European Parliament
Committee on industry, research and energy

December 1st, 2010

Public Hearing on
"Management of radioactive waste"

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Considerations on deep geological disposal

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Why geological disposal - advantages

- **distance** between waste and biosphere
- capacity of geological barriers to **confine / retain radionuclides** / other harmfull substances transported by water / gas
- geological barriers provide **passive safety** (maintenance and repair not necessary - however: must be confirmed for selected site)
- status of **passive safety reached within "short" time span** (as compared to the isolation time needed)
- (long-term) **function and stability** of safety relevant properties of geological barriers at a given site can be demonstrated by use of nature oberservations (indicators)
- **low costs**

⇒ early concentration on (deep) geological disposal of HAW / SF

Why geological disposal - disadvantages

Due to the long time span to be considered:

- long-term **monitoring impossible** / limited
- long-term **maintenance and repair impossible**
- **not sustainable** (particularly SF)
- **correctness of long-term safety demonstration cannot be verified** in terms of natural science / mathematics: predictions of future development of the disposal system, particularly of barrier behaviour, show uncertainties (incomplete acquisition and evaluation of system properties, deficiencies in process understanding, prognostic uncertainties, …)
- **wrong site decision** (if identified at all) **cannot be corrected** after waste emplacement / closure ("irreversible")

⇒ **reduce uncertainties! "robust" disposal system!**

⇒ **public resistance against final disposal / siting of disposal repositories**
⇒ **request for alternatives with "active guarantee of safety" / retrievability of waste / reversibility of decisions and measures**

Siting processes - experiences (1)

during late 1950ies and 1960ies

- **final disposal** in deep geological formations becoming the **most accepted waste management strategy** for radioactive waste, particularly HAW
- some countries intend to dispose off **all types of radioactive waste** in deep geological formations (e.g. Germany, Switzerland), others **only HAW**

late 1970ies / 1980ies

- planning / start of **national siting programmes** for repositories (HAW, all types of waste) - e.g. France, Germany, Sweden, Switzerland, USA

  in some countries **delays, even failure of site selection processes** due to increasing resistance of (parts of) the public against pure technical siting approaches

  ⇒ increasing interest of the public / stakeholders / concerned persons in final disposal / siting regarding societal and ethical questions and results of political / administrative decision making (not only radioactive waste management)

Siting processes - experiences (2)

1980ies ctd.

- **societal and ethical aspects** of radioactive waste management **intruding into** the national and international **debates** about waste management, particularly siting of deep geological disposal facilities: sustainability / equity / intra- and intergenera-tionale justice…

  ⇒ procedural and technical key-words: **transparency, participation, fairness, rules, retrievability** of waste / reversibility of measures and installations…

1990ies

- in several countries **restart of public debate** about national waste management strategy / disposal concept (e.g. France, Sweden, Switzerland)
- discussion / investigation of **alternatives / modifications of "pure" final disposal** (e.g. partitioning and transmutation - P & T, retrivability of waste, reversibility of measures and installations, long-term storage of waste)
- attempts to **improve public participation in decision making**

Siting processes - experiences (3)

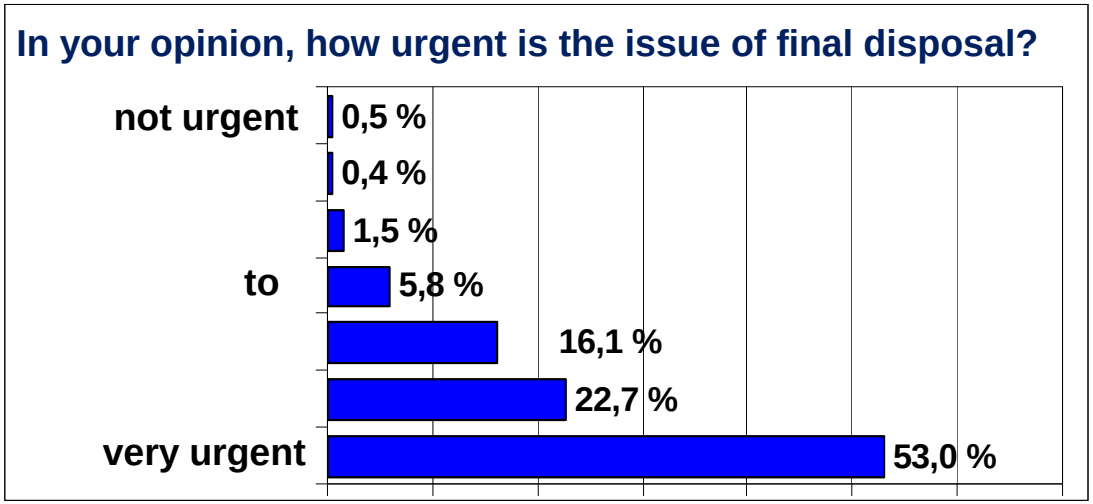
(late) 1990ies and 2000s

- **re-design / modification of waste management strategies**, particularly disposal concepts (Sweden: demonstration phase / France: retrievability / Switzerland: "geological deep disposal" with testing and limited retrievability, UK: debate starting from scratch)
- start of new **siting programmes** / re-start of modified programmes including **public participation / stakeholders discourse**
- international organizations discuss **ethical aspects of waste management** and its consequences for decision making processes (e.g. **participation of stakeholders on national / regional / local levels**), e.g.:

  ⇒ OECD/NEA (Forum on Stakeholder Confidence)

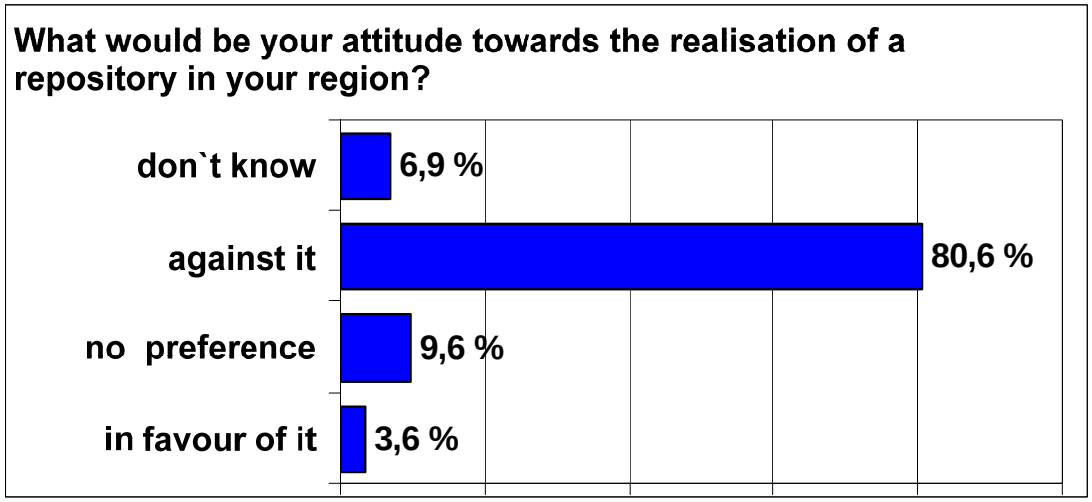
  ⇒ international research projects on stakeholder participation, e.g. Euratom Project Community Waste Management - COWAM (2000 - 2009)

Expectations of the public -
Final disposal in the view of the public (2002)



Example Germany:

Attitude of the German public towards final disposal - indicator of a dilemma between safety and public risk perception?



from:

AKEND - Committee on Site Selection Procedure (2002):
Site Selection Procedure for Repository Sites - Recommendations of the AkEnd

Expectations of the public -

Expectations of stakeholders regarding EU "disposal policy" (2010)

Principles and requirements of RWM policy as asked for during public consultation:

protect future generations from the dangers of ionising radiation	***82,5%***
implement transparency arrangements	***64,5%***
independence of the regulatory authority	64,3%
"polluters pay" principle	59,4%
actively involve the public in the decision-making process	***59,2%***
necessary legal, human and financial resources for the regulatory authority	54,7%
7 more fundamental principles and requirements with 54,5 - 43,9 %	
establishment and implementation of quality assurance programmes	41,2%
foresee geological disposal as the endpoint for HAW / SF	***36,5%***
dedicated organisation at national level for the RWM	33,5%
Other	7,6%
None of the above	1,8%
No opinion	1,2%

from: Accompanying document to the revised proposal for a council directive…, impact assessment. 3.11.2010)

Expectations of the public -

Expectations of stakeholders regarding decision making processes

17 Recommendations of COWAM 2 (Euratom "Community Waste Management")

A	Define goals	J	Define roles and responsibilities
B	Always provide alternatives	K	**Ensure early and inclusive participation**
C	Ensure weighing and balancing of values and interests	L	Establish control of the process
D	**Be comprehensive** (technical / societal)	M	Adapt formats to tasks
E	Proceed stepwise	N	Allocate adequate resources
F	Ensure flexibility	O	Ensure continuity of structure and awareness
G	Be transparent and open	P	**Secure influence of participants**
H	Allow sufficient time	Q	Enhance well-being
I	Stick to the “rules of the game”		
from: COWAM 2 WP 3 final report (2007)			

Consequences for site selection processes

today

- discussion and (in case of advantages regarding safety or / and acceptance) implementation of modifications of "pure" final disposal or even alternatives to it
- consideration of ethical and societal aspects (particularly: equity, fairness, sustainability) and their consequences for decision making
- participation of concerned persons / stakeholders / the public in decision making processes on different levels (national, regional, local)
- procedural rules and transparancy
- appreciation of burden to regional / local people hosting a (future) disposal facility
- not only compensation of disadvantages, but assistance for regional development

are inevitable attributes of decision making in radioactive waste management ment (particularly site selection for geological disposal facilities)

⇒ decision making = socio-technical issue

Suitability features of repository systems (1)

- **integrity and functional efficiency of the barriers** for the time span required
- **"predictable"** repository system
- **robustness** of the disposal system (non-sensitive against internal and external influences and failures)
- **robustness of the results** of the final safety analysis against deviations of unforeseen reality from input assumptions

⇒ **favourable overall geological setting**

However:

- **integrity and functional efficiency** of barriers and **robustness** of repository systems are **no apparent / measurable properties** but have to be derived from (geo-scientific) properties of the respective system
- **all "generally suitable" types of host-rock** (e.g.: rock-salt, argillaceous rocks, crystalline rocks, paticularly granite) exhibit rock-specific advantages and dis-advantages and
- **all forms of appearance** of of host-rock types and **all potential repository sites** with these rocks exhibit form- and site-specific advantages and disadvantages

Suitability features of repository systems (2)

- **no ideal** waste management strategy and no ideal repository site!

  ⇒ inevitable to **compare** all relevant strategic options and all potential sites with respect to their pros and cons to identify the **relatively best strategic option** and the **relatively best repository site** resp.

- this **weighing process** is an **inevitable pre-condition** for a methodically appropriate and safety-technically successfull DMP, it is the **key element** of all systematic site selection procedures

  such a weighing process requires at least

  - a **common understandig** of the safety requirements defining the goal of the decision making process
  - **rules** for content and course of the decision making process
  - **appropriate instruments** (criteria) for the identification and comparison of potentially feasible sites / repository systems as well as for the assessment of the results of site investigations
  - qualitatively and quantitatively sufficient information for the upcoming decision ⇒ **no site decision without site investigation!**

Example AkEnd site selection process -
Scientific and technical approach (1)

Principles (fair, equitable, ...) and their procedural consequences

- safety first
- "best possible" site (result of a weighing process between alternatives, not the absolutely best site!)
- rules of the process to be specified prior to application (criteria, weighing, consequences of assessments
- transparent (stepwise) procedure
- covering all relevant aspects (safety, societal, ethics...)
- no spatial preselection ("white map of Germany")
- scientifically based criteria
- independend control of siting process
- scientific discussion during development
- public participation during development and implementation
- …

Example AkEnd site selection process -

Scientific and technical approach (2)

Methodological main features

- 5 steps
- guided by geoscientific and socio-scientific criteria
- volunteerness
- flexible (step backwards), to allow response to new findings
- uncertainties to be reduced / show consequences of remaining uncertainties

Example AkEnd site selection process - Procedure (1)

Procedure Steps	Proceeding, Criteria, Assessments
1st Step Identification of areas fulfilling specific minimum requirements	• Geoscientific exclusion criteria and minimum requirements
2nd Step Selection of partial areas with particularly favourable geological conditions	• Geoscientific weighing criteria
3rd Step Identification and selection of site regions for exploration from the surface *Step backwards, if required* ↑	• Planning-scientific exclusion criteria • Planning-scientific weighing criteria • Socio-economic potential analysis • Specification of programmes for exploration from the surface and corresponding assessment criteria • Willingness to participate regarding exploration from the surface • Geoscientific and mining aspects
4th and 5th Step	

Example AkEnd site selection process - Procedure (2)

Procedure Steps	Proceeding, Criteria, Assessments
3rd Step	
4th Step Determination of sites for underground exploration *Step backwards, if required* ↑	• Exploration from the surface • Orienting safety assessment • Development of test criteria • Willingness to participate regarding underground exploration programmes
5th Step Decision on a site *Step backwards, if required* ↑	• Underground exploration and its assessment • Safety case • Comparison of the different sites explored • Orienting vote about willingness to accept underground exploration
Repository site for licensing procedure	

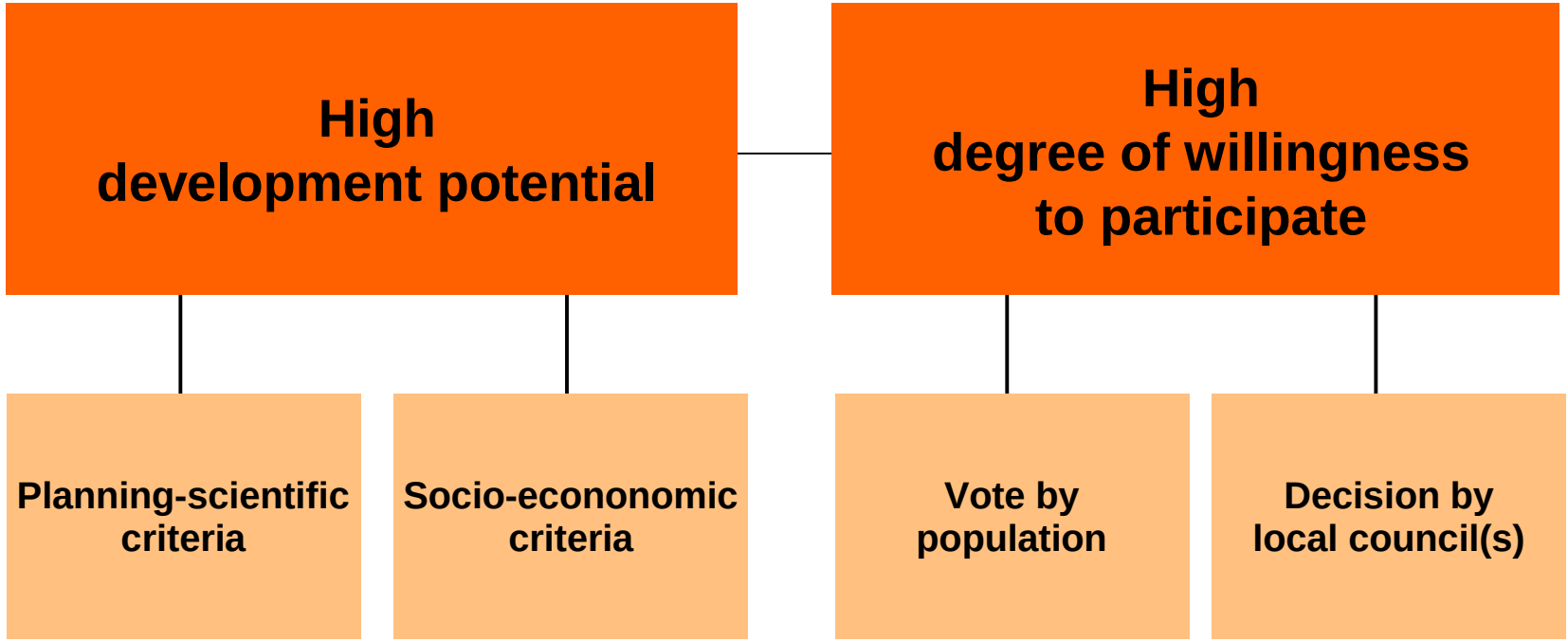
Example AkEnd site selection process -

Instruments for participation

Procedure Steps	Instruments of participation	
1st Step areas **2nd Step** partial areas	Information and control: • Establishment of an information platform • Control committee verifies adherence to the rules of the procedure	
3rd Step site regions **4th Step** sites **5th Step** Decision on a site		• Citizens' forum as a central element of participation • Centre of competent experts supports citizens' forum • Round table of stakeholders • Determination of willingness to participate in Steps 3, 4 by vote • Preparation of regional development concepts • Local council(s) take(s) final decision • Orienting vote of the public and the local council(s) at the end of Step 5

Example AkEnd site selection process -
Socio-scientific criteria

AkEnd
Socio-scientific requirements and relevant criteria



(AkEnd 2002)

Example AkEnd site selection process -
Limitation of participation

Willingness to participate

willingness to participate is an obligation of society to establish a repository

Criterion

- willingness to participate is decisive for the progress of the procedure
  - before starting surface-bound site investigations
  - before starting underground investigations
- the agreement to these investigations consists of a positive vote by the population and a positive vote by the local council(s)

Limitation of the consequences of missing willingness to participate

- when safety assessments of selected sites suggest the construction of a repository, the population will be asked as to how they will vote on the construction
- inquiry has orienting character and will help the German Bundestag to decide on the site to be chosen. In case of missing willingness - the safety related result of the selection procedure does not allow for a return to preceding steps

Résumé

regardig the relationship between technical and non-technical aspects (1)

Aggregating technical and non-technical aspects

- the aggregation of technical and non-technical partial results to an overall decision is methodologically difficult
  - there is **no overall "benefit value function"** allowing for simple, *e.g.* mathematical, aggregation of different technical and non-technical aspects
  - the "safety first" principle requires a **clear priority of (safety related) technical aspects** compared to non-technical aspects
  - the priority of safety **limits the procedural relevance of non-technical aspects** and determines the kind of aggregation
  - the procedural relevance of technical and non-technical aspects will change with the different phases of a decision making process

Résumé

regardig the relationship between technical and non-technical aspects (2)

"Safety first"

- procedure consequently directed to safety
- comparative evaluation of several options
  - inevitable from a geo-scientific and procedural point of view
  - societaly demanded (weighing)

⇒ technical objective: relatively best site

Fairness, equity

- no pre-determination (geographic, host-rock)
- participation of concerned people in the decision making process, assured by early participation of the public
- no inadequate burden through consequent orientation of the siting procedure to (long-term) safety

⇒ societal objective: relatively best site (as precondition of fairness)
⇒ societal / political acceptance
⇒ reduction of societal costs and controversies

References

AKEND - Arbeitskreis Auswahlverfahren Endlagerstandorte (2002): Site Selection Procedure for Repository Sites - Recommendations of the AkEnd - Committee on a Site Selection Procedure for Repository Sites

EC (2010): Accompanying document to the revised proposal for a council directive (Euratom) on the management of Spent Fuel and Radioactive Waste. Impact Assessment.- SEC(2010) 1289 final, Brussels, 3.11.2010

COWAM 2 - Community Waste Management, Work Package 3 - Quality of decision making process (2007): Decision-making processes in radioactive waste governance.- http://www.cowam.com/IMG/pdf_cowam2_WP3_v2.pdf