British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Communication and Confidence Building – International Experience

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Caesium Workshop: Fukushima Recovery – understanding, modelling and managing radiocaesium decontamination
30 September to 3 October 2013

JAEA

My Background

- Principal Scientist, British Geological Survey;
- Geomicrobiologist by training

Radioactive Waste

- 25 years+ experience of geological disposal of radioactive waste (Canada, Japan, Sweden, Switzerland, UK etc)
- Involved in Swiss/Japanese work on communication to stakeholders
- Use of analogies for communication (Poços de Caldas, Maqarin, UK analogue sites) – Nagra, Numo, NDA
- Lecturer on ITC course on use of natural analogues for communication

CCS

- Technical input into Focus Group discussions to evaluate public acceptance of technology (EU project)

Outreach

- Visiting Professor, University of Manchester
- BBC Media Fellowship; Qualified High School Teacher; UK School Science Ambassador
- Community work: Magistrate in Adult courts in Nottingham, UK

Outline of presentation

- **Examples of experience from past contamination incidents:**
  - **Reactor incidents**
  - **Weapons testing**
- **Perceptions of ‘nuclear’.**
- **Successes and failures.**
- **Other industries.**
- **Lessons for Fukushima.**
- **New ways forward…**

Past major reactor accidents (most core melt)

Reactor	Date	Immediate deaths	Environmental effect	Follow-up action
NRX, Canada (experimental, 40 MWt)	1952	Nil	Nil	Repaired (new core), closed 1992
Windscale-1, UK (military plutonium-producing pile)	1957	Nil	Widespread contamination. Farms affected (c 1.5 x 10^{15} Bq released)	Entombed (filled with concrete); being demolished.
SL-1, USA (experimental, military, 3 MWt)	1961	Three operators	Very minor radioactive release	Decommissioned
Fermi-1 USA (experimental breeder, 66 MWe)	1966	Nil	Nil	Repaired and restarted, then closed in 1972
Saint Laurent-A1, France (commercial, 480 MWe)	1969	Nil	Minor radiation release ?	Repaired (decomm. 1992)
Lucens, Switzerland (experimental, 7.5 MWe)	1969	Nil	Very minor radioactive release	Decommissioned
Browns Ferry, USA (commercial, 2 x 1080 MWe)	1975	Nil	Nil	Control room fire, repaired
Three-Mile Island-2, USA (commercial, 880 MWe)	1979	Nil	Minor short-term radiation dose (within ICRP limits) to public, delayed release of 2 x 10^{14} Bq of Kr-85	Clean-up programme complete, in monitored storage stage of decommissioning
Saint Laurent-A2, France (commercial, 450 MWe)	1980	Nil	Minor radiation release (8 x 10^{10} Bq)	Repaired (decomm. 1992)
Chernobyl-4, Ukraine (commercial, 950 MWe)	1986	47 staff and firefighters (32 immediate)	Major radiation release across E. Europe and Scandinavia (11 x 10^{18} Bq)	Entombed
Vandellos-1, Spain (commercial, 480 MWe)	1989	Nil	Nil	Turbine fire, decommissioned
Fukushima 1-3, Japan (commercial, 1959 MWe)	2011	Nil	Local contamination, extensive on site	Rapid decommissioning / cleanup

Major activity releases from reactors

- **Windscale**
  - Core fire during secret production of Po
  - Extensive releases of volatile components & water used for fire-fighting
- **Chernobyl**
  - Criticality excursion during tests
  - Explosive release of core contents
  - Long-term releases during / after responses to control fire / criticality
- **Fukushima**
  - Core melt and fuel pond damage after loss of power following tsunami
  - Responses ongoing

Windscale: impact

- Activity releases lower (about 20 TBq Cs-137) but maybe more radiologically hazardous than Fukushima (Po-210).
- Initial attempt to conceal accident – no protection for highest-exposed local populations during maximum I releases and complete secrecy wrt Po-210 (probable main hazard). Possibly resulting thyroid cancers.
- Poor records of operator doses, especially during fire-fighting actions.
- Attempts to flood core resulted in large volumes of contaminated water – initially discharged directly into local river.
- Rating of 5 in terms of both immediate and long-term environmental impact debatable due to Po releases – but certainly very much less long-distance impact than Chernobyl.

