Determining «Best Practicable Environmental Options» for Final Waste Disposal of Radioactive Waste

Graham Smith
QuantiSci, UK

The Best Practicable Environmental Option (BPEO) for a particular job is clearly an interesting concept and something useful to try and identify. The term BREO was coined at least as early as 1976, and has been developed in practice through the 80's and 90's. but it still seems to mean different things to different people. This presentation discusses some ideas on what the BPEO process should include.

1. Best Practicable Environmental Options

The term BPEO was probably first used in the UK in 1976, though the general idea must have existed well before then. The concept was certainly developed and applied to a variety of problems during the 80's and 90's, but it was not always clear what the scope of a BPEO study should include.

Safety: Now or later?
Long term issues have sometimes not considered, even to the extent of excluding decommissioning stages of a project, let alone post-closure issues. Radwaste studies have generally been better at this than other work, considering timeframes which others consider ridiculous.

Human health: Radiation, other impacts, workers, public?
Radwaste studies sometimes do not take account of the non-radiological environmental implications. Or perhaps only the public are considered and not workers. In the UK the working environment is included as part of the environment so far as the Environmental Protection Act 1990 is concerned.

Protection of the environment: Biodiversity, Rare species?
Most radwaste studies have limited consideration to human health effects, relying on the contention made by ICRP that adequate protection of individual humans will adequately protect other species. Probably the ICRP view is correct in many circumstances, but probably not all circumstances, and in any event, omission of specific consideration of environmental consequences would mean provision of less than a fully transparent BPEO argument.

High consequence - low probability events: Transport, construction, containment failure?
Sometimes only routine effects are considered in BPEOs. Abnormal circumstances should also be considered, including accident or unplanned releases as well as planned releases occurring in abnormal conditions.

Long term low-level pernicious pollution: acceptable levels, multiple sources?
Often only local and immediate effects are considered in environmental studies. The combined effect of other sources and the potential for long term accumulation in media should be taken

into account, especially if non-linear concentration-effect relationships are relevant to the pollutants under consideration.

Resource Implications: Sustainability, land use, groundwater.
Impacts on resources should be taken into account. Bringing the sustainability principle within the study may also be necessary for evaluation of major projects. However, different interpretations of sustainability are offered.

Technology: old-tested, new-untried?
Options considered may not be equally tested or robust.

Approval: Regulatory, Public?
The scope of a BPEO study may be influenced by the audience. Regulatory approval may place different requirements on an assessment from public approval.

Cost of Protection: what's it worth? who pays?
In comparing options, costs are certainly a factor. The financial cost of carrying out some engineering can reasonably be estimated and the experience and opinion of a quantity surveyor is more relevant than that of other people. But the financial evaluation of environmental detriment and the appropriate trade-off between spending money and avoided detriment is much more a social or political decision.

2. Not Just Post-Closure Safety
A BPEO study to help develop a radioactive waste management strategy should not only look at post-closure safety of a facility. Other stages in waste management should be considered, eg:

- Waste characterisation
- Waste treatment
- Waste packaging
- Waste transport
- Interim storage
- Emplacement in Disposal facility
- Surrender of control over facility
- Final disposal decision

3. Legal Framework for BPEO
In the UK there is a legal framework for BPEO studies.

- The concept was developed from the 1976 «Royal Commission on Environmental Pollution»
- The Environmental Protection Act 1990 provided a link to 'Integrated Pollution Control' and demonstration that 'operators of prescribed processes' use 'Best Available Techniques Not Entailing Excessive Costs' (BANTEC)

This is similar to concept of optimisation -As low as reasonably achievable (ALARA) economic and social factors being taken into account, as given by the International Commission on Radiological Protection.

4. Practical Implementation?

- In the UK there was a 1986 Study of BPEOs for management of low and intermediate level radioactive wastes. This was intended to help develop radioactive waste management policy by answering important strategic questions
- such as:
  - -What are the practicable options;
  - -Which wastes should go to shallow burial;
  - -Which wastes should go to sea disposal?
  - -How does storage compare with disposal;
  - -What are the cost and environmental trade-offs.

The work is summarised in '*Assessment of* Best Practicable Environmental Options *(BPEOs) for Management of Low- and Intermediate –Level Solid Radioactive Wastes. Report prepared for the Radioactive (Professional) Division of the Department of the Environment, March 1986, Her Majesty's Stationery Office.*

But what was done to answer these questions?

5. What was done: Waste types and quantities!

A much better national radwaste inventory was developed taking account of

- Fuel manufacture
- Reactor operations (Magnox, AGR, FBR, MTR, PWR)
- Reprocessing Wastes
- Decommissioning
- Military
- Research, hospitals, non-nuclear industry radioactive wastes

NOTE: No uranium mining or milling wastes arise in the UK but just about everything else you can think of.

Inventories were projected in to the future based on two nuclear energy production scenarios, each with a 40 y arisings schedule.

