



General Training On Methodologies For Geological Disposal in North America
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Deep Geological Repository Development Programme

CZECH REPUBLIC

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 SURAO/RAWRA
 Radioactive Waste Repository Authority, Czech Republic

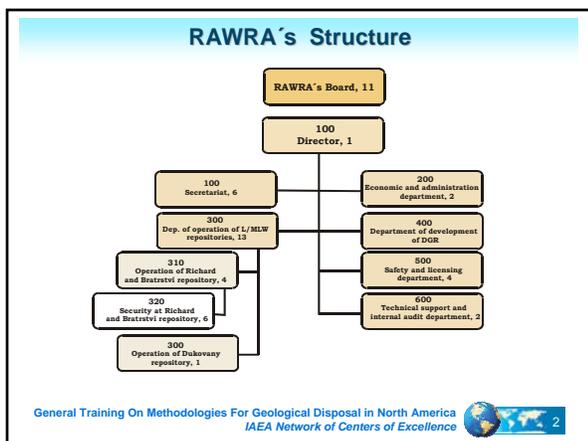
RAWRA
Radioactive Waste Repository Authority



State organisation responsible for safe disposal of all present and future radioactive waste in the Czech Republic

Established by
 Act No. 18/1997 Coll., §26, on the Peaceful Use of Nuclear Energy and Ionising Radiation (Atomic Act) as amended.

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LEGAL FRAMEWORK (1)

- The State guarantees safe disposal of all radioactive waste, including monitoring and supervision of repositories after their closure
- To provide for activities associated with radioactive waste disposal, the Ministry of Industry and Trade shall set up a Radioactive Waste Repositories Authority as a State organization
- Generators cover all expenses for disposal of radioactive waste including research and development
- An importation of radioactive waste into the territory of the Czech Republic is prohibited, except for the re-importation of ionizing radiation sources produced in the Czech Republic or radioactive waste originated from materials exported from the Czech Republic, for the purpose of their processing or reprocessing

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LEGAL FRAMEWORK (2)

- Act No. 18/1997 Coll. - the Atomic Act - and on alteration and amendments to related legislation
- Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management
- The Concept of Radioactive Waste and Spent Nuclear Fuel Management in the Czech Republic (Czech Government Decree No. 487/2002 of May 15, 2002)
- IAEA Guidelines Siting of Geological Disposal Facilities (SS. No. 111-G- 4.1, IAEA 1994)

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The Concept of Radioactive Waste and Spent Nuclear Fuel Management (1)

framework

- Concept based on:
 - Atomic Act – 18/1997 Coll.
 - Energy Policy – 50/2000
 - State Environmental Policy – 38/2001
- responsibility of the Ministry of Trade and Industry
- EIA Statement

areas

- Legislation
- LLW/ILW Management
- HLW/SNF Management
- Economics Aspects

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The Concept of Radioactive Waste and Spent Nuclear Fuel Management (2)

The fundamental document defining government and state authority strategy for further period

- determines the main objectives and phases of the Deep Geological Repository Development Programme
- sets out the following goals for RAWRA as regards the Geological Repository Programme:

Concept – goals of GRD Programme

- **2005** - reduction of the prospective area of sites, non-destructive testing of sites
- **2007** - near surface investigation of these sites
- **2015** - complete investigation to characterize potential disposal sites with suitable geological features, preselect two sites for further characterization, **2 sites included in regional plan**
- **2025** – to further characterize the two preselected sites and assess their suitability to host a geological repository, detailed investigations, **feasibility study for 1 site**
- **2030** - **to start the underground research laboratory construction**, to prepare the necessary documentation for construction of URL
- **2065** – to apply for a license for a geological repository for spent nuclear fuel and HLW, to design and construct the repository and to commence operation

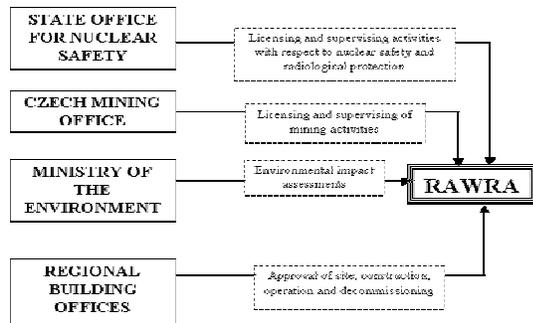
Radioactive Waste Management – Basic Principles

- Import of radioactive waste is forbidden
- Generators of RW are responsible for safe management
- RAWRA is responsible for disposal
- Nuclear account established to collect financial means for disposal
- NPP operator is responsible for NPP decommissioning and processing for RW before its final disposal
- NPP operators shall create financial provisions to cover expenses of the feature NPP decommissioning