Windscale: recovery

- Remediation focused on site – no evacuation zone or external clean-up. Releases considerably reduced by “Cockcroft’s Folly” filters.
- Off-site activities focused on restriction of dose – e.g. restriction of consumption of contaminated milk over an area of 500 km^2 (especially until decay of short-lived radio-Iodine).
- Main concern initially capture and treatment of water used to cool core.
- Once stabilised, reactor core entombed and decommissioning not planned until 2037 (80 years after accident). Concerns about possible re-combustion risk remain.
- Accident effectively forgotten: main area contaminated is major tourist attraction (Lake District).

Chernobyl: impact

- Releases orders of magnitude more radiologically hazardous than Fukushima.
- Initial attempt to conceal accident – no protection for highest-exposed local populations during maximum I releases (thyroid cancers).
- Direct exposure of damaged core giving lethal doses to “Liquidators”.
- Explosive release giving very long distance dispersal of volatiles (esp I & Cs).
- Local explosive distribution of core material and releases from water contact with exposed “corium”.
- Well deserves rating of 7 in terms of both immediate and long-term environmental impact.

Chernobyl: recovery

- Initial focus on stabilising exposed core.
- Next main step construction of sarcophagus.
- Highly contaminated debris on site dumped in trenches – now source of contaminant plumes.
- Eventual evacuation led to abandoned zone – no attempt to remediate.
- Present focus is instability of sarcophagus (initial design rushed and quality poor) : plans for construction of more robust structure.
- Outside highly contaminated region, re-assessment indicated that protection measures were often over-conservative.
- Anything nuclear is linked to Chernobyl…

Some accidents and other discharges

Release of radioactivity	TBq
MAYAK: Total releases of long lived radio-nuclides into Lake Karachay	20,000,000
Tomsk-7: liquid radioactive waste injected into the ground	15,000,000
Hiroshima bomb 1945, activity 12h after explosion	5,550,000
MAYAK: Present activity Lake "Karachay"	4,400,000
KRASNOYARSK: liquid radioactive waste injected into the ground	4,000,000
Chernobyl accident 1986	1,850,000
Releases of long lived radio-nuclides from Atmospheric bomb tests	1,550,000
MAYAK: Kyshtym accident 1957	740,000
Sellafield, UK reprocessing plant, total discharges (since 1951)*	130,000
MAYAK: Present radioactive inventory Lake "Staroe Boloto"	110,000
MAYAK: Discharges into "Techa" 1949-1956	100,000
MAYAK: Kyshtym accident 1957 spread over the region	74,000
MAYAK: Present radioactive inventory Reservoir 17	74,000

Underground tests

There has generally been no attempt to remediate underground test sites. Recently discussed for Pacific atolls where high yield tests were carried out, but little action to date.

- US: greatest contamination of Nevada Test Site – over 1000 nuclear explosions (residual activity of about 200 PBq Cs-137).

- Soviet Union: much wider range of test locations... But mostly unknown until now (secrecy).

Locations of nuclear explosions in the Soviet Union

So how is all this perceived by those outside the ‘nuclear industry’?

The result for nuclear

The result for radwaste disposal

- Failure to start a repository in the in many countries as a result of public opposition.
- **D**ecide, **A**nnounce, **D**efend (**A**bandon) in the past (DADA) – failure.
- Lessons from Scandinavia mean volunteer communities have been sought. MRWS approach in the UK.
- Open procedure.
- Slow process (but rapid considering past failures).
- **BUT inevitable linkage to Nuclear New Build – who is making the money?**
- Benefits (medical, power) seem to be lost.

