4th Canadian Conference on Nuclear Waste Management, Decommissioning and Environmental Restoration
Ottawa Marriott Hotel, Ottawa, ON, Canada, September 8-11, 2019

# DBHD 1.4.1 Canada – nuclear repository in deep rocksalt New Brunswick, Nova Scotia

[1] **Volker Goebel Dipl.-Ing.,** [2] **Gerhard Herres Dr.,** [3] **Sonja Philipps Prof.-Dr.,** [4] **Todd Busch M.A.Sc.**
[1] University of applied sciences Dortmund / Germany
[2] University of Paderborn / Dr. Physicist / Germany
[3] University of Göttingen / Prof. Dr. Geologist / Germany
[4] University of British Columbia / Mechanical Engineering / Canada
**and the 14.700 radwaste experts of the world who know the DBHD concept**

[1] info@ing-goebel.ed, [2] herres@thet.uni-paderborn.ed, [3] sonja.philipp@geo.uni-goettingen.ed, [4] toddbusch@consulting.ac

## Abstract

DBHD is a building plan for a nuclear repository – Deep Big Hole Disposal is now possible by Shaft Boring Machines and Shaft Boring Roadheader tools from Germany – Diameter = 12 M.

DBHD 1.4.1 Canada is a building plan that allows to bring 83.200 tons of spent Candu fuel into deep geological repository - for a price of 12,5 Billion Canadian Dollars over a time of 80 years.

The white DSC containers, in concrete-pellets, in rocksalt, are a safe storage for 1-10 Mio. years. In rocksalt - hard gamma radiation only goes 30 cm far and gases like IOD 129 are encapsulated.

The DBHD building plan has been examined by all 14.700 experts worldwide - without critics. There is a calculation based on German price situation and company offers. - Also a time table.

DBHD concept is mature after years of development. What it needs now is more local geology data on deep rocksalt geologies in the areas New Brunswick and Nova Scotia in north Canada.

It needs a long term calculation/simulation by a scientific team using DBHD geometry/geology that calculates : 1. Geo-Mechanics – 2. Geo-Chemistry – 3. Corrosion and 4. Thermodynamics

We propose a safe “street–ship–street transport” of the DSC’s with bumpers on - shielded by a sheet metal hull made of tank-weapon steel – the transport out of town has to be extremely safe.

For the reason of good progress we recommend you to bring the main developer Ing. V. Goebel to Canada – he has 13 years of experience in all themes related to nuclear repository planning …

We wish you a good conference and encourage you to ask questions concerning DBHD 1.4.1 CA

**Keywords:** Nuclear Repository for spend Candu fuel, Geological repository in rocksalt geology Dry Storage Containers, Concrete-Pellets, Rocksalt – **83.200 tons capacity for 12,5 Bio. CAD** “Street-Ship-Street Transport” – Safety – Nuclear Safety – Radiation Safety - **Safe Repository**

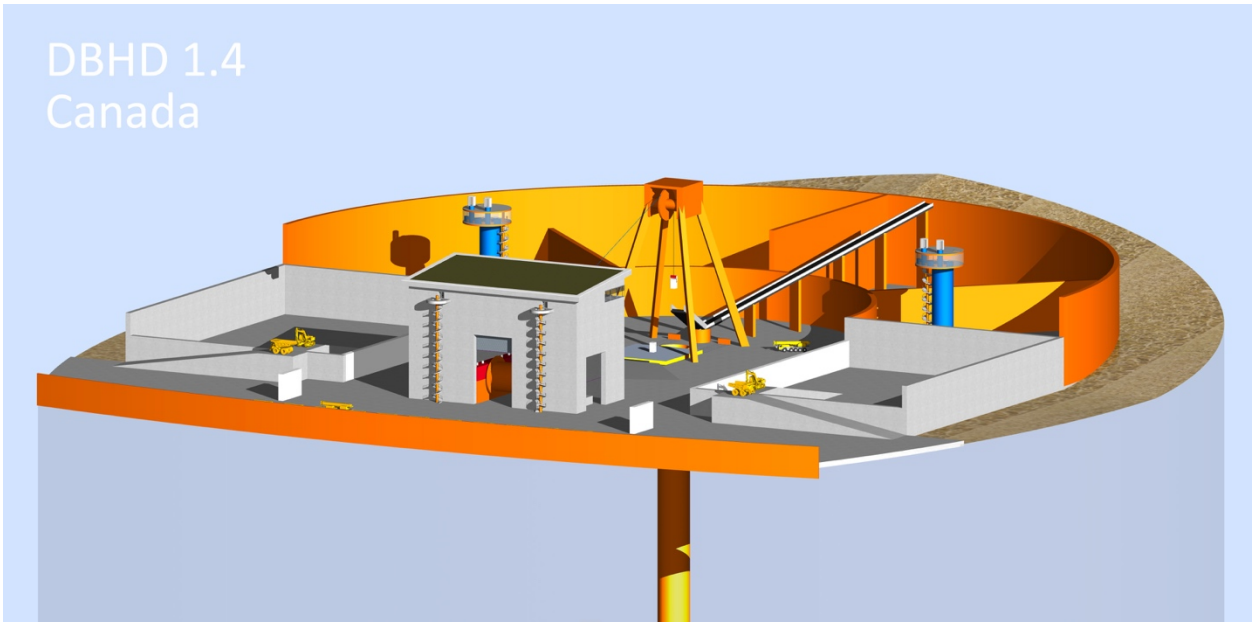

Picture 001: DBHD 1.4.1 Canada concept explained in a simple picture

## 1. Introduction

Actually Canadas nuclear industry is doing fine – but they piled up more then 7.120 full DSC in densely inhabited areas and their disposal agency NWMO failed with the 6 th safety case test concerning the old horizontal geological repository idea. As it is not possible to store activated uranium for 100.000 to 1.000.000 years in the biosphere there is an urgent need to build SAFE and deep nuclear repositories into old suitable host-rock geologies like rocksalt. – SAFETY is more then just a word – it is taking responsible actions by the generation that caused the wicked problem. – With DBHD 1.4.1 Canada there is a proven nuclear repository plan available. The need for nuclear power within the power mix of a country will be always given. Therefore all new permits for nuclear plants have to been decided within the context that the nuclear industry takes on its responsibility. – There is already funds of 4,4 Bio. CAD on account for repository.

For this reason all DSC container data and decay heat data were handed over from NWMO to Ing. Goebel / Switzerland, Germany – to develop a DBHD (Deep Big Hole Disposal) concept. DBHD 1.4.2 Canada nuclear repository plan was defined on the base of 30 years experience in Germany with rocksalt, and over 1.040 public scientific papers that have been published by the Parliament Commission on high level nuclear waste storage. This commission debated for more than 2,5 years, and had more than 11 Mio. EUR on hand, to pay scientific expertise. – Canada is the first foreign country having a profit of this extraordinary quality and science development.

In the actual Version 1.4.1 Canada the repository for 83.200 tons in 8.320 DSCs is planned with 10x DBHD locations in New Brunswick and Nova Scotia – invest 12,5 Bio. CAD over 80 years. There is a technical building plan, a calculation and a time table – all based on experience from other nuclear repository planning works – It is on OPG, Bruce and NB Power to decide now !




Picture 002: Surface Installations of DBHD 1.4.1 Canada with the typical white DSC's

## 2. Science – all art and science that went into the DBHD 1.4.1 Canada plan

- The choice of the right host-rock geology – based on epic scientific knowledge
- The thermodynamic calculation to find the right dimension for vertical storage
- The new SBM (Shaft Boring Machine) drilling technology Diameter 12 Meters
- The architecture of the "concrete storage pellet" (not column, and with Magnetit)
- The science of "keeping the DSC's closed and intact under mountain pressure"
- The architecture of the "stretching fugue" (to buffer thermodynamic expansion)
- The architecture of "efficient room usage" (no empty horizontal corridors)
- The science of encapsulation fast moving gases like IOD 129 for ever in salt
- The science of "perfect closure" (by rocksalt under massive mountain pressure)

In the end of all days, nuclear repository has to work stabile with having every barrier destroyed, and thinking it as the fuel bundles are situated naked in the old rocksalt for ever.

Only an old geology can do nuclear repository – we humans can only build temporary entrance buildings into the suitable geology. Only an old geology can do nuclear repository.

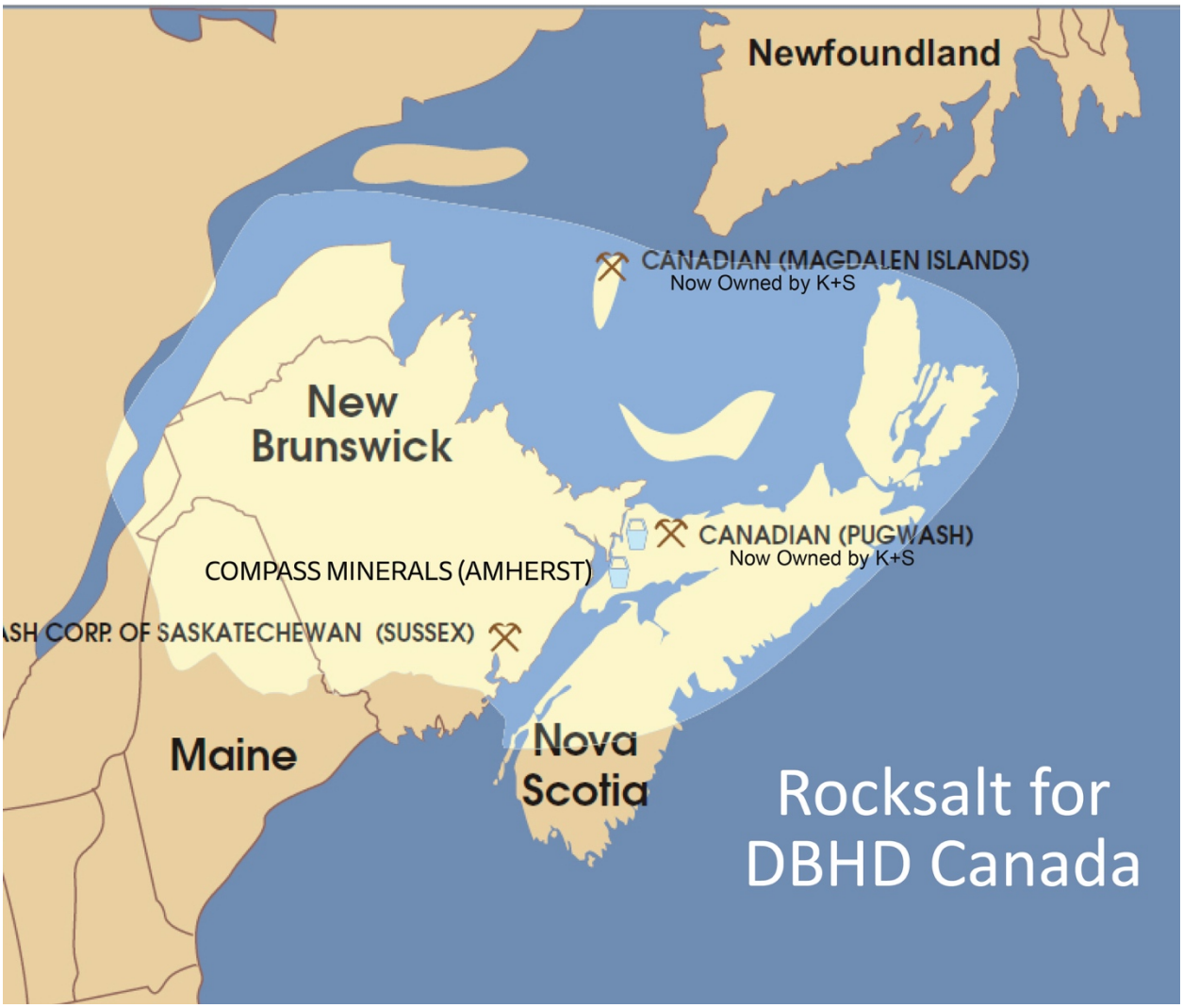

Picture 003 and 04: Rocksalt samples from the age of Perm - app. 255 years old

## 2. The choice of the right host-rock geology – based on epic scientific German knowledge

**Canada is blessed with a huge, massive super world rocksalt geology in the north-west.**

There has to be a sediment overlay – and every repository has to be so deep that coming ice ages will not be able to open them – also the perfect closure by mountain pressure requires deepness – the ideal situation is 900 Meters Sediment overlay and 1.300 Meter Salt thickness. Such geologic location circumstances can be found – and they have to be "on land - not on sea".

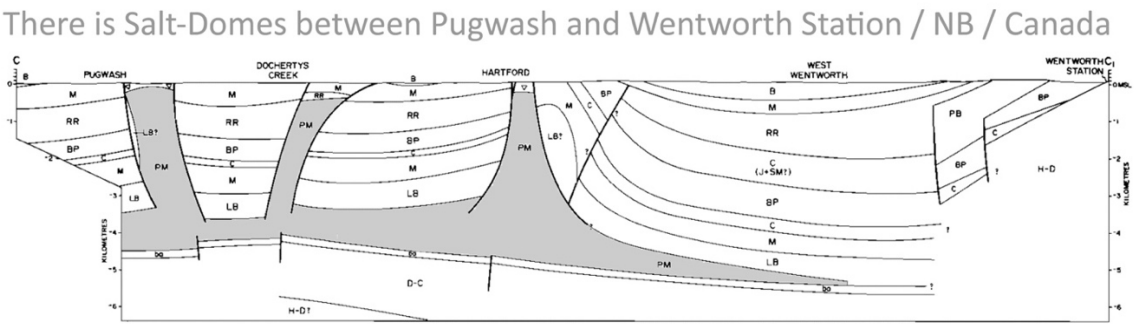
The requests for geological information have been send to the government geologists in New Brunswick and Nova Scotia. – But even that does not vanish the need for expensive core drilling to be ensure that the location offers what it needs for repository. Core drilling within calculation



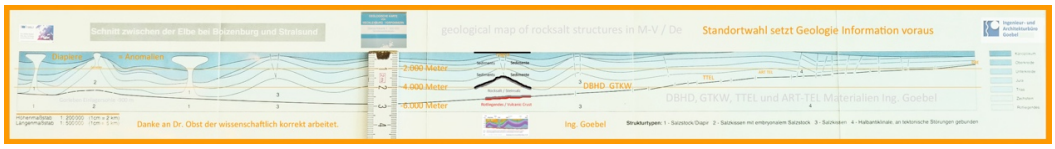

Picture 005: Geological overview picture to the deep rocksalt geology in Canada

## The choice of the right host-rock geology – based on epic scientific German knowledge

Where the salt comes up to the surface it is found and mined first – but these 5,5 km high salt domes are just a part of the rocksalt – the domes are usually the "anomalies" of a huge rocksalt cushion – they are also 250 Mio. years old – formed just after the salt was there by weakness of the surrounding areas the salt could creep up slowly. – Most of the rocksalt cushion is like a more or less flat landscape. – The deep salt is not so easy to find – only deep core drilling can identify these "cushions" – They are always there – One just have to find them …




This is how an equivalent geology cut looks like in Germany ("Zechstein"- also from Perm)



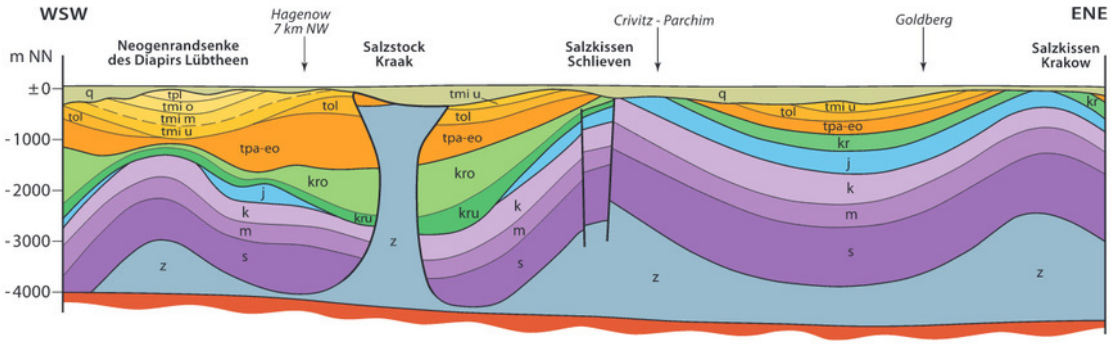




*Abb. 3 Schnitt durch verschiedene Zechstein-Salzstrukturen (z) in SW-Mecklenburg (LUNG 2002, verändert)*
*Fig. 3 Section through different Zechstein salt structures (z) in SW Mecklenburg (LUNG 2002, modified)*

## The choice of the right host-rock geology – based on epic scientific German knowledge

The best way to identify a location that is prosperous for core drilling is by looking into the geological gravity lines maps – rocksalt (2,2 kg/dm3) to sediments (2,5 kg/dm3) can be told apart by gravity measurements – the resulting map can give a good idea of how the salt is formed in the underground – for further information you have to consult the geologist …

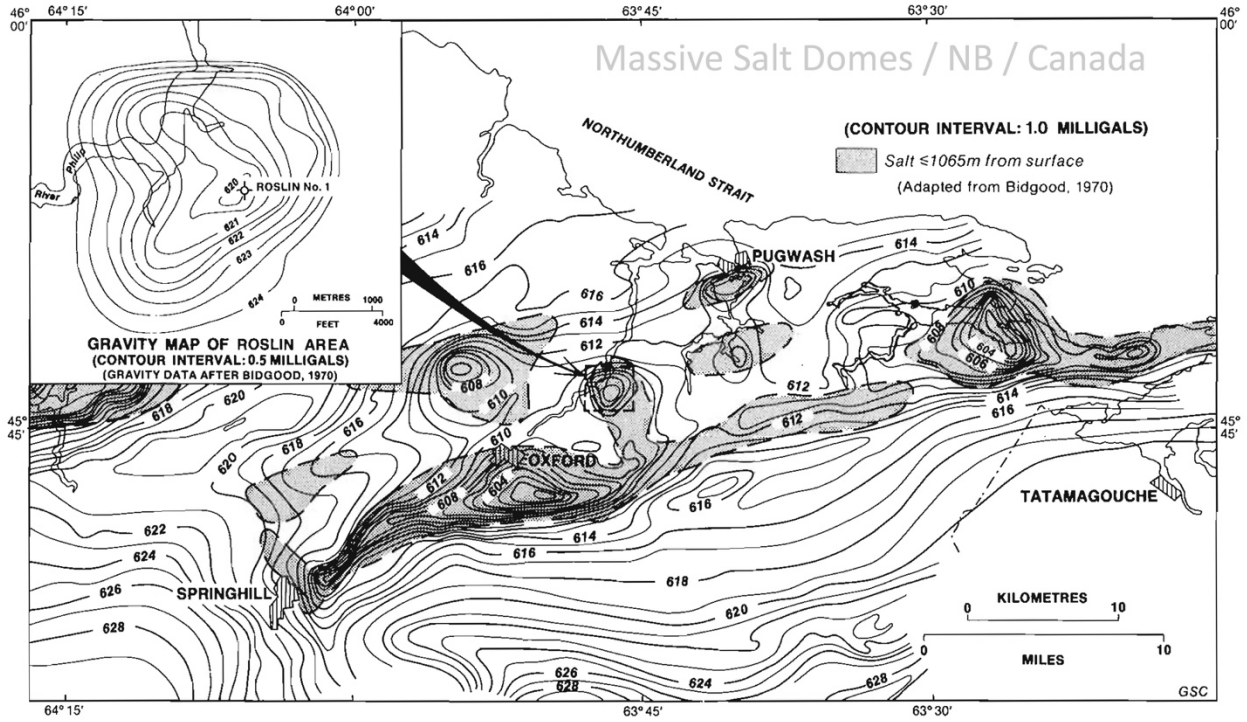
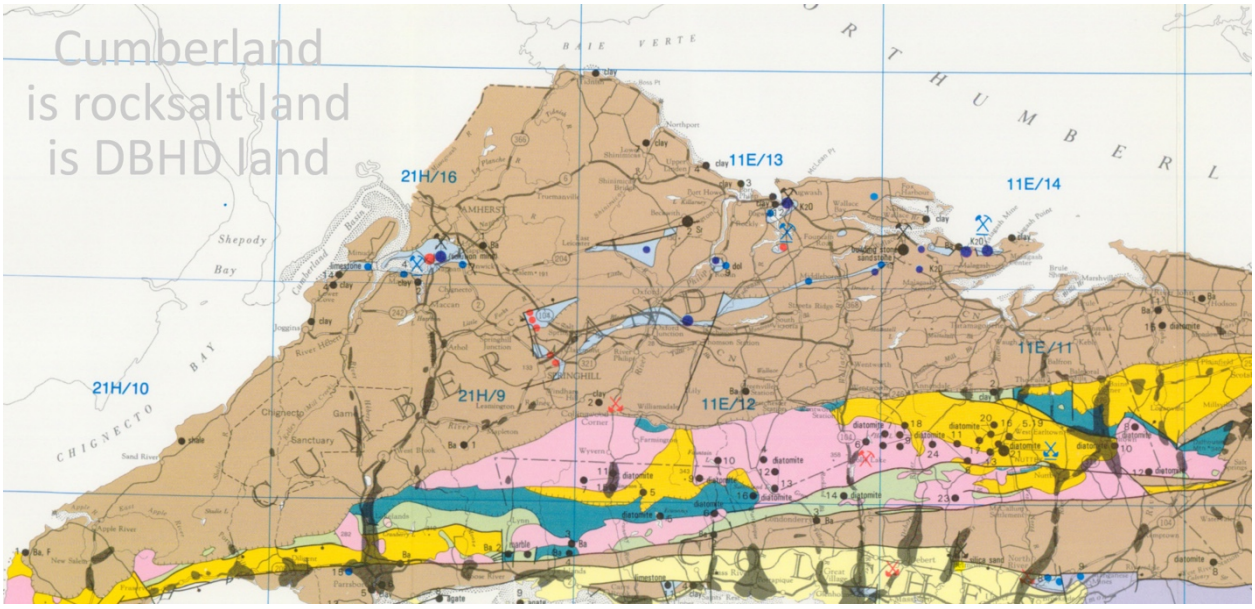



**Figure 47.** Gravity map, Cumberland subbasin, Nova Scotia.




DBHD
1.4.1 CA
for NWMO
DBHD Materialien
578 m. casing bc. of GWL
300 m.
415 m. Closure by mountain-pressure
785 Meter DSC storage area
100
volcanic crust of the earth
906 Meter Sediments
1.300 Meter rocksalt geology
0.00 m
1 bar
Biosphere
-300 m
+65 bar = 6,5 MPa
+9°C
-600 m
+129 bar 12,9 MPa
+18°C
-900 m
250 Mio. years old
+194 bar 19,4 MPa
+27°C
-1.200 m
+259 bar 25,9 MPa
+36°C
-1.500 m
+324 bar 32,4 MPa
+45°C
-1.800 m
+388 bar 38.8 MPa
+54°C
-2.100m
+453 bar 45.3 MPa
+63°C
258 Mio. years old
-2.400 m
+518 bar 51.8 MPa
+72°C
-2.700 m
+583 bar 58.3 MPa
+81°C
Sediments
Heat Conductivity Sediment Rock app 2 bis 3 W/mxK
Density app. 2.200 bis 2.500 Kg / m³
Groundwater requires possible "Grouting Action"
Groundwater possible
NWMO before
Max. depth of inter Ice Age scarfs
Rocksalt " Halit "
" Heat Conductivity " Rocksalt = 5,6 W/mxK
Density app. 2.200 Kg/m³
Melt-temp. = 801 °C Boil-temp. + 1.465 °C
Closure by putting salt back and natural "Mountain-Pressure"
Heat-Emissions of 832 old DSC Containers taken in account here with 4.04 MW
This heat can not be taken in from the Mountain rocksalt in the speed it comes ...
The heat will sum up for 400 years and then slowly go off
terrain elevation from heat expansion app. 7,6 m Radius 185 m
Concrete Pellets
Heat conductivity concrete = 2,1 W/mxK
Density app. 3.000 Kg/m³
up to + 400°C full compressive strength
from then on sinter up to Melt-temp. + 1.350 °C
nuclear repository for 832 old DSC Containers Dry Storage container white
in rocksalt the hard gamma rays would only reach 30 cm
inclusion of IOD 129 gases for one eternity in rock salt
"Pellets" because of heat expansion AND for the Earthquake-case are constructively necessary
Volcanic crust of the earth
Heat Conductivity rocks app. 2 bis 3 W/mxK
Density app. 2.200 bis 2.500 Kg / m³
1.349 m³ - 146 m³ = 1.203 m³
Pellet-Diameter = 16,18 m.
Storage Area DBHD is D = 16,18 Meter / SBM Drill D = 12 m.
We calculate with 83.200 tons net in 8.320 DSC containers !!!
As Canada got so much spent Candu fuel it will need to build 10 DBHD's for a price of app. 19,7 Bio. CAD - takes 80 years ?
... and how it's stored
Inside a dry storage container
CATARINAN (MAGDALEN ISLANDS) Now Owned by K+S
New Brunswick
COMPASS MINERALS (AMHERST)
CANADIAN (PUGWASH) Now Owned by K+S
Maine
Nova Scotia
Rocksalt for DBHD Canada
There is Salt-Domes between Pugwash and Wentworth Station / NB / Canada
ONTARIO POWER GENERATION
Energie NB Power
Bruce Power
nwmo
FOR THE EXPERTS CHECK THE PLAN
This general technical draft-plan shows parts of the finished, already built, closed DBHD 1.4.1 construction. To achieve this state of repository building it needs a lot of highest level scientific calculations and many site construction plans to built this CA-Innovation.
DBHD can do perfect closure by mountain pressure
Also compare calculation sheet - compare time tables
Deep Salt in New Brunswick and Nova Scotia - Probe Drillings required
± 0.00 = xx meters above sea l. (Location xx°xx'xx.xx" North / xx°xx'xx.xx" East) "near .."
Top Rocksalt -900 meters, Thickness 1.300 meters / geol. deepstep +3.0 °C / 100 meters
DBHD 1.4.1 Canada, deep safe nuclear repository, 83.200 tons spent fuel "Deep Big Hole Disposal" / Vertical Castor Storage
Deep, safe, geological "DSC Container repository" with the white Containers in concrete-magnetit pellets in rocksalt - SBM drilling
Canada - for: Ontario Power, Bruce Power, New Brunswick Power
NWMO, 22 St. Clair Avenue East, 6th Floor Toronto, ON M4T 2S3
Ingenieur- und Architekturbüro Goebel / Dept. of nuclear waste
8532 Willen b. Weiterau, Switzerland / Rabbach 15, 19057 Schwerin
024
DBHD_1.4.1_Canada_DSC_disposal
nwmo
Ingenieur- und Architekturbüro Goebel

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 | | Version 0.2.4 | | http://www.dbhd-hlw.de + http://www.ing-goebel.de | | | | |
| 2 | **Calculation 10 x DBHD 1.4.1 Canada nuclear repository** | | | | | | | |
| 3 | Last edit: 18. March 2019 / Dipl.-Ing. Volker Goebel Switzerland / Nuclear Repository Planner ww | | | | | | | |
| 4 | **Capacity : 8.320 DSC's Canada** (white 60 tons concrete **D**ry **S**torage **C**ontainer with +10 tons net spent fuel) | | | | | | | |
| 5 | **Repository-Storage-Depth in DBHD 1.4.1 Canada : from -1.350 Meters down to -2.100 Meters** | | | | | | | |
| 6 | Based on : Draft-Planning from 2014 - 2019 actually in Version **1.4.1** - Final for NWMDER | | | | | | | |
| 7 | | ONTARIO POWER GENERATION | Bruce Power | | Énergie NB Power | nwmo | | |
| 8 | | | | | | | | |
| 9 | | **Type of invest** | **Amount** | **Offer / Quote** | **Factor** | **Total** | **Comment** | **dwg** |
| 10 | | | | or hint from : | | | | |
| 11 | | Repository Plans | 2014-2019 (5,25 yrs) | Ing. V. Goebel + T. | 562'000 CAD | 2'950'000 CAD | Draft-Plans, B-Plans | yes |
| 12 | | Probe-Drillings | 20 x | Prof. Dr. M. Reich | 9'500'000 CAD | 190'000'000 CAD | Cores > -2.250 m | |
| 13 | | 24x Land Purchase | 1,1 km2 | from local owners | | 396'000'000 CAD | 10 x 110.000 m2 | |
| 14 | | Shaft-Boring-Ma. | 4 x SBM / SBR | Herrenknecht AG | 90'000'000 CAD | 360'000'000 CAD | 2 yrs. delivery time | yes |
| 15 | | External streets | 70 km | make-over | | 30'000'000 CAD | new / enhance | |
| 16 | | E-powerconnection | 10 x | local NB Power | | 38'000'000 CAD | 10 kV med. voltage | |
| 17 | | Water-connection | 10 x | incl. water | | 45'000'000 CAD | 10 bar with DN 200 | |
| 18 | | Internal Logistics | | anticipation | | 75'000'000 CAD | 10 building sites | |
| 19 | | Drilling platforms | 10 x | 43.000 m3 | 1500 CAD/m3 | 645'000'000 CAD | floors and walls | yes |
| 20 | | Mat. storage ring | 10 x | 70.000 m3 | 1350 CAD/m3 | 945'000'000 CAD | floors and walls | yes |
| 21 | | Conveyor Belts | 5 x | | | 150'000'000 CAD | diverse types | |
| 22 | | Heavy load trucks | | | | 22'500'000 CAD | Dump trucks | |
| 23 | | Compensationes | 20.000 Shares | direct local people | 45'000 CAD | 600'000'000 CAD | payment not bribe | yes |
| 24 | | Planning Offices | Scientific expertise | many disciplines | | 308'000'000 CAD | over 80 years | |
| 25 | | Approval Fees | | many agencies | | 124'000'000 CAD | to Gov. Agencies | |
| 26 | | Start-Setting SBM | 10 x | Thyssen Schachtbau | 4'500'000 CAD | 45'000'000 CAD | temp. Structures | |
| 27 | | Shaft Drills D=12 m | 10 x | Thyssen Schachtbau | 53'000'000 CAD | 530'000'000 CAD | autom. Maschine | |
| 28 | | Spray-concr.-wall | 9,3 m2 x 1.315 m | 12.230 m3 x 10 | 900 CAD/m3 | 110'070'000 CAD | steel-fibre-amored | yes |
| 29 | | Shaft completition | 6 sets | Siemag Tecberg | 45'000'000 CAD | 270'000'000 CAD | Vent., Transport | |
| 30 | | Air-Conditioning | 5 x | Siemag Tecberg | 10'500'000 CAD | 52'500'000 CAD | cold dry air IN | |
| 31 | | Flow-Ice Piping | 5 x | Siemag Tecberg | 9'000'000 CAD | 45'000'000 CAD | 50 Liters / Sec. | |
| 32 | | Cable-Drum-Houses | 10 x | 90.000 m3 S.T. | 1'500 CAD | 1'350'000'000 CAD | House with crane | yes |
| 33 | | Cabledrum&Motor | 5 x | Siemag Tecberg | 6'000'000 CAD | 30'000'000 CAD | Drum-Diam.=14 m | |
| 34 | | Work-Over Rigs | 3 x | Steelbuilders | 4'800'000 CAD | 14'400'000 CAD | with return pulley | yes |
| 35 | | Dyneema Ropes | 16 x | Gleistein DE | 4'400'000 CAD | 70'400'000 CAD | D=60 mm 2.100 m | |
| 36 | | Transition Cone | 10 x | concrete constr. | 1'100'000 CAD | 11'000'000 CAD | 12 m. to 16,18 m. | yes |
| 37 | | Hole-opening | 10 x | to Diam. = 16,2 m. | 2'700'000 CAD | 27'000'000 CAD | with chain-saws | |
| 38 | | Staff 80 years | 50 Man&Woman | 4 h. shifts down t. | | 3'100'000'000 CAD | Work & Safety | |
| 39 | | Rocksalt-Salt-Sale | 10 x 310.000 m3 | rough quality | 75 CAD/m3 | - 232'500'000 CAD | Salt many uses | K+S |
| 40 | | Concrete-Pellets | 832 Pellets | 1.203 m3 x 832 x 10 | 150 CAD/m3 | 1'501'344'000 CAD | Quality-Concrete | yes |
| 41 | | Sand/fine gravel | 832 Layers 1m | 206 m3 x 832 x 10 | 105 CAD/m3 | 179'961'600 CAD | D = max. 3 mm | |
| 42 | | Magnetit powder | 832 Portions | 70 m3 x 832 x 10 | 1020 CAD/m3 | 582'400'000 CAD | Rio Tinto, Billiton | yes |
| 43 | | Closure works | 10 x | own Salt grain | | 134'000'000 CAD | Salt + M. Pressure | |
| 44 | | building back | 10 x | | | 30'000'000 CAD | farmland again | |
| 45 | | Unforseeables | 4% | | | 471'281'024 CAD | the un-expected | |
| 46 | | **Total** | **March 2019** | **Version 24** | | **12'253'306'624 CAD** | | |
| 47 | | | | | | | | |
| 48 | | | | | | | | |
| 49 | | plus **street - ship - street** transports, plus law cases | | | | **12,5 Bio. CAD** | Ingenieur- und Architekturbüro Goebel GmbH | |
| 50 | | | | | | | | |
| 51 | | | | | | | | |
| 52 | | | | | | | | |



capacity 8.320 DSC container
83.200 tons spent Candu fuel

deep rocksalt
New Brunswick
& Nova Scotia

ONTARIO POWER GENERATION

Énergie NB Power

Bruce Power

WANO

Canadian Nuclear Laboratories

FOR THE EXPERTS
**CHECK THE PLAN**

this is a technical drawing of DBHD 1.4.1 Canada from a german nuclear disposal planner. NWMO supported by giving the DSC container data and "decay heat data".

The required deep rocksalt geologies are given up there in New Brunswick and Nova Scotia !

In rocksalt gamma rays go only 30 cm and gases like IOD 129 are hold back in the salt hostrock.

proposal for

nwmo

by Ing. Goebel


This general technical draft-plan shows parts of the finished, already built, closed DBHD 1.4.1 construction. To achieve this state of repository building it needs a lot of highest level scientific calculations and many site construction plans to built this CA Innovation.

DBHD can do perfect closure by mountain pressure
Also compare calculation sheet - compare time tables

HEIGHT, LOCATION, GEOLOGY: Deep Salt in New Brunswick and Nova Scotia - Probe Drillings required
± 0.00 = xx meters above sea l. (Location xx°xx'xx.xx" North / xx°xx'xx.xx" East) "near ..."
Top Rocksalt -900 meters, Thickness 1.300 meters / geol. deepstep +3.0 °C / 100 meters

BUILDING:
**DBHD 1.4.1 Canada, deep safe nuclear repository, 83.200 tons spent fuel "Deep Big Hole Disposal" / Vertical Castor Storage**
Deep, safe, geological "DSC Container repository" with the white Containers in **concrete**-magnetit pellets in rocksalt - SBM drilling

CLIENTs:
Canada - for: Ontario Power, Bruce Power, New Brunswick Power NWMO, 22 St. Clair Avenue East, 6th Floor Toronto, ON M4T 2S3

PLANAUTHOR:
**Ingenieur- und Architekturbüro Goebel** / Dept. of nuclear waste
8832 Wilen b. Wollerau, Switzerland / Ratsteich 15, 19057 Schwerin

PLANNIINGPHASE:
**Draft-Plan DBHD 1.4.1 Canada / Nuclear Repository with 832 white DSC HLW Containers**

PLANNUMBER: 024

PLANTITEL: DBHD_1.4.1_Canada_DSC_disposal

nwmo

Ingenieur- und Architekturbüro Goebel

PROJECT-NUMBER:
Project Nr. 07 Version 1.4.1

DRAFTSMAN:
Dipl.-Ing. Volker Goebel

DATE: Beginning with DBHD plans
02. September 2014

LAST EDIT:
**16. March 2019**

SCALES:
**many - but all " to scale "**

PLANSIZE:
1.682 x 594 mm put on a door

EN_DBHD_1.4.1_Canada_Nuclear_Repository_DSC_HLW_Rocksalt_New_Brunswick_Nova_Scotia_Ing_Goebel_for_NWMO_payment_required.pln

## 2.1 First location for DBHD 1.4.1 Canada defined - based on gov. geological drill data

We managed to define a first location, because we received core drilling data from the New Brunswick geological service by Ms. Susan Johanson - Government geologist at NB / Canada

The core drilling of " Dorchester 01 " undertaken by Shell in 1956 shows massive rocksalt at

**Attitude : 45° 54' 51" and Longitude : 64° 31' 54"  New Brunswick / Canada**

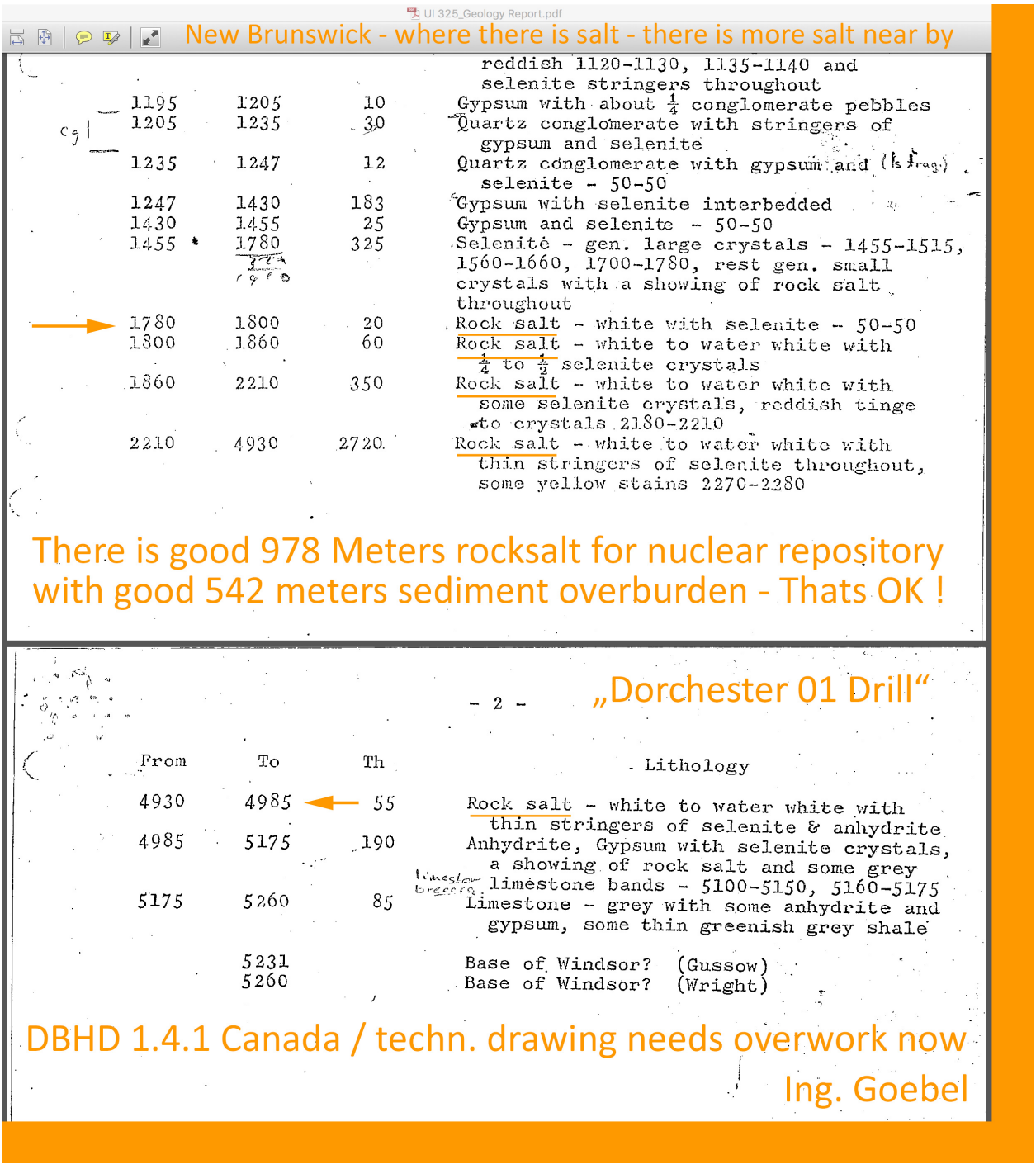
**Top Salt**
**1.780 feet = 542 Meters**

**Bottom Salt**
**4.985 feet = 1.520 Meters**

**that is 978 Meters rocksalt**

**DBHD 1.4.1 Canada**


Picture 014: Location Definition for DBHD 1.4.1 Canada nuclear repository No 1

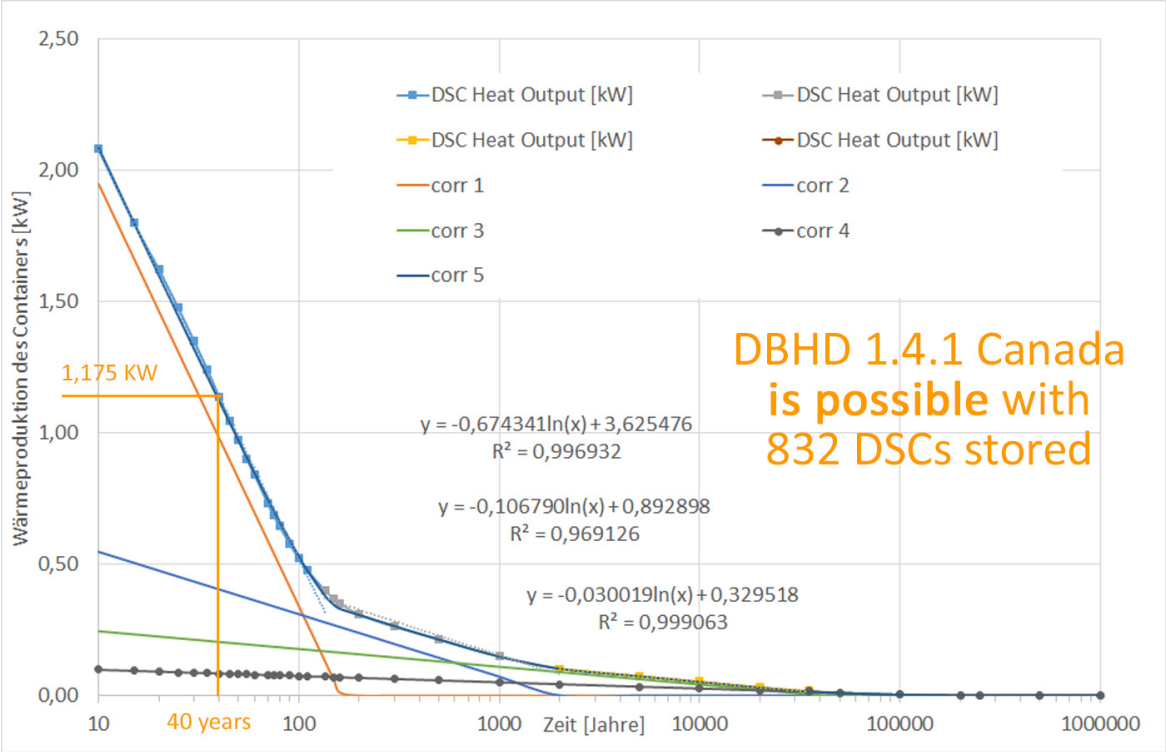



Picture 015: Core Drilling Stratigraphy from “Dorchester 01” shows massive rocksalt geology

## 3. Decay Heat question - How many DSC's are possible in one DBHD

As the white DSC's contain un-enriched spent Candu fuel the decay heat is by far not as massive as in the German DBHD that stores Castor containers with activated enriched fuel and vitrified waste. - That means - the Canadian DBHD can contain a lot more tons within each DBHD.

Based on an .xlsx table received from NWMO we have made the following conclusions :




DSC Canada „**decay heat curve**" in a chart
Based on an .xls table received by NWMO
That is „calculated", „not measured" values
1A Graphic by Dr. G. Herres / Uni. Paderborn
Result : the 40 years old 70 tons DSC's give
app. 1.175 KW heat out !!! **good for DBHD**
**1.4.1 Canada** / 832 DSC x 1,175 KW = **978 KW**
WooW - that is much less then we expected !
DBHD can take app. 3 MW - but we have only 1 MW
we could even store „fresh CA DSC's" - Great news !
(much different to german spent fuel heat !!!)

Start information:

**there is 384 FB (fuel bundles) in one DSC**

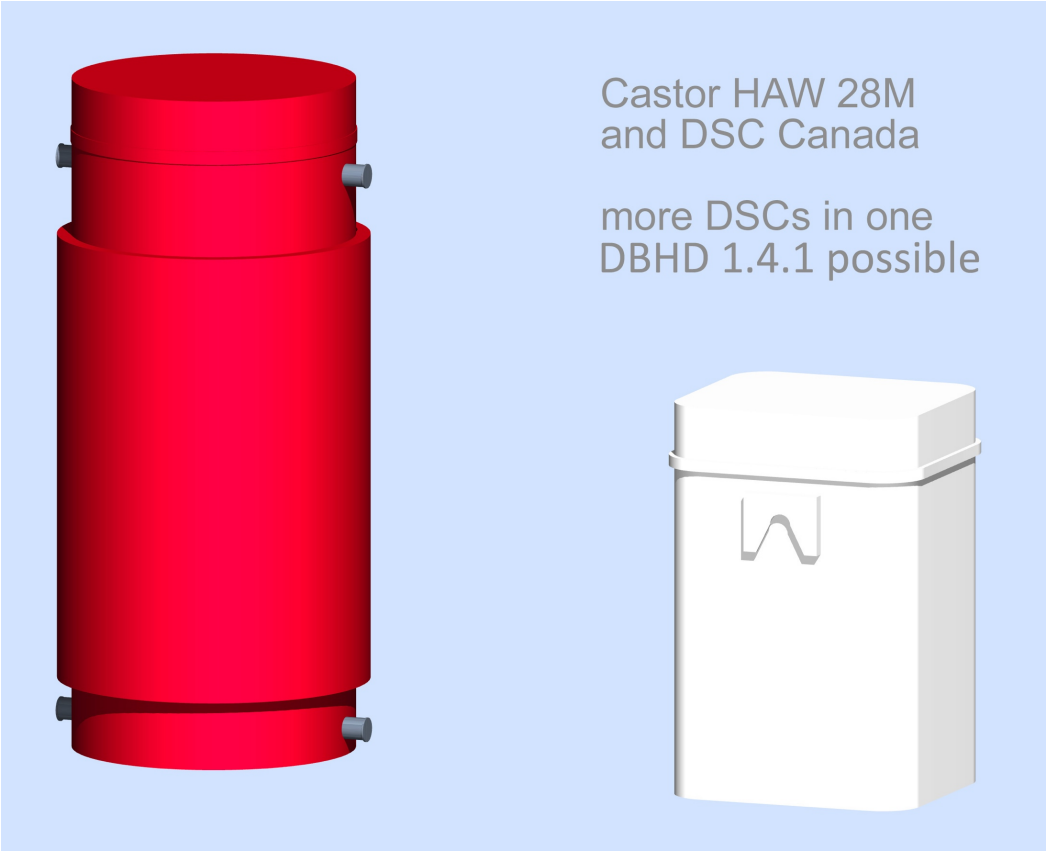
DSC = Dry Storage Container / concrete and welded metal

**1x white DSC with 3,55 x 2,12 x 2,41 Meters = 1,175 KW (40 years old)**

**832 DSC's x 1.175 KW = 977,6 KW = 0,98 MW = 1 MW**

**DBHD can take up to 2,83 MW per column with German Castor containers**

**with only 1 MW decay heat from the DSC's the DBHD 1.4.1 Canada is SAFE**

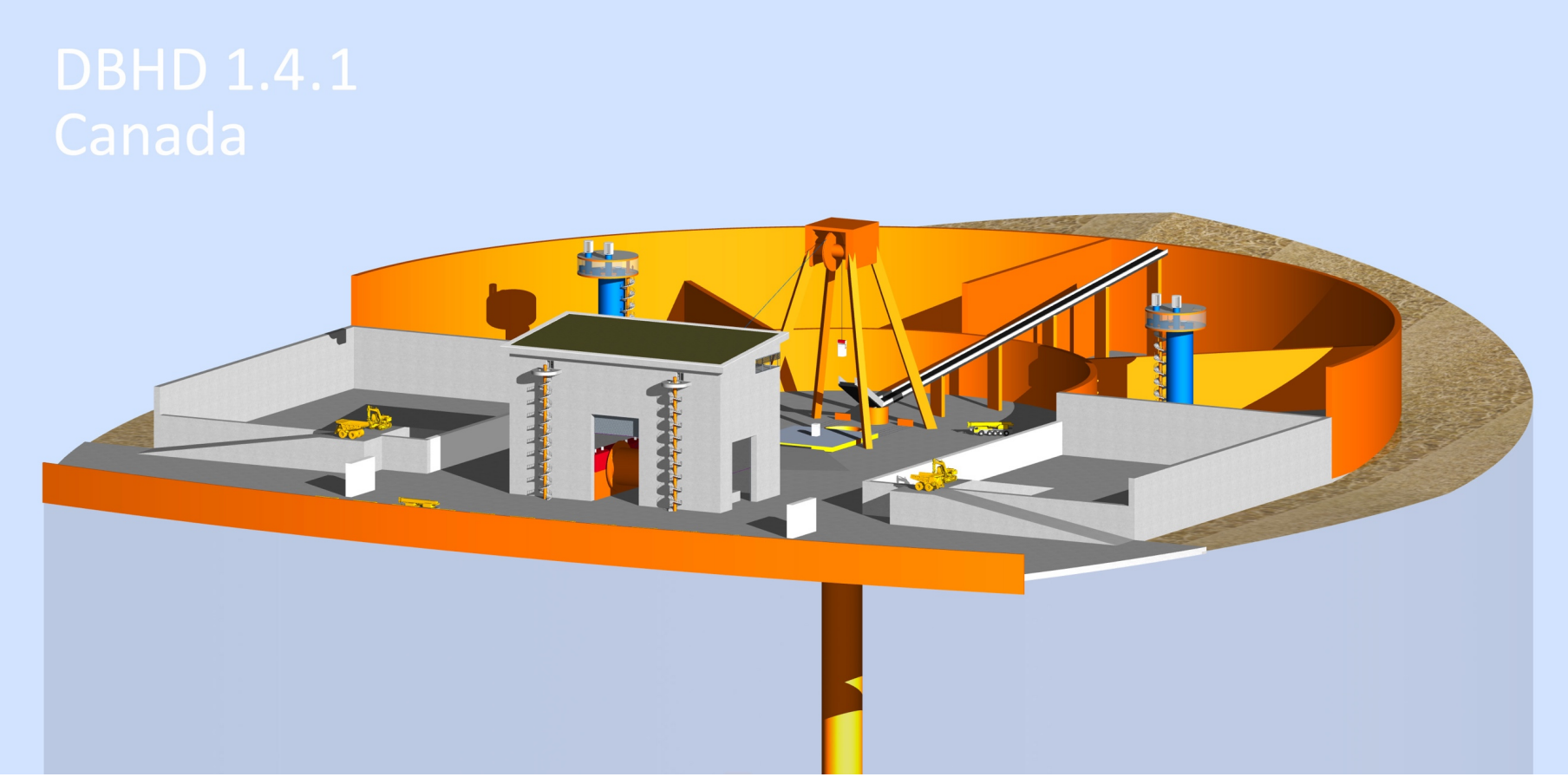



Picture 017: Castor with enriched spent fuel and DSC with unenriched spent fuel

## 4. How to bring the DSC containers down into the deep rocksalt geology

Basically the transport it is done by a steel or dyneema cable and a work over rig - the DSCs travel down on a wire - a cable.

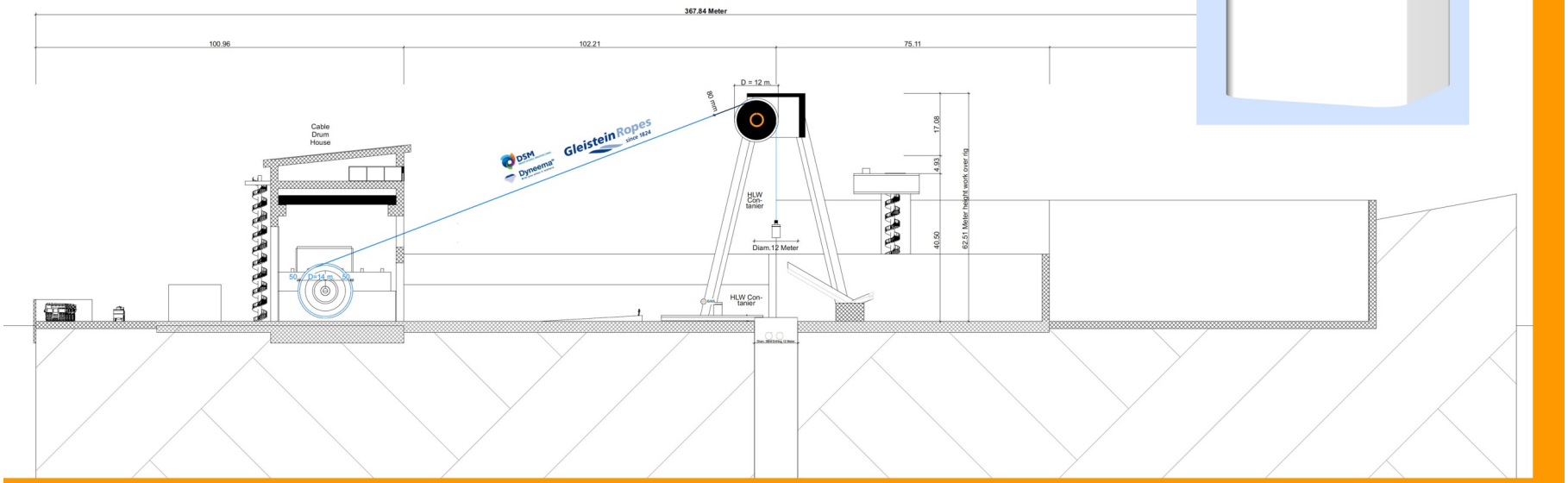
It also needs a lot more on site - but mainly - Ventilation for Airconditioning - and space for interim store of dig out and closing materials




Picture 018: Draft plan of the visible in biosphere installation required for DBHD 1.4.1 Canada

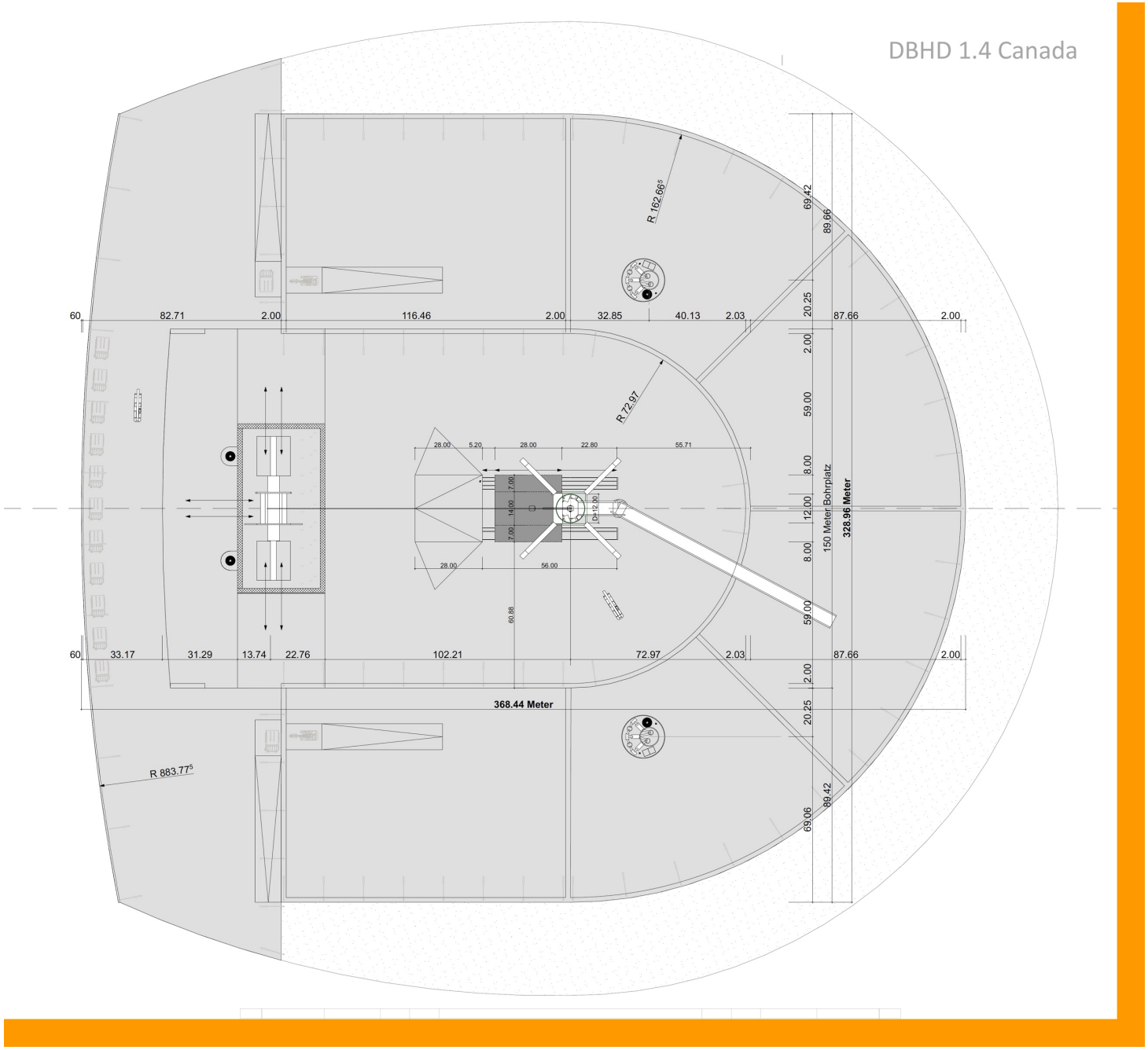
# DBHD 1.4 Canada

**D**eep **B**ig **H**ole **D**isposal = DBHD / geological nuclear repository for DSC




Picture 019: Draft plan - Cut of the drilling platform showing cable drum house and work over rig for transport

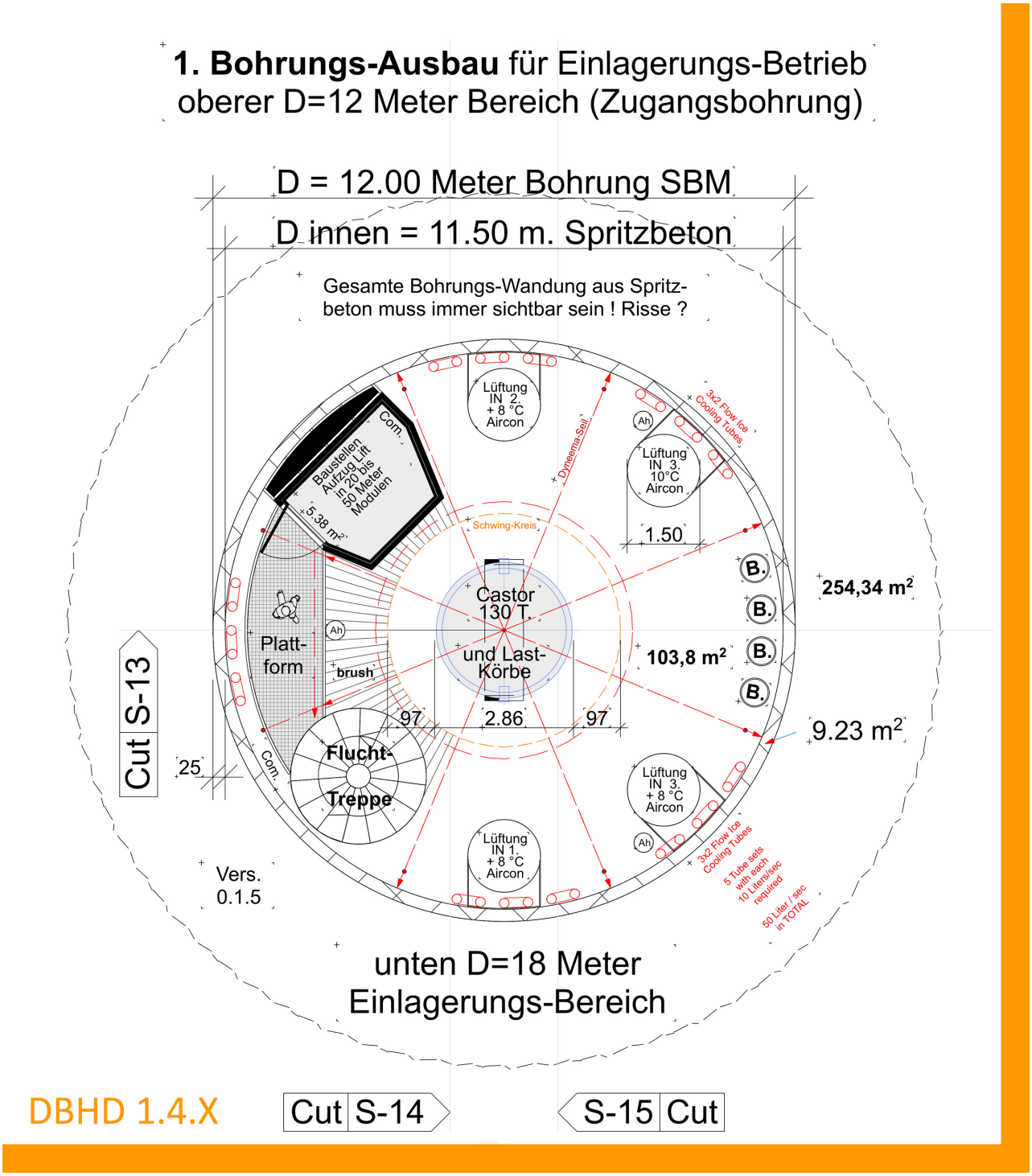
As these plans were originally made for the 130 tons Castor and a deepness of 3.350 meters
It is very likely that a plan workover for the 70 tons DSC and a deepness of app. 2.100 meters
leads to a smaller drilling platform - also the work over rigs offered today look different from
what the architects technical drawing show. All plans have to refer to the site and its geology.


DBHD 1.4 Canada
R 162.66°
R 72.97
R 883.77°
60
82.71
2.00
116.46
2.00
32.85
40.13
2.03
87.66
2.00
69.42
89.66
20.25
2.00
59.00
8.00
12.00
8.00
59.00
2.00
20.25
89.42
69.06
150 Meter Bohrplatz
328.96 Meter
28.00
5.20
28.00
22.80
55.71
7.00
14.00
7.00
12.00
28.00
56.00
60.88
60
33.17
31.29
13.74
22.76
102.21
72.97
2.03
87.66
2.00
368.44 Meter

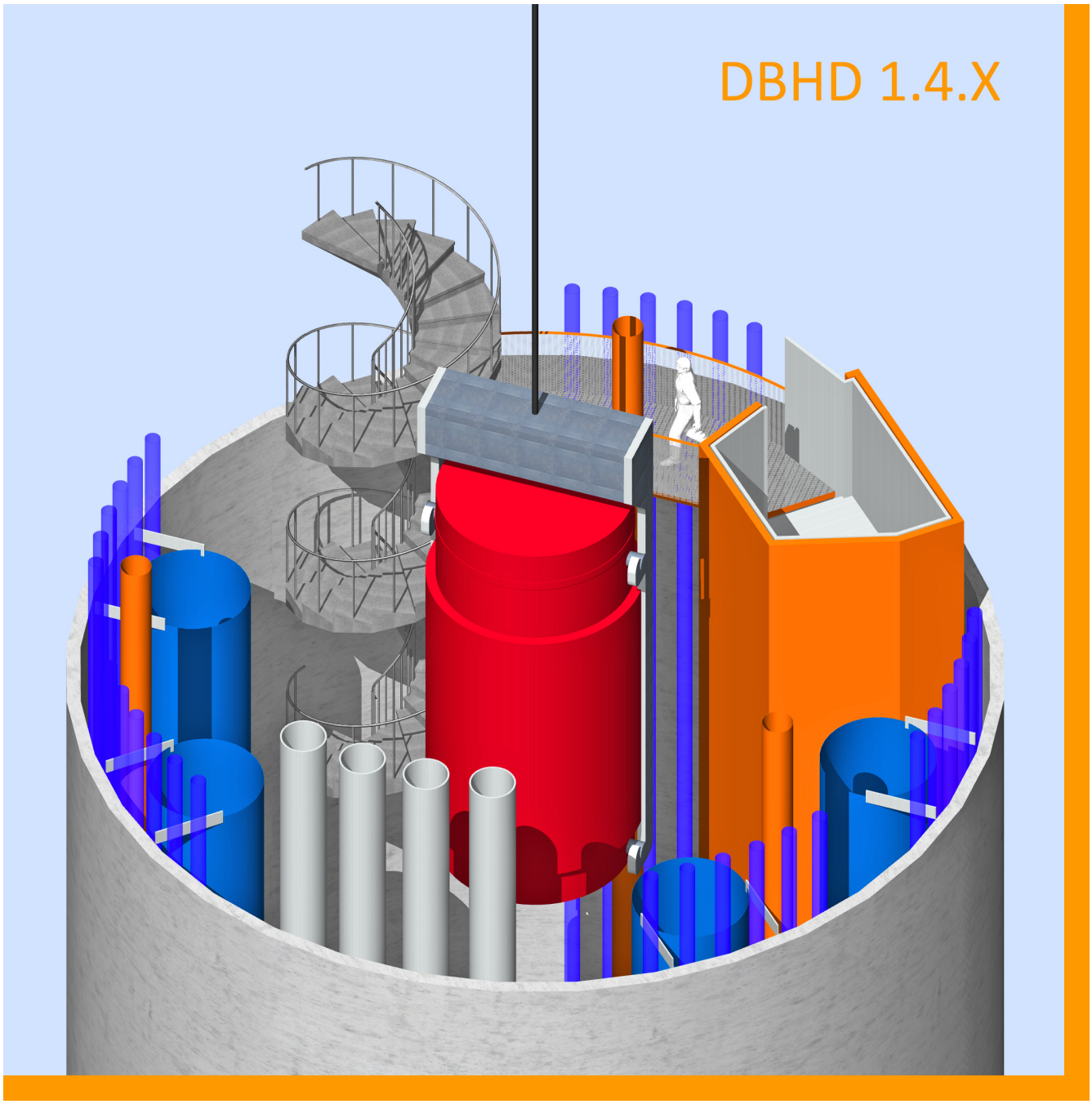
Picture 020

## 5. Completing the Diameter 12 Meter drill hole for storage work

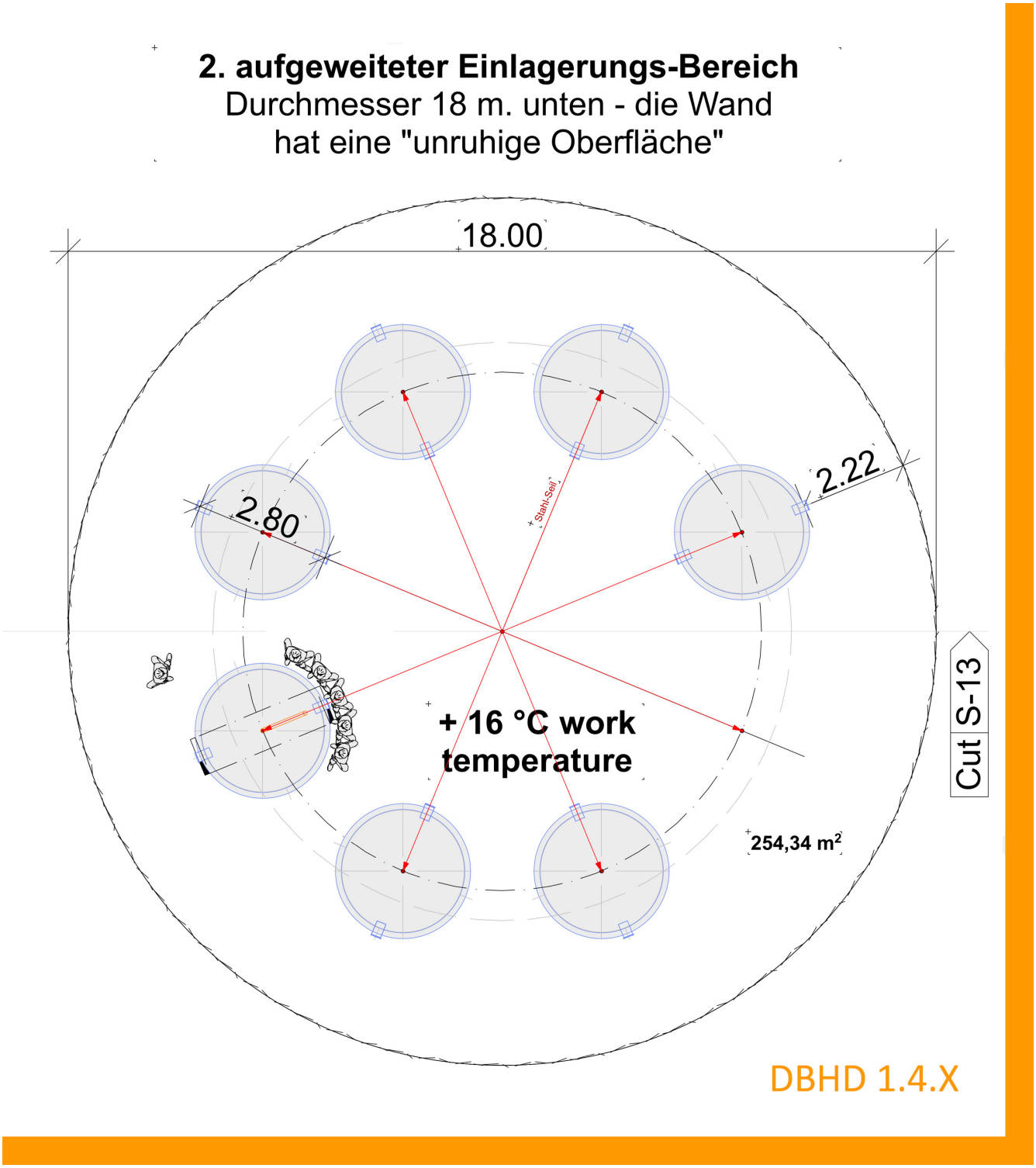
The big hole - drilled with Shaft Boring Machine or Shaft Boring Roadheader offers 113 sqm of space that is needed for : Container on cable - Lift - Staircase - Airconditioning - Flow Ice cooling and the required tubes for concrete and electricity - Please see what is planned for Germany - Canada is similar




Picture 021: Draft plan of the D=12 Meter big hole completition for all DBHD Generation 1.4.X

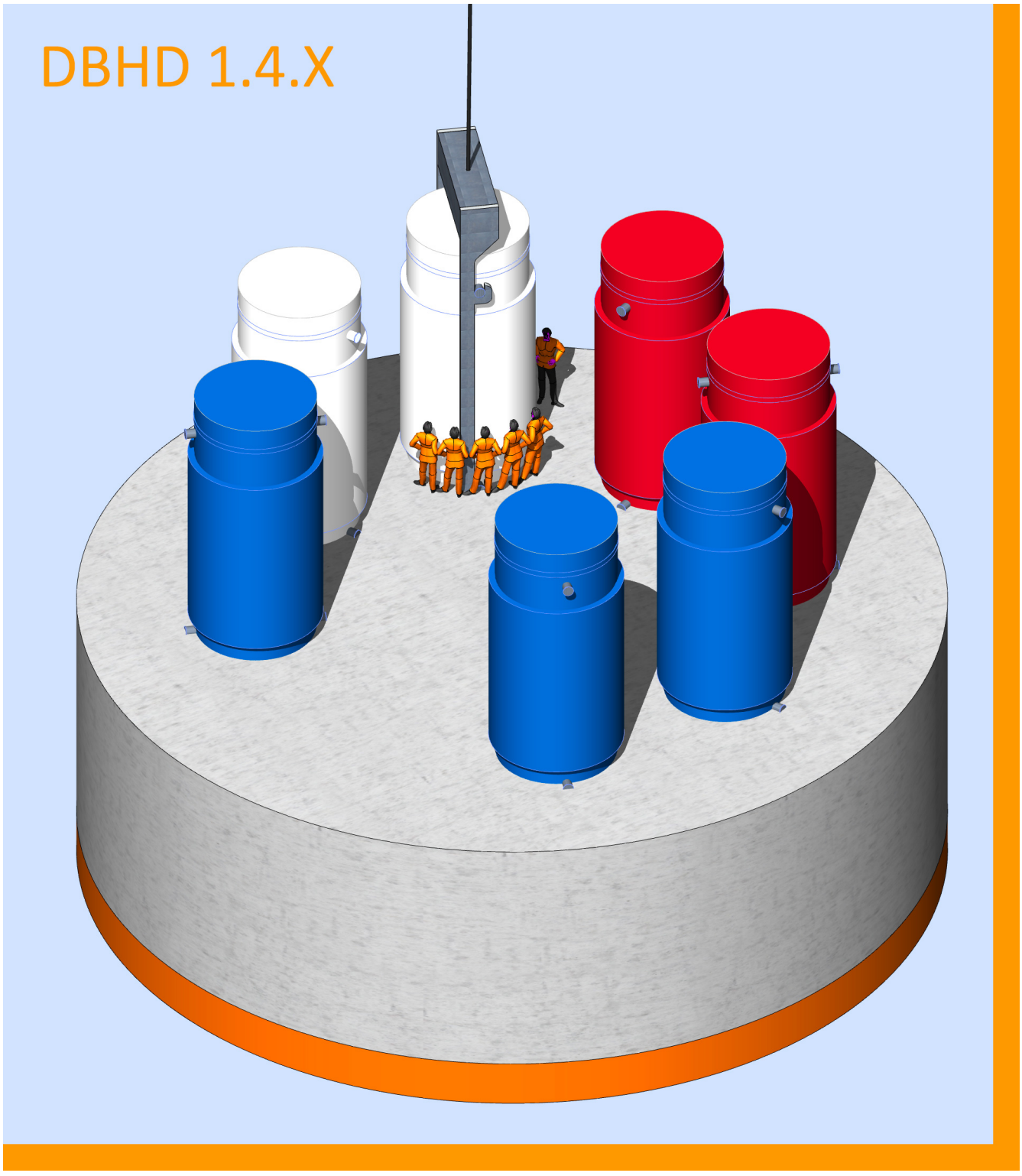



Picture 022: Draft plan of how to use the Diameter 12 Meter hole - starts with a spray concrete wall of 25 cm thickness - new diameter now 11,5 Meters - keeping a circle of D = 4,8 Meters in the centre free for the “traveling Castor - the travelling DSC container” - on the sides you see 4 big blue sheet metal tube for air-conditioning - you also the idea of a lift and / or protection chamber - there is a steel platform leading to the staircase - grey is the pipes for concrete - orange is the pipes for electricity and the small blue tubes are for the flow ice cooling system - we have to provide +16°C in a very deep environment that usually got +60 °C - cooling out the big hole is one of the main tasks to enable the staff to open the drill hole from 12 to 18 Meters and to cast the DSC or Castor containers into concrete.




Picture 023: Draft of situation in the storage area Diameter 18 Meters

The Diameter 12 goes down to the bottom, then the Diameter is opened with chain saws to 18 Meters Time to cast the first storage pellet - build back the hole completion on more then 7,55 Meters and cast the next concrete pellet. - There is a lot of work to be done by hand and it takes a hour to travel down - 3-4 hours of work on the bottom and an hour to travel up again. - Very short shifts please …




Picture 024: Draft of storage work in the storage area Diameter 18 Meters

There is man pushing the heavy Containers into the right position - the concrete from the bottom cast have to be solid enough to take the weight of the Containers placed - when all eight Containers are placed - the casting of the concrete pellet can be completed. - Work place temperature there + 16 °C.

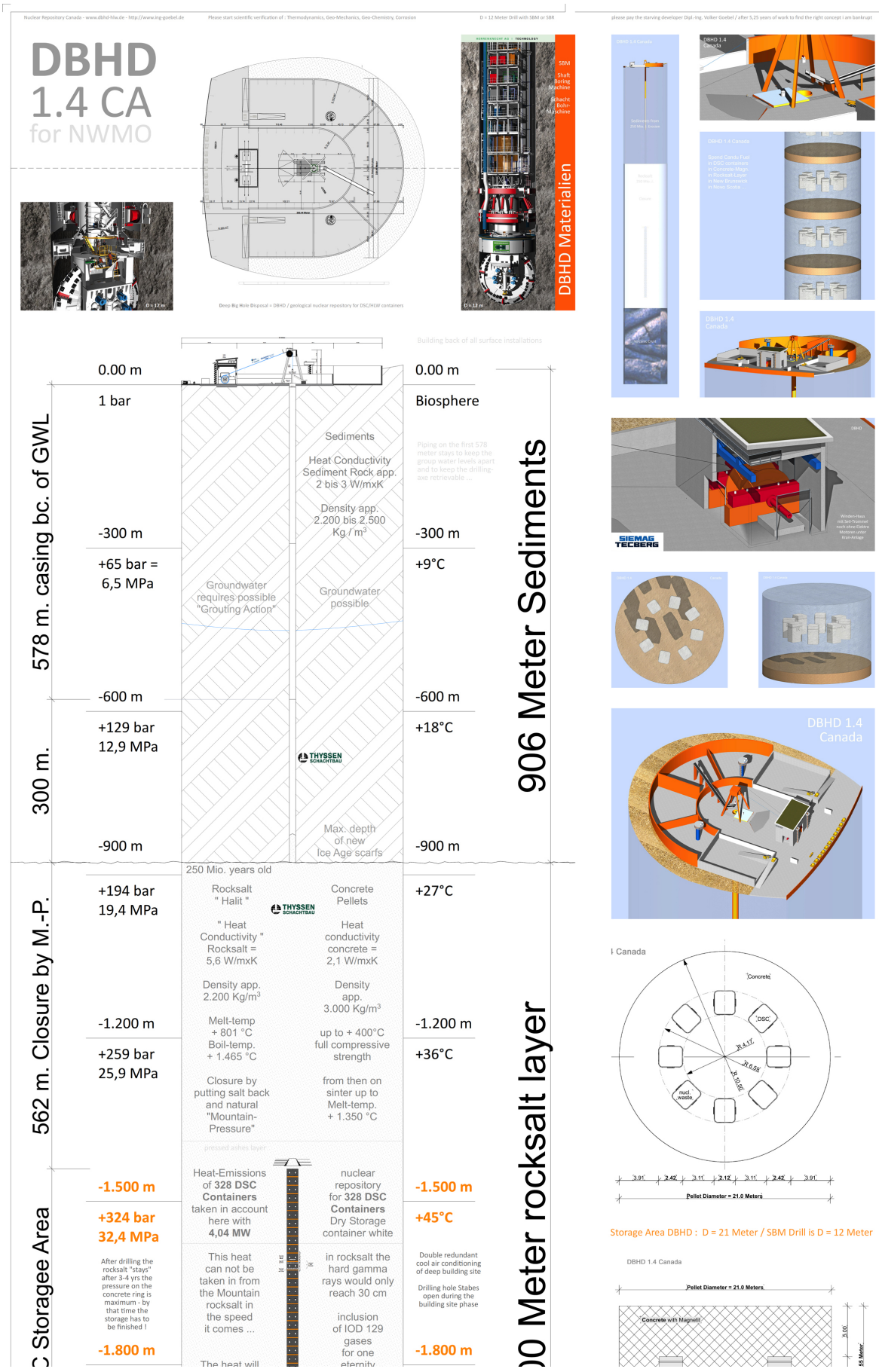
## 6. Conclusion

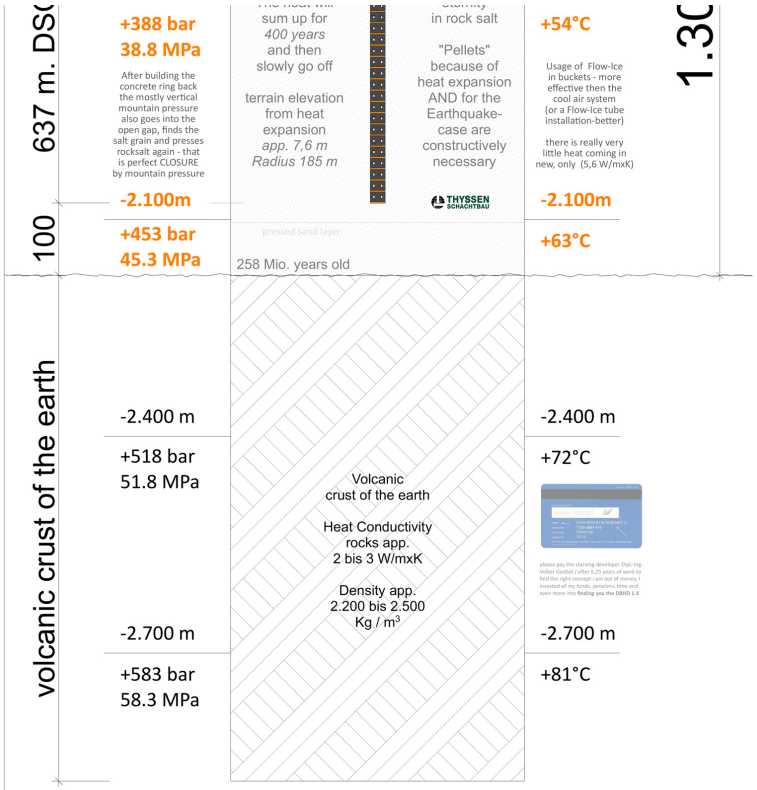
DBHD 1.4.1 Canada is a very ambitions building plan - and also the only solution for the safe long term storage of spent nuclear fuel. - It is a 73 to 80 years building plan that provides safety to Canada for one Million years and solves the nuclear storage problem with a geological waste storage.

The main item is the technical drawing - because DBHD is always a BUILDING - it is a temporary entrance building into a deep geology that is able to do what it needs - long term HLW storage …


150.240,- Canadian Dollars cost for each white DSC for its geol. long term disposal within DBHD 1.4.1 Canada

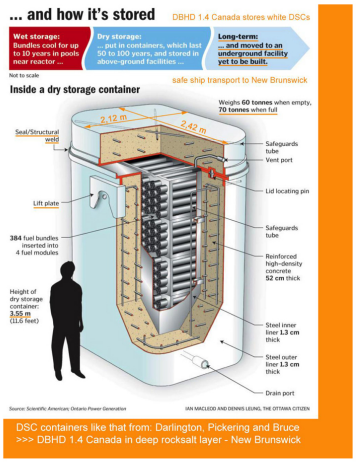
Picture 025: Definition of cost to bring down a white DSC into geological long term storage

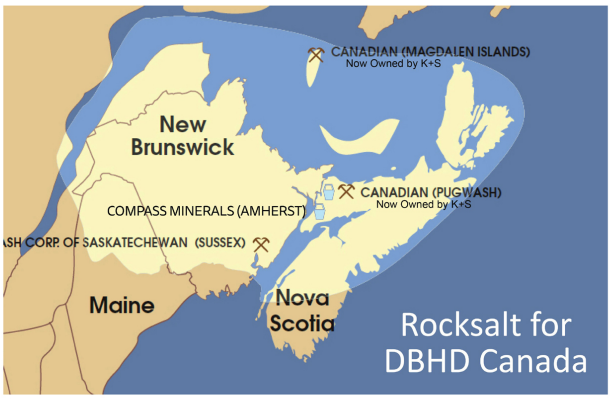

DBHD
1.4 CA
for NWMO
DBHD Materialien
0.00 m
1 bar
Biosphere
Sediments
Heat Conductivity Sediment Rock app. 2 bis 3 W/mxK
Density app. 2.200 bis 2.500 Kg / m3
-300 m
+65 bar = 6,5 MPa
+9°C
Groundwater requires possible "Grouting Action"
Groundwater possible
578 m. casing bc. of GWL
-600 m
+129 bar 12,9 MPa
+18°C
300 m.
906 Meter Sediments
Max. depth of new Ice Age scarfs
-900 m
250 Mio. years old
+194 bar 19,4 MPa
Rocksalt " Halit "
" Heat Conductivity " Rocksalt = 5,6 W/mxK
Density app. 2.200 Kg/m3
Melt-temp + 801 °C Boil-temp. + 1.465 °C
Closure by putting salt back and natural "Mountain-Pressure"
Concrete Pellets
Heat conductivity concrete = 2,1 W/mxK
Density app. 3.000 Kg/m3
up to + 400°C full compressive strength
from then on sinter up to Melt-temp. + 1.350 °C
+27°C
562 m. Closure by M.-P.
-1.200 m
+259 bar 25,9 MPa
+36°C
-1.500 m
+324 bar 32,4 MPa
Heat-Emissions of 328 DSC Containers taken in account here with 4,04 MW
nuclear repository for 328 DSC Containers Dry Storage container white
+45°C
After drilling the rocksalt "stays" after 3-4 yrs the pressure on the concrete ring is maximum - by that time the storage has to be finished !
This heat can not be taken in from the Mountain rocksalt in the speed it comes ...
in rocksalt the hard gamma rays would only reach 30 cm
Double redundant cool air conditioning of deep building site
Drilling hole Stabes open during the building site phase
inclusion of IOD 129 gases for one eternity
-1.800 m
-1.800 m
C Storagee Area
00 Meter rocksalt layer
DBHD 1.4 Canada
Concrete
DSC
nucl. waste
Pellet Diameter = 21.0 Meters
Storage Area DBHD : D = 21 Meter / SBM Drill is D = 12 Meter
Concrete with Magnetit

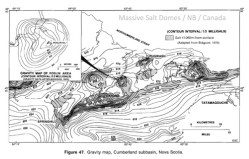


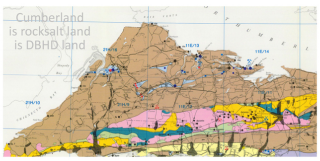



We calculate with 78.720 tons net in 7.872 DSC containers !!!
As Canada got so much spent Candu fuel it will need to build 24 DBHD's for a price of app. 27,7 Bio. CAD - takes 80 years ?

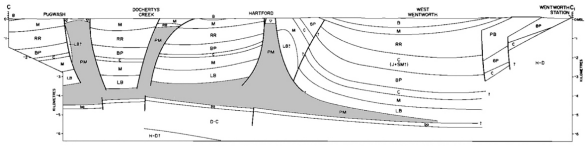



There is Salt-Domes between Pugwash and Wentworth Station / NB / Canada

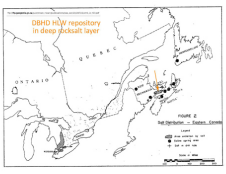




There is a massive Rocksalt Geology given in Canada !

Good for a nuclear repository - we just have to get all core drilling data deeper then -2.000 m. to make a map for a clever decision ...

DBHD 1.4 Canada




ONTARIO POWER GENERATION
Énergie NB Power
Bruce Power
K+S
WANO
Canadian Nuclear Laboratories

FOR THE EXPERTS
**CHECK THE PLAN**

this is a technical drawing of DBHD 1.4 Canada from a german nuclear disposal planner. NWMO supported by giving the DSC container data and "decay heat data".

The required deep rocksalt geologies are given up there in New Brunswick and Nova Scotia !

In rocksalt gamma rays go only 30 cm and gases like IOD 129 are hold back in the salt hostrock.

proposal for
nwmo
by Ing. Goebel

78.720 tons net spent Candu fuel

This general technical draft-plan shows parts of the finished, already built, closed DBHD 1.4 construction. To achieve this state of repository building it needs a lot of highest level scientific calculations and many site construction plans to built this CA Innovation.

DBHD 1.4 costs less then the half compared to horizontal storage and offers twice as much depth / safety
DBHD can do perfect closure by mountain pressure
Also compare calculation sheet - compare time tables

HEIGHT, LOCATION, GEOLOGY: Deep Salt in New Brunswick and Nova Scotia - Probe Drillings required
± 0.00 = xx meters above sea l. (Location xx°xx'xx.xx" North / xx°xx'xx.xx" East) "near ..."
Top Rocksalt -900 meters, Thickness 1.300 meters / geol. deepstep +3.0 °C / 100 meters

BUILDING:
**DBHD 1.4 Canada - deep safe nuclear repository - 40.000 tons spent fuel "Deep Big Hole Disposal" / Vertical Castor Storage**
Deep, safe, geological "DSC Container repository" with the white Containers in **concrete**-magnetit pellets in rocksalt - SBM drilling

CLIENTS:
Canada - for: Ontario Power, Bruce Power, New Brunswick Power NWMO, 22 St. Clair Avenue East, 6th Floor Toronto, ON M4T 2S3

PLANAUTHOR:
**Ingenieur- und Architekturbüro Goebel** / Dept. of nuclear waste
8832 Wilen b. Wollerau, Switzerland / Ratsteich 15, 19057 Schwerin

PLANNINGPHASE:
**Draft-Plan DBHD 1.4 Canada / Nuclear Repository with 328 white DSC / HLW Containers**

PLANNUMBER: 024
PLANTITEL: DBHD_1.4_Canada_DSC_disposal

nwmo
Ingenieur- und Architekturbüro Goebel
PROJECT NUMBER: Project Nr. 07 Version 1.4
DRAFTSMAN: Dipl.-Ing. Volker Goebel
DATE: beginning with DBHD plans 02. September 2014
LAST EDIT: **09. March 2019**
SCALES: **many - but all " to scale "**
PLANSIZE: 1.682 x 594 mm put on a door

EN_DBHD_1.4_Canada_Nuclear_Repository_DSC_HLW_Rocksalt_New_Brunswick_Nova_Scotia_Ing_Goebel_for_NWMO_payment_required.pln