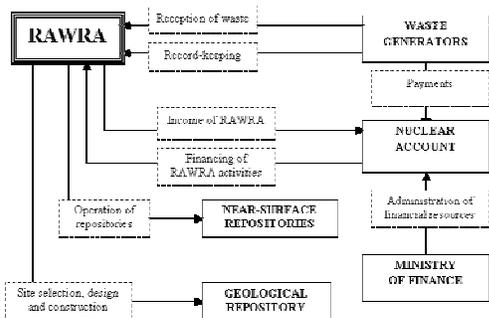
Nuclear account

- established in accordance with Government Decision No. 224/97
- places at the Czech National Bank
- managed by the Ministry of Finance
- Czech Power Company pays levies to cover future costs including the Deep Geological Repository Development Programme
- a rate of 50 CZK per 1 MWh

RAWRA vs. Regulators



RAWRA vs. Radioactive Waste Generators



Main RW Producers

- **Czech Power Company, Plc.**
operates both the Dukovany and Temelin nuclear power plants
- **DIAMO, state - owned comp.**
manages uranium production facilities
- **The Nuclear Research Institute, Plc. at Rez**
is engaged in nuclear research and development

Nuclear Facilities in Czech Republic



LLW/ILW Management

- From 2nd half of the 1950s – intensive research of nuclear energy and ionizing radiation use
- 1959 – repository Hostim, closed 1964
- 1964 – repository Richard near Litomerice
- 1974 repository Bratrstvi near Jachymov
- 1995 – repository Dukovany
- Until 2100 amount of 41 400 m³

Dukovany LLW/ILW repository

Engineered near surface repository
Disposal from NPP
Capacity 55 000 m3
Operation until 2100



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Richard Repository

Mined limestone cavity
Disposal from institutional generators
Capacity 8 000m3
Operation until 2070



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Bratrstvi Repository

Mined cavity
Disposal for institutional waste with natural radionuclides
Capacity 1000m3
Operation until 2030



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HLW/SNF Management (1)

- Amount:
 - HLW – 3000 m³
 - SNF – NPP Dukovany: 1940t (40 years of operation)
 - SNF –NPP Temelin: 1790t (40 years of operation)
- Storage:
 - NPP Dukovany (in operation)
 - NPP Temelin (proposed)
- Final disposal at deep geological repository

HLW/SNF Management (2)



NNP Temelin



NPP Dukovany

HLW/SNF Management (3)

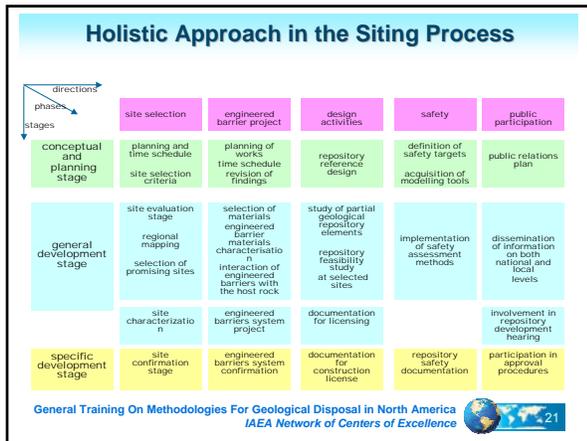
Capacity in Dukovany storage 600t
(enlargement prepared)