This is happening in other industries - CCS experiences

Ways to reduce CO_2 emissions

‘Green energy’

CCS from coal fired power stations

CCS from gas fields

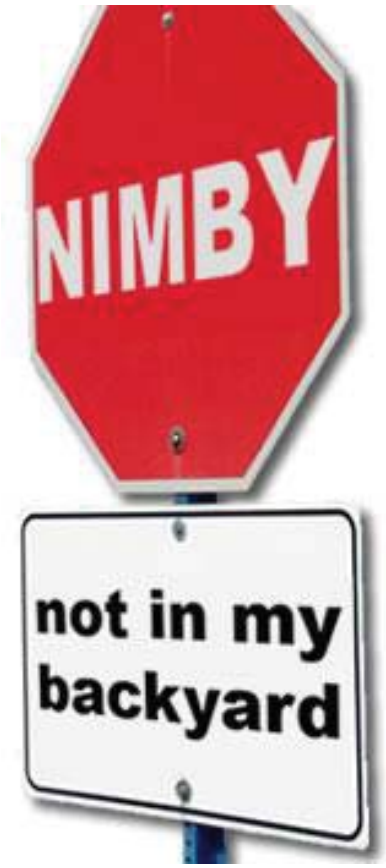
Activists view: ‘Climate Camp’ Wales August 2008

Another kind of activist

guardian.co.uk

Not under our backyard, say Germans, in blow to CO2 plans

German carbon capture plan appears to be a victim of 'numbyism' - not under my backyard



Germany

- A number of citizens initiatives against CCS.
- These organisations are unequivocally opposed to CCS.
- First German coal-fired power plant capable of capturing 90% of CO_2 emissions has nowhere to store.
- Locals fear CO_2 storage will result in:
  - leaks causing asphyxiation
  - turning groundwater acidic
  - Lead to expanded surface mining in the region

From Bürgerinitiative Kein CO2 Endlager Altmark

Dangers in the way CCS is portrayed

How is it being sold to the public?

CCS as a money spinner…..

- Good to see there are opportunities.
- But public sceptical about who will make the money?

What does all this mean for Fukushima?

A change in how things are done…

- ‘The consequences of the negligence at Fukushima stand out as catastrophic, but the mindset that supported it can be found across Japan…’

  Kiyoshi Kurokawa, Chairman, Fukushima Nuclear Accident Independent Investigation Commission

- Defensive, paternalistic attitudes in many countries.

This must stop!

- This statement is a huge step forward.

Special issues for Fukushima

- Extremely high national and international profile.
- Extensive (and justified) criticism of poor communication/management.
- Sensitivity to contamination for significant regional agriculture & aquiculture.
- Recovery is possible only when communities understand the future cleanup of the environment – both natural and via remediation: communication must be a focus for all work carried out.
- Technically (and will require good communication too!):
  - Need to develop inventories for all wastes on site and those distributed through areas considered for regional clean-up.
  - Inventory of materials & radionuclide activity levels forms the basis of an efficient and structured remediation programme.
  - Integrated assessment needs to consider also marine releases.

How can international experience be used?

- Learn from experiences and new communication approaches being adopted elsewhere (must be put into Japanese context).
- Realise that other industries are having the same communication experiences (needs dialogue and networking).
- Use communication professionals.
- Develop a strategy for communication using different ‘persuading’ industries. Don’t be reactive!

Specifically:

- Put releases into context and help communicate remediation requirements to local populations.
- Show strategies that improve remediation (holistic planning).
- Talk about pros and cons of specific remediation approaches and technologies.

Going further…

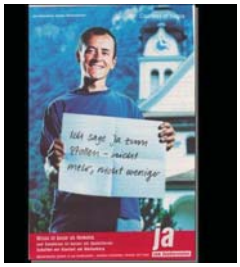
- Develop holistic approach to remediation using advanced KM tools and tailored models (JAEA has such tools!).
- Recognise that much relevant international experience is not documented. Use your contacts.
- Establish training infrastructure for the teams who will be required to carry out long term remediation and associated waste disposal.
- Consider also the root causes of the Fukushima and other international accidents and ensure that lessons learned are taken up by other nuclear facilities/sensitive or hazardous industries.

And further into the future in the broad nuclear context…

Understanding needs (industry/non industry)

Some Considerations!

- The Emotional vs the Unemotional
- Perception vs Reality
- Non technical (majority) vs Technical (the minority)
- Societal/peer memory vs Corporate/peer memory
- ‘Us’ (my environment) and ‘Them’
- ‘Soft’ Science vs ‘Hard’ Science
- Personal vs Impersonal
- Everyday language vs Technical language (‘Jargon’)
- Individual agendