

Nuclear Energy in European Countries



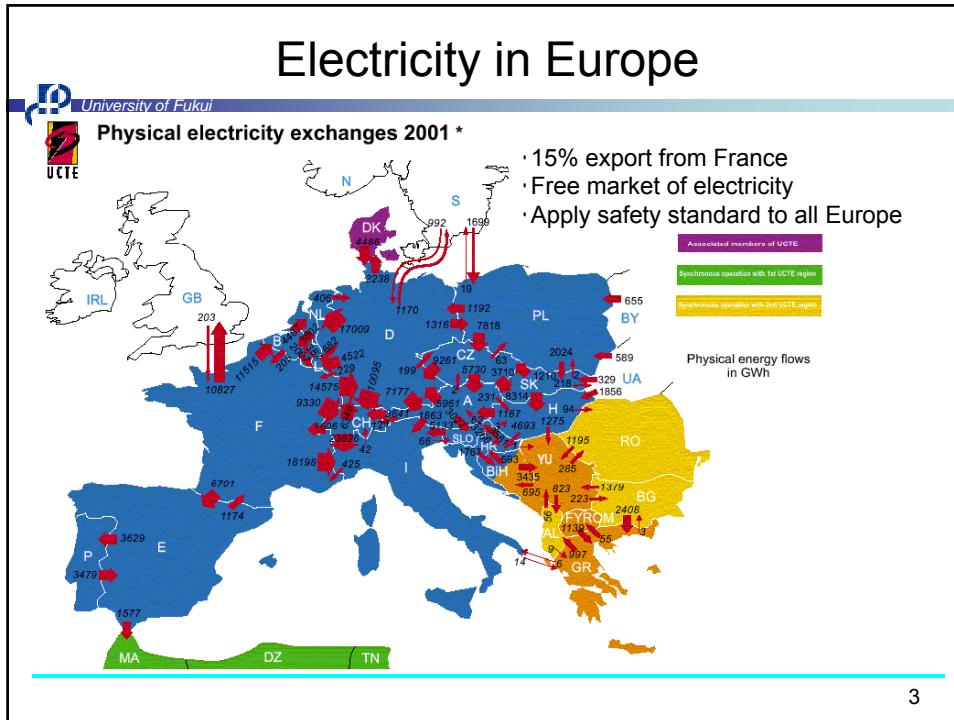
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- About France
- Nuclear in Europe
- Fast Reactors
- MOX & reprocessing plants
- Nuclear waste issue





Comparison between Japan and France

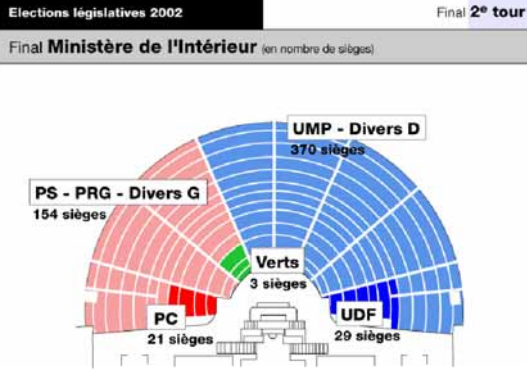
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	Japan	France
Area (km ²)	374,744	545,630
Popuration	127,463,611	60,876,136
Electricity (TWh)	1,037	520
Self-sufficiency ratio	4%+ 16%(Nuclear)	9%+ 42% (Nuclear)
Ratio of nuclear power to total	35%	77%

Data from <https://www.cia.gov/cia/publications/factbook/index.html>

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Politics in France



- **UMP** (Union Mouvement Populaire)
- People thinks that nuclear is important to hold independence

CEA Headquarters



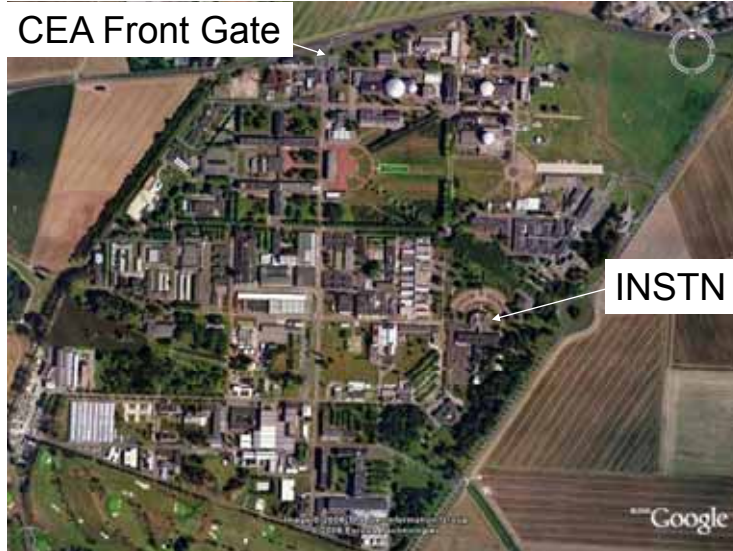
Culturel Franco Japonais

Centre de Saclay, CEA



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CEA Front Gate



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INSTN(Institut national des sciences & techniques nucléaires)



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Écoles (Schools) are special school to throw up elites who run the country . Universities make researchers.

- École normale supérieure
- École polytechnique
- École Nationale d'Administration
- École des mines

· INSTN is the only school in France where bring up engineers and researchers about nuclear.

· They will become managers just after the graduation.

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Medical treatment of radioactive exposure



IRSN
SPRA : Radiation Protection Center of military
Percy Hospital
Curie Hospital

- Treatment of patients due to RI accidents in east European countries
- Treatment of entire body burns

Nuclear Power in France

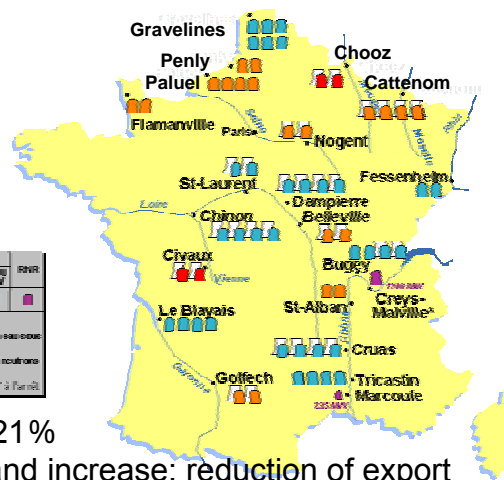


900MWe: 34 units
 1300MWe: 20 units
 1450MWe: 4 units
 Total 58 units

85% of total electricity of 511TWh

TRANCHES	REP	RNR
	300 MWe	1300 MWe
en exploitation		
refroidissement		
circuit ouvert		
circuit fermé		

REP : réacteur à eau sous pression
 RNR : réacteur à neutrons rapides
 * à l'état



- Renewable energy: 15 → 21 %
- Counter-measure to demand increase: reduction of export
- EPR at Flamanville

Nuclear Power Plants in France



Nogent
1300MWe 2 units

Bugey
900MWe 4 units

- Specialty
- Inland
 - By the river
 - Large cooling tower



Nuclear Power in UK



- Many Calder Hall type plants were closed.
- Next plant will be AP1000
- Development of PBMR

PWR: 1 unit

Magnox: 19 units
Total electricity: 369TWh
Nuclear: 18% share

Nuclear Power in Germany



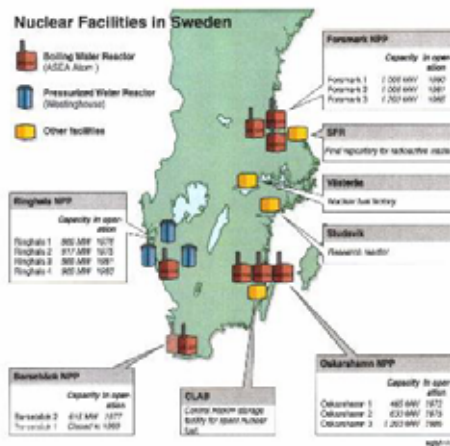
BWR: 6 units
 PWR: 13 units
 Total electricity: 593TWh
 Nuclear share: approx. 30%

- Many people think that phase-out policy is wrong.
- People thinks that policy will be changed in the case of the different government. However, electricity company thinks that returning will not be easy.