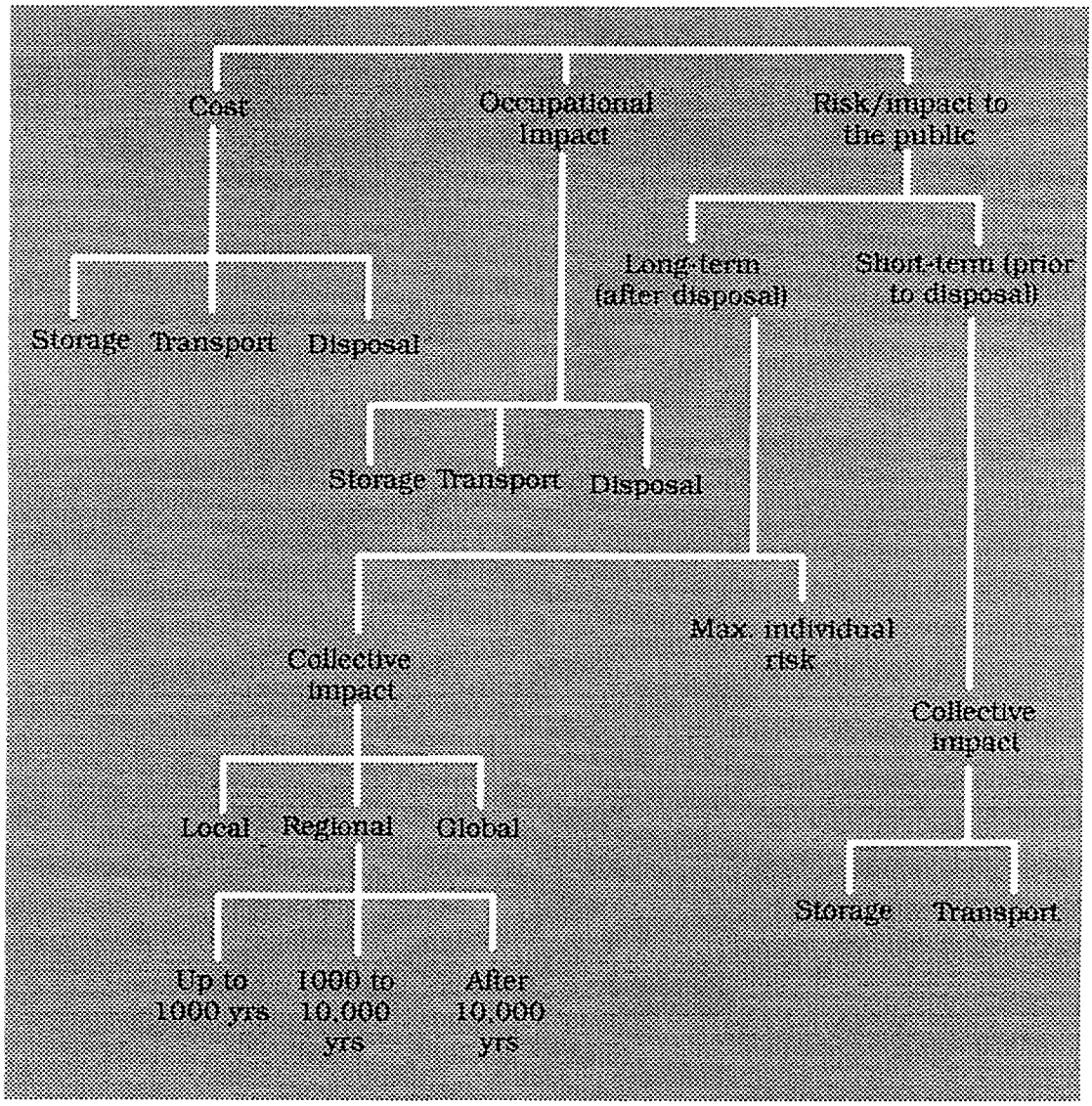
6. What was done: Options

- Disposal on deep ocean seabed
- Shallow-land burial, trench and fully engineered
- Deep land disposal, alternative rock types,
- Off shore boreholes in marine continental shelf,
- Long term storage followed by disposal,

Provisional activity limits were set for disposal via each option, according to the then existing standards of waste acceptance. An important option which might be additionally considered toady would be indefinite surface storage.

7. What was done assessed for each option

The following measures were assessed.



8. What was done: Comparison of Options

- Identified acceptable options for each waste type, ie acceptable disposal routes were determined for each waste stream.
- Identified preferences among options summing over factors:
  - -Cost
  - -Occupational collective dose
  - -Public doses from storage
  - -Peak individual doses
- With each factor weighted so that direct conversion between, say cost and a given level of dose could be made.
- Since such weighting factors include social as well as technical judgements, 4 sets of weighting factors were used, intended to represent four perspectives, those of operators, regulators, local concerns, and global impact concerns.

9. What was done: Optimisation

- Linear programming techniques borrowed from operational research were used to calculation a schedule of storage, transport and disposal operations for all waste streams

taking into account the schedule of arisings and minimising overall impact according to the weighting sets, thus proving four strategic plans for waste management.
- The process does not prove that one option is best, but it does provide a good picture of the alternatives and what the implications are of adopting one plan rather than another. And, if you find you do not like one particular option, it helps to identify what is important to you.

10. Outcome of the BPEO Study
- Major improved effort to characterise waste (national inventory)
- Much greater quantitative understanding of where and when the real costs, and environmental and radiological impacts arise
- All options would be useful within a national strategy
- However some options are no longer available to UK
  -seabed
  -shallow burial of short-lived intermediate level waste.

This is because of issues of national and local political acceptability.

11. What now?
The lessons are recognition of the need for:

- resolution of political acceptance problems,
- integration of policy with other hazardous waste management,
- stronger legal framework.

12. Regulatory Technical Guidance on BPEOs
Some contributions to solving the problems have come from regulators. The Environmental Protection Act 1990

- Defines

-environmental harm
-releases into the environment, and what the environment consists of.

And work done to implement the Act:

- Provides a generic BPEO methodology, which takes account of

- natural ambient
- combined effects of multiple sites
- defines insignificant releases
- defines environmental assessment levels
- defines environmental quality standards
- provides a basis for determining costs
- provides a basis for arguing when further costs would be disproportionate to detriment saved.

Site specific studies are on-going to evaluate BPEOs.