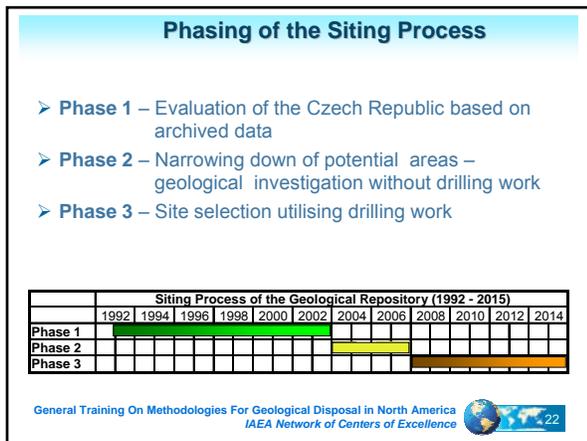
Safe storage in dual purpose containers

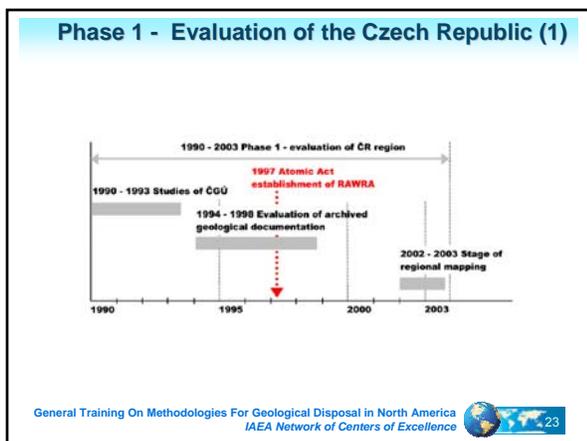
Castor – 440/84

- Transportable container
- 2,6 x 4,1 m
- 116 t
- 84 fuel element
- cast metal
- He filled

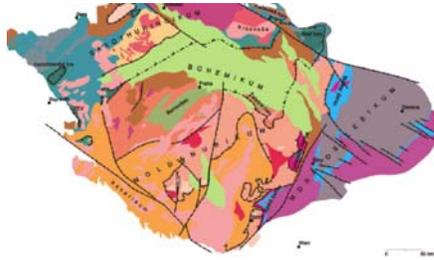






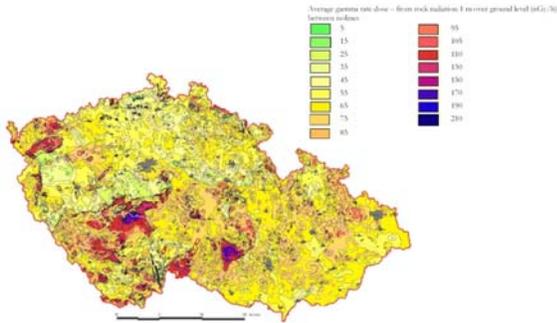


Evaluation of the Czech Republic (2) Tectonic Map of Bohemian Massif



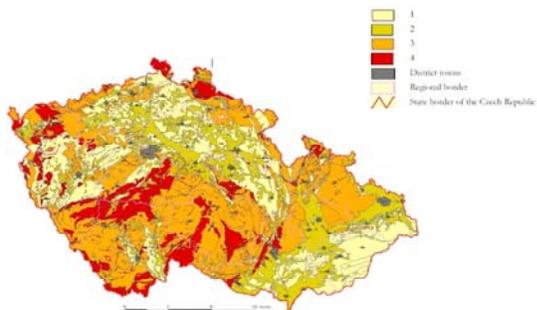
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Evaluation of the Czech Republic (3) Radiometric map



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Evaluation of the Czech Republic (4) Radon Risk Map



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Evaluation of the Czech Republic (5)

The Czech Geological Survey has chosen 27 geologically potential sites based on archived geological documentation

red – regions with recommended sites
 blue – not recommended for further evaluation
 green – rejected areas for other than geological reasons

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Evaluation of the Czech Republic (6) Geologically Prospective Areas

- > Energoprůzkum study – delimitation of 11 sites prospective for DGR
- > Decision of RAWRA:
 - > 6 prospective sites for further investigation (black) - phase 2
 - > 5 potentially prospective (white)

Site	Region	Host rock/strata	Geological unit
Lázně - Hraná	East Bohemia	granite	Čertovo hlávo
Parou - zábravice	West Bohemia	granite	Middle Bohemian Massif
Rejšpice - Vráž	South Bohemia	granite	Middle Bohemian Massif
Příhoř - Železná Lhota	South Bohemia	granite	Middle Bohemian Massif
Rejšpice - Ráje	Highland	granite	Central Bohemian Massif
Budkov	Highland	granite	Čertovo hlávo
Rožmitál	Podohří	granite	Záhořský Plátek
Epřín	Krušné hory	granite	Epřín complex
Plzeň	South Bohemia	granite	Krušné hlávo
Opava - Štávek	Central Bohemia	granite	Krušné hlávo
Luhačovice - Nový Bydžov	Highland	granite	Rejšpice

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Phase 2 Narrowing down of Prospective Areas

Geological work

- > Remote sensing
- > Aerial geophysical investigation
- > Field reconnaissance including VLF measurement

Design

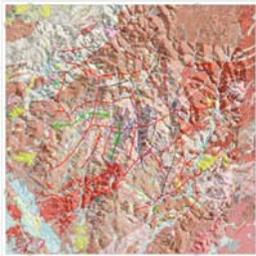
- > Pre-feasibility studies of the location of the surface facility
- > Identification of local interest interference
- > Reference project for the geological repository