Nuclear Power in Sweden



Nuclear Facilities in Sweden



BWR: 8 units
 PWR: 3 units
 Total electricity: 144TWh
 Nuclear share: 47%

- Poll about closure of nuclear PP was done in 1980. All the plants should be closed by 2010. Now, 80% people thinks that nuclear is necessary.
- An old nuclear plant in Oskarshamn was refurbished by replacing the pressure vessel.
- Forsmark was selected as HLW repository.

Nuclear Power in Finland



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Eurajoki: 840MWe BWR 2 units
Loviisa: 488MWe VVER 2 units

Total electricity: 77TWh
Nuclear share: 27%

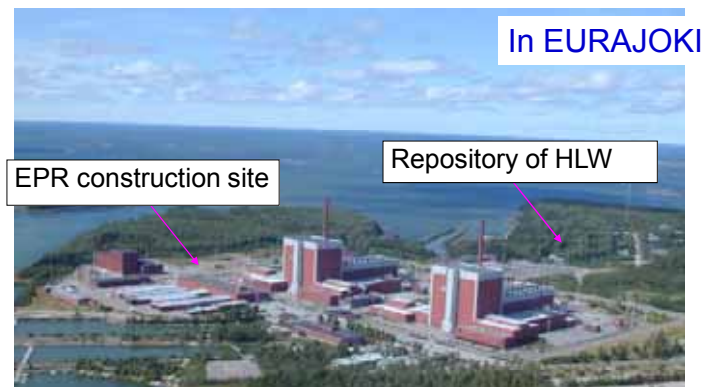
- Characteristics of a nation: to understand common practice.
- Most people are for the nuclear.

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Olkiluoto Cite



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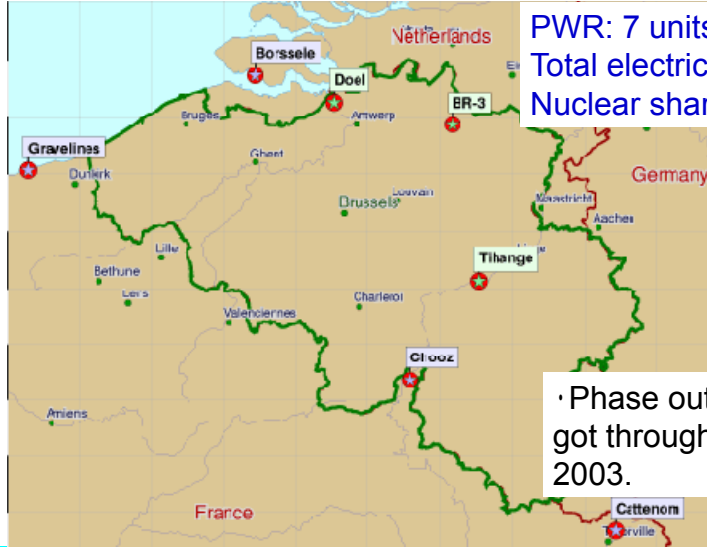
- Prospective provision of information from government to people
- 5th & 6th NPP (EPR) for domestic consumption and export

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Nuclear Power in Belgium



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PWR: 7 units
 Total electricity: 82TWh
 Nuclear share: 58%

· Phase out law was got through in January 2003.

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Nuclear Power in Switzerland



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BWR: 2 units
 PWR: 3 units
 Total electricity: 64TWh
 Nuclear share: 36%

· Pu is useful resource
 · MOX loading in 3 units

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Super Phénix (SPX)



Electrical rating:
1200MWe
Demo. plant

- Prime minister Jospin decided to sacrifice SPX on 2 Feb. 1998.
- Safety authority announced that there was no problem in the safety.

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Inside of SPX

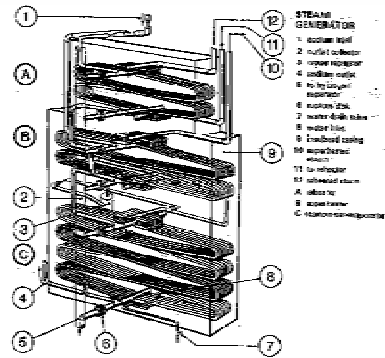


First and last
chance to take
photos in SPX.



