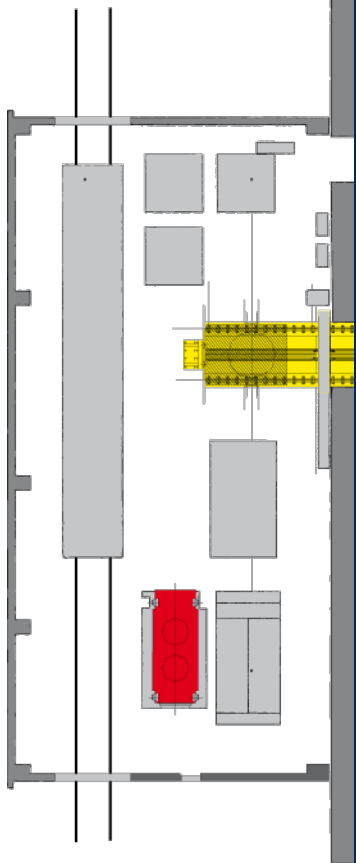
All events $> 10^{-6}$ covered

- earthquakes VI½ Mercalli
- plane crash (F16-A Falcon fighter)
- flooding +10 m NAP
- lpg gas cloud explosion
- severe winds 125 m/s



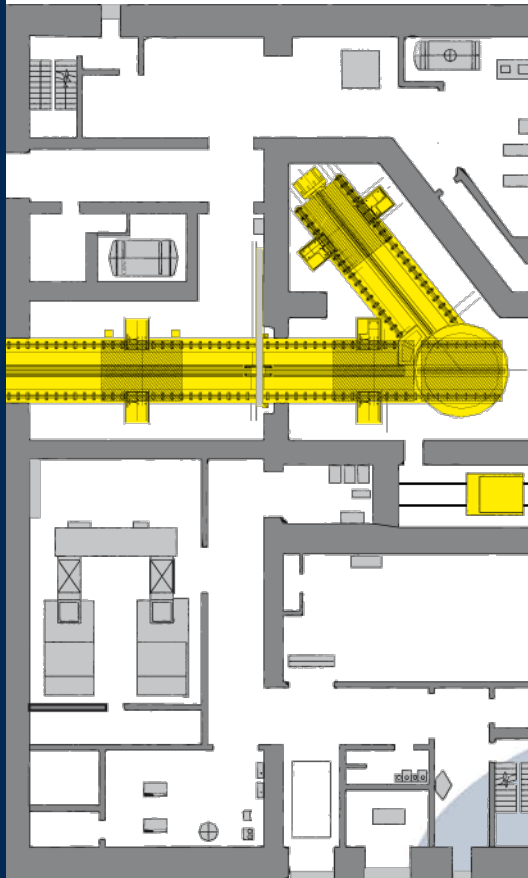
HABOG LAYOUT

Reception



HABOG LAYOUT

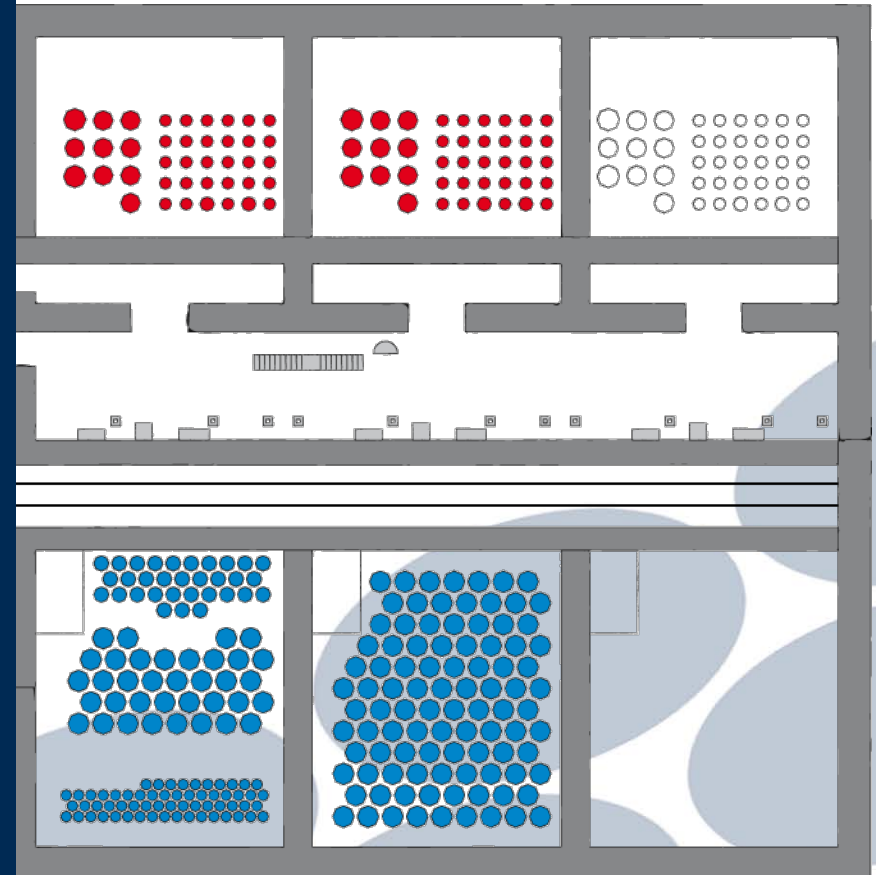
Treatment



HABOG LAYOUT

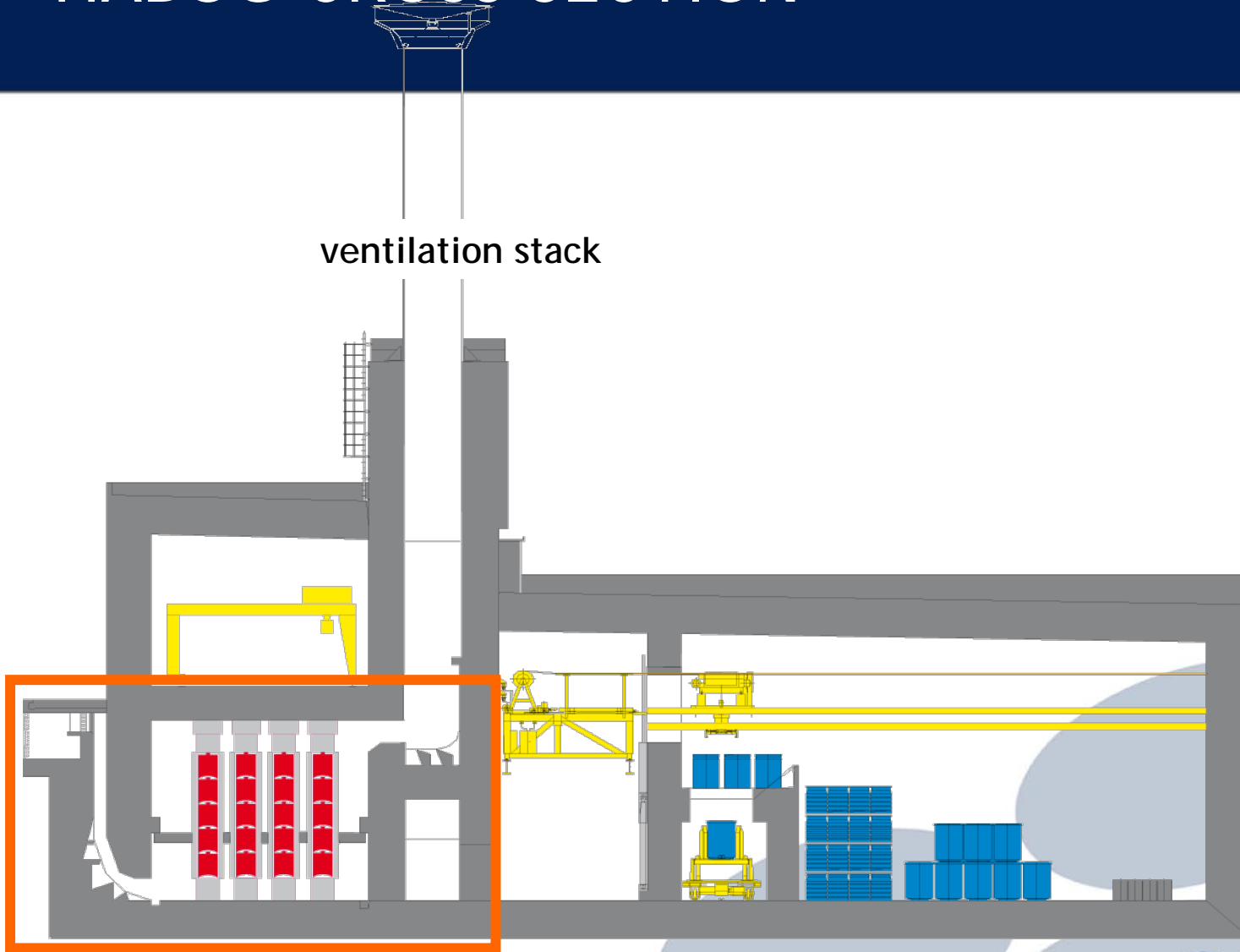


Storage



HABOG CROSS SECTION

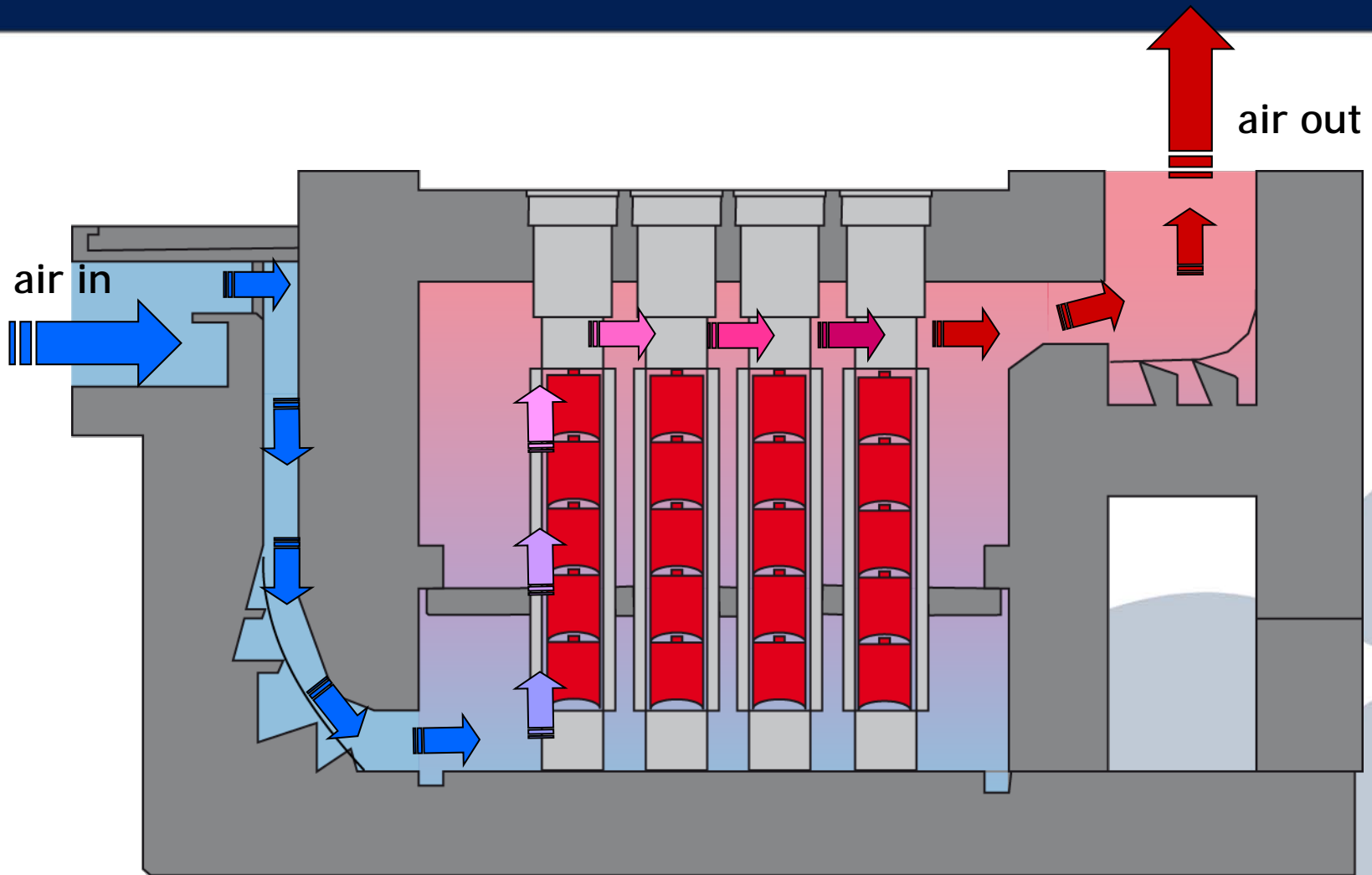
ventilation stack