GIS Implementation

Siting Process of the Geological Repository (1992 - 2015)												
	1992	1994	1996	1998	2000	2002	2004	2006	2008	2010	2012	2014
Phase 1	█	█	█	█	█	█	█	█	█	█	█	█
Phase 2												
Phase 3												

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Narrowing down of Prospective Areas (1)
Remote sensing



Morfotectonic analysis

Data sources:

- Satellite images: RADARSAT, Landsat ETM+, QuickBird;
- Aerial photographs: digital orthophoto maps ZABAGED, stereoscopic aerial photos;
- Digital terrain model (DTM): contour lines 1 : 10 000, shaded relief 1 : 25 000

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Narrowing down of Prospective Areas (2)
Helicopter-born geophysical measurement (1)



- Helicopter born electromagnetic, gamma-spectrometry and magnetic survey was carried out over six sites.
- Data acquisition commenced on November 4th, 2003, and was completed on November 19th, 2003.
- A total of 1845.1 line-km of surveying were flown, covering a total area of 263.3 km², with a survey grid of 200 metres x 500 metres.
- Nominal survey speed was 25 to 30 metres per sec. Scan rates for the EM and magnetic data acquisition was 0.1 second, 1.0 second for the spectrometer, radar and barometric altimeters, and the GPS navigation /positioning system.

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Narrowing down of Prospective Areas (3)
Helicopter-born geophysical measurement (2)



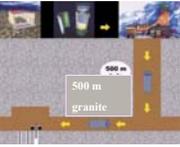
➤ **The instrumentation installed in the aircraft included:**

- A Geometrics G-823 cesium magnetometer installed in the HummingBird sensor system, with a resolution of 0.001nT/sampling 10 times per second (10 Hz)
- A Pico-Envirotech GRS-410 gamma-ray spectrometer with 16.78 litres down-looking and 4.2 litres up-looking NaI(Tl) crystal detector packs
- A Geotech frequency domain Hummingbird helicopter-borne EM system
- A NovAtel Millennium 24-channel GPS Receiver, & real-time OMNISTAR DGPS-Max
- Dual HummingBird and AGIS PC-based data acquisition systems with large volume hard disks, colour LCD display, LARMOR processor with 0.001nT/10 Hz resolution, and proprietary SURVEY, REPLOT and other proprietary and commercial software
- A Terra model TRA-3000/TRI-30 Radar Altimeter for measuring the aircraft's height above the ground (ground clearance)

Results of measurements

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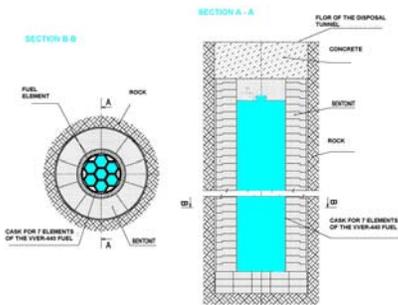
Reference Project Concept



- > Storage of spent fuel in unassembled form
- > Storage of spent fuel in unshielded casks
- > Casks are encased in a bentonite layer in the vertical position
- > Storage area is situated at a depth of 500m below the granite massive

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Barriers and Positioning of Cask



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Reference project (1) Surface Facility Layout



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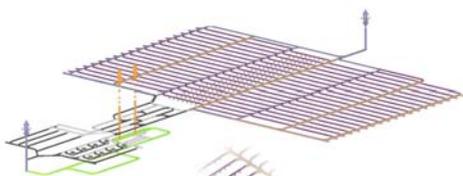
Reference Project (3)

- 3D model of a deep geological repository surface facility



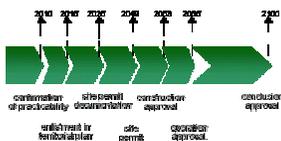
Reference project (4)

- 3D model of the underground part of the repository



Timing of Deep Geological Repository

- Research and development work including siting and site preparation will continue up to 2050.
- Subsequently, in the period 2053 - 2070 surface and underground facilities will be constructed.
- Operation of the first part of the repository should commence in 2065.



Brief Summary

- 1991 Czech Geological Survey has chosen 27 perspective sites on the base of archived data
- 1993 project of deep geological repository has started
- 1997 RAWRA was established
- 1999 Reference project of deep geological repository was finished
- 2003 first phase of siting procedure was finished with the output - 6 perspective sites and 5 potentially perspective
- 2003 second phase of siting procedure started with investigations of 6 perspective sites
- 2004 because of local authority resistance, investigations have been interrupted for 5 years

Further Information

- miksova@rawra.cz
- www.rawra.cz (web pages in english)