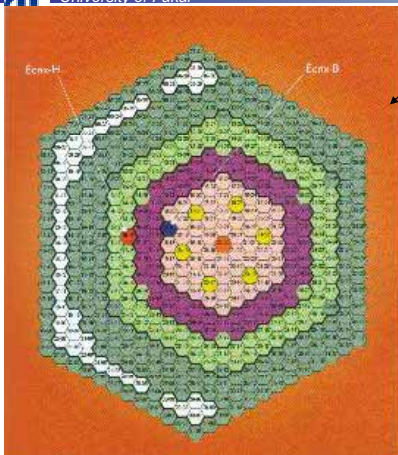
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Phénix

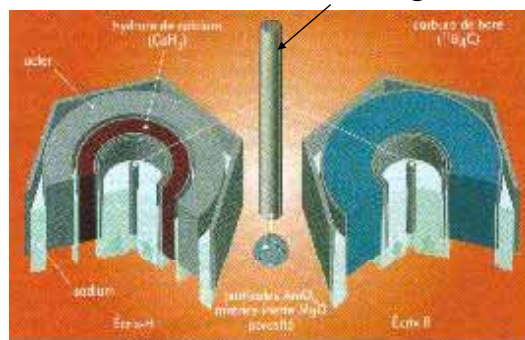


- Back fitting of seismic
- SG repair
- End of life test in 2009
- MA burning test

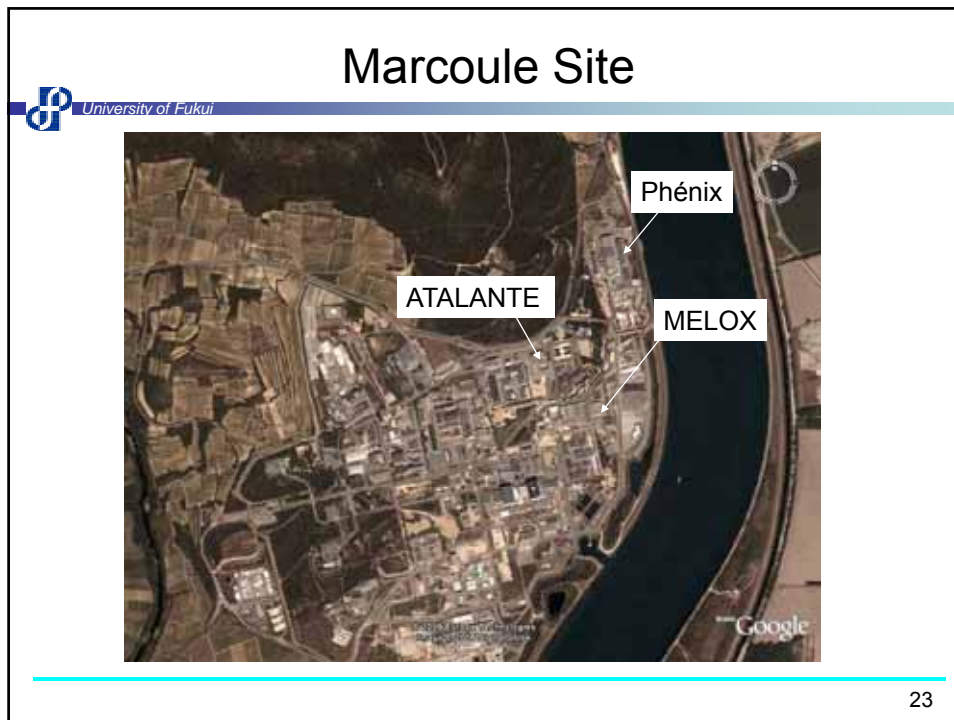
Minor actinide burning



Core of Phénix
Minor actinide bearing fuel



After the closure of Phénix, re,qing tests will be conducted at 'Joyo' and 'Monju'.



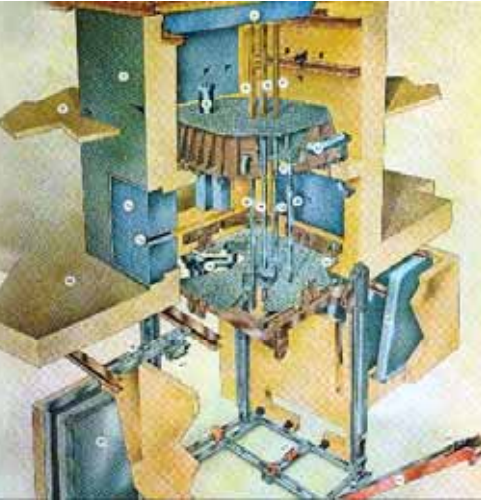
FBR development policy in France

- Fast reactor is required to burn minor actinide.
- Hydrogen for fuel cell should be generated in 50 years.
- Conversion ratio is nearly unity because Pu is sufficient.
- Sodium cooled fast reactor with power of 250–600 MWe, to start operation by 2020.
- CEA project “*ASTRID*”: lead or gas cooled experimental fast reactor with power of 50–100 MWth.

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MASURCA

Maquette Surgénérateur Cadarache



- Experiments for gas cooled FBR and ADS
- Life extension in 2004 by 15 years
- In 2020-2030, experiments for Generation-IV reactor will be conducted.

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MOXFuel fabrication (MELOX)



- Production: 100t/year U&Pu Metallic ton
- Pu contents of 3-11%

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SMP (Sellafield MOX Plant)



•Production: 100t/year U&Pu Metallic ton

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MOX plant in Belgium



Factory of Belgonucléaire (Closed)

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Reprocessing plant in La Hague



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Photograph provided by COGEMA

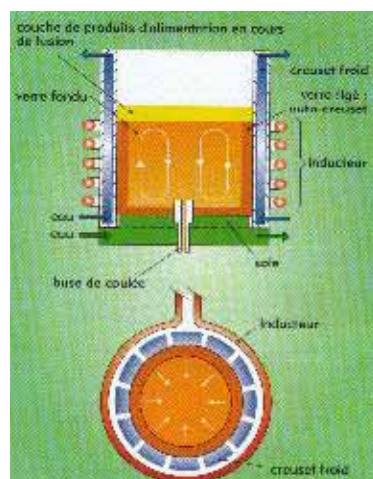
· 1000 ton fuels are reprocessed in UP-2 and UP-3 respectively.
Fuels in the casks are waiting to be reprocessed for 3-4 years.

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Cold crucible



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BNFL Sellafield



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BNFL was broken down.

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The law of radioactive waste and ANDRA



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La loi n ° 91-1381 du 30 décembre 1991 relative aux recherches sur la gestion des déchets radioactifs

ANDRA (Agence nationale pour gestion des déchets radioactifs)

Signature:

François Mitterrand, Edith Cresson (Prime minister) other 5 politicians

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La Manche low level radioactive waste repository



- Closed in 1994
- Water from the site is monitored.
- Sound an alarm will be activated in case of abnormal situation.



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La Manche et La Hague



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Aube low level radioactive waste repository



- Radioactivity of the most wastes are very low.
- Site for exclusive use of VLLW was constructed near this site in order to minimize management budget.

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HLW repository in France



Bure site

- Communication between public and government
- Provision of contributive facilities to local municipal
- Introduction of University



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National discussion about Rad Waste



Discussion in Ministry of Research on 30 April 2003



Discussion in Assemblée national on 24 March 2003

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Status in Finland about HLW



- Environmental assessment was conducted with the participation of public people. People of 50% participated in the assessment and satisfied with the result.
- Many people understand nuclear. Especially, younger generation understands nuclear in order to solve the CO₂ issue.
- They have common sense to dispose waste by themselves.
- Cooperation by the construction body
- Appropriate information provision from regulatory

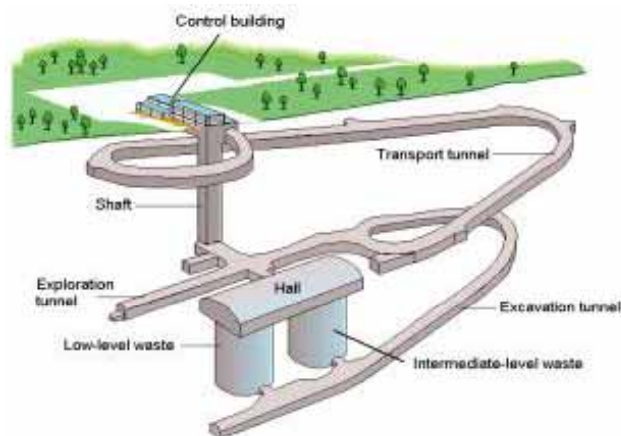
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Snapshot at Olkiluoto in Finland



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Medium level radioactive waste repository in Finland in operation



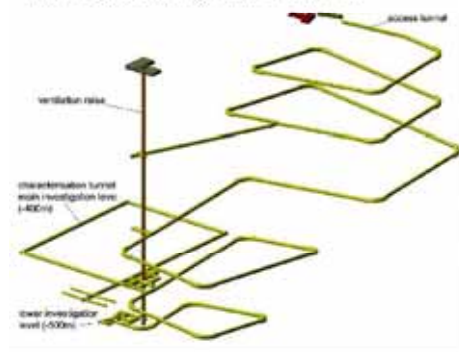
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Design of HLW repository in Finland



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First layout design for ONKALO



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Research lab. for HLW repository



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Äspö

- Granite
- Large facility
- Open to public
- Many communicators



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HLW issue in Sweden



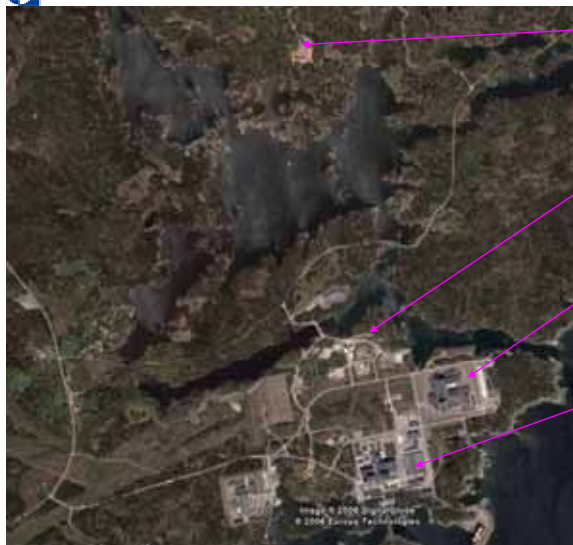
Candidate:
Oskarshamn



Decision:
Forsmark

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Oskarshamn



Äspö
Research Center

Entrance of
Äspö HRL

Oskarshamn
NPP

CLAB facility

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UGL in Gorleben (Germany)



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Research Lab. for UGR in Switzerland



Grimsel

- Granite
- Research in 20 years



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Grimsel

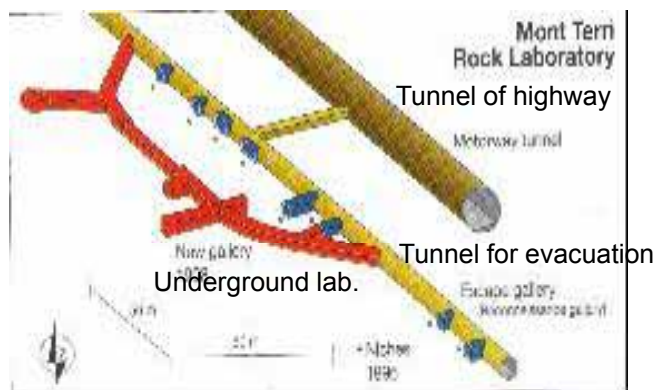


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Research Lab. for UGR in Switzerland



Mont Terri



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Research Lab. for UGR in Switzerland



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Sediment Facility: **Mont Terri**
 Research in 10 years
 High priority in research



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LLW in Belgium



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- Intermediate storage for medium and low level waste is full.
- Corrosion problem of drum
- Problem of returned HLW

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Research Lab. for HLW in Belgium



Mol Laboratory
Sediment layer