heat generating waste

non-heat generating waste

HABOG, PASSIVE COOLING SYSTEM

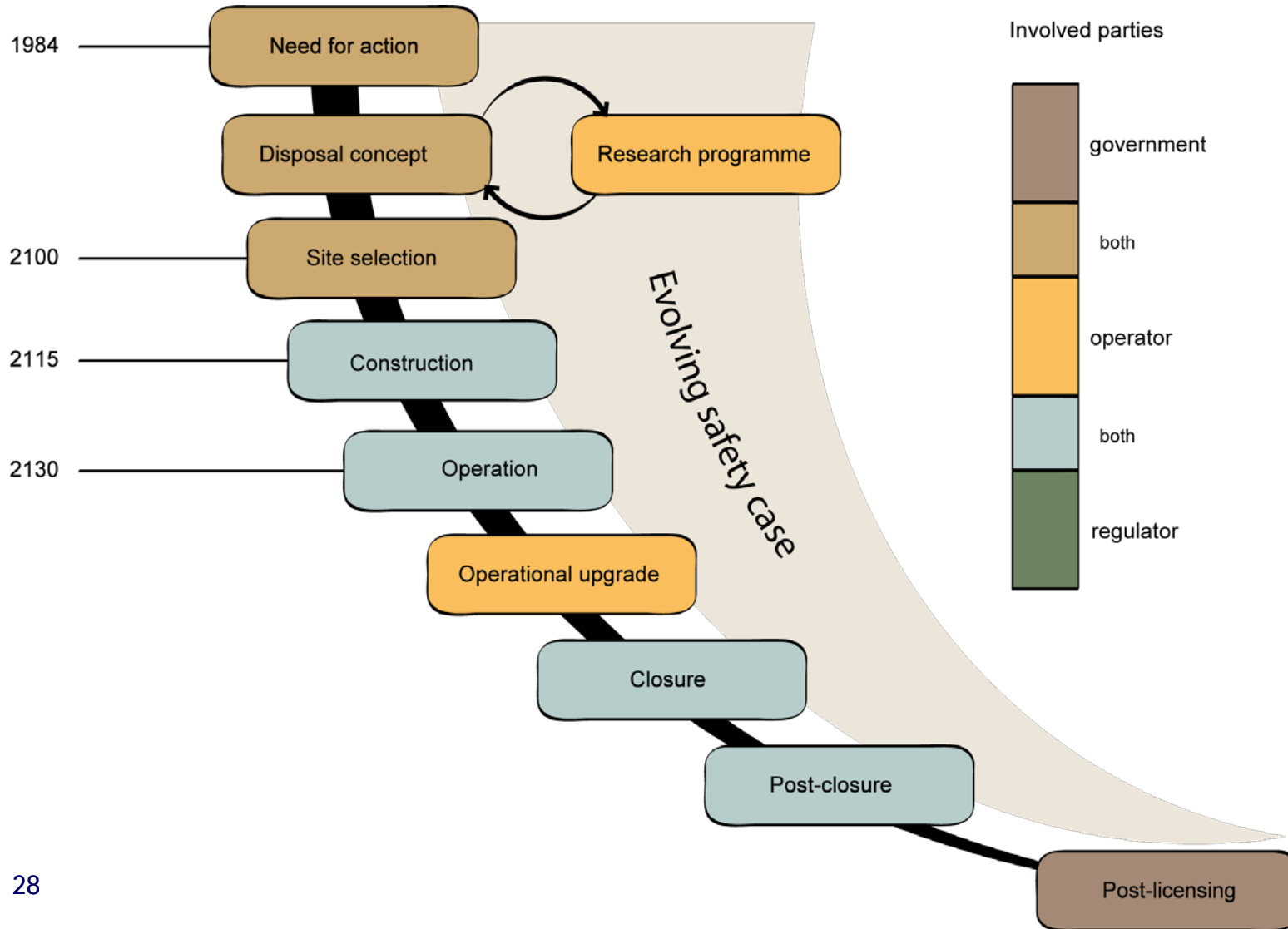
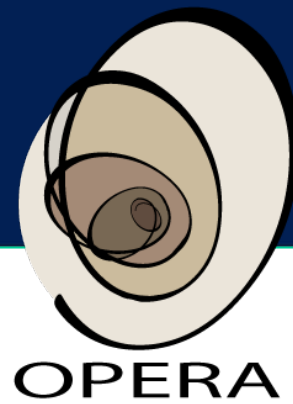


RADIOACTIVE WASTE

100,000 years or more

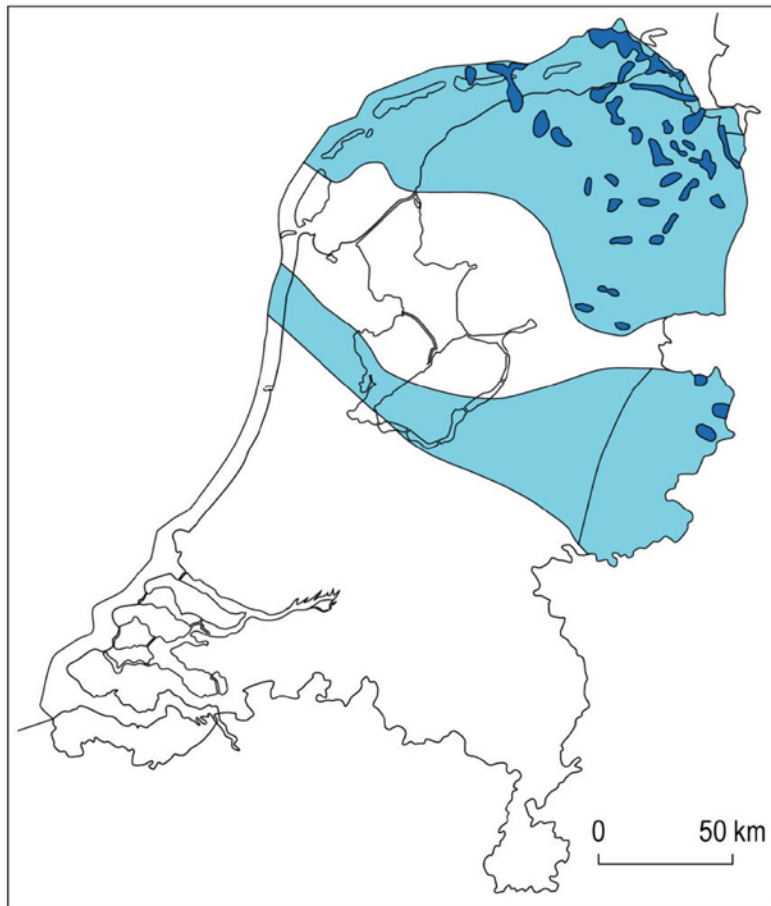
OPERA



Research programme disposal radioactive waste



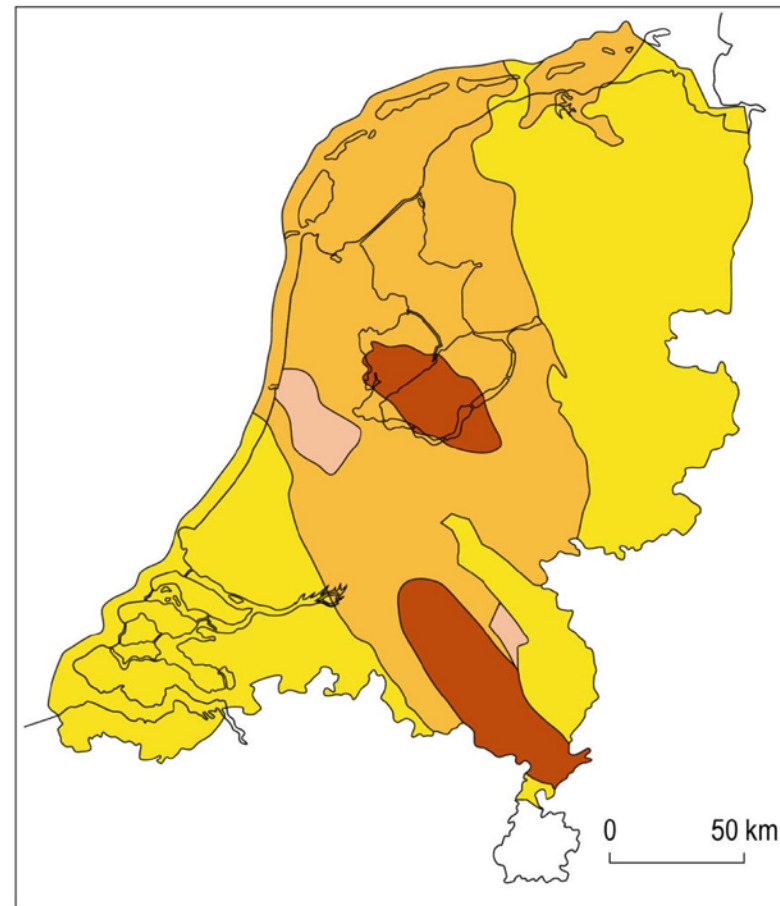
RESEARCH

Zechstein rock salt



-  salt layers
-  salt domes and pillows

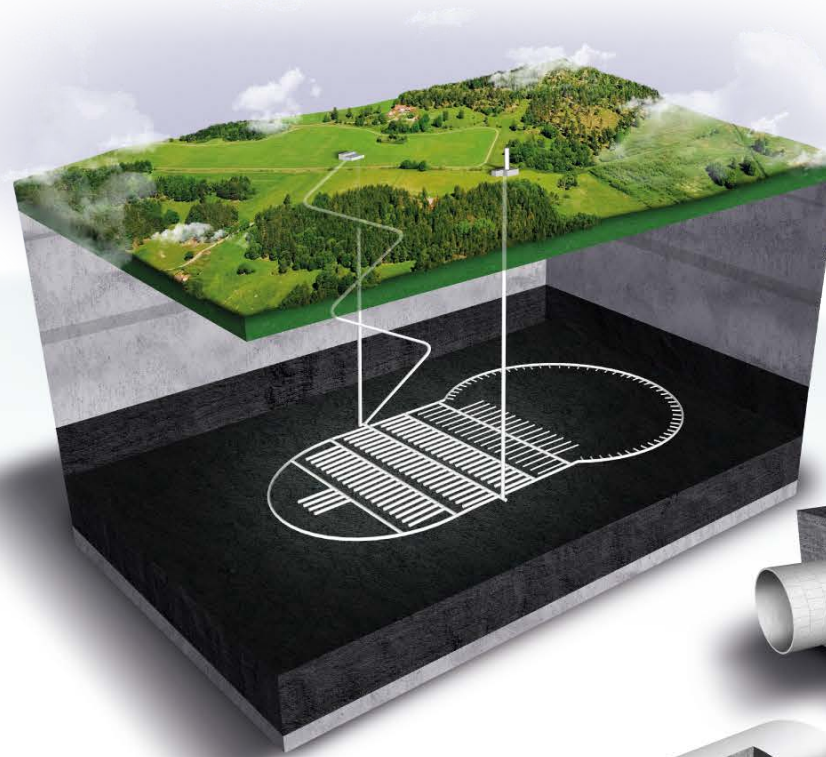
Boom Clay



-  0 - 500 m
-  500 - 1000 m
-  1000- 1500 m
-  depth uncertain

OPERA

LLW



HLW



Repository

- in Boom Clay,
- somewhere in the Netherlands
- assumed depth of 500m



Supercontainer
(ONDRAF/NIRAS)

From 2018 onwards ... OPERA-2

Goals & ambitions

- Detail roadmap R&D:
 - evaluation studies and experiences
 - ensure competences
 - secure knowledge
 - (international) research contribution
- Focus:
Boom clay (and rock salt)

100,000 YEARS OR MORE?

Do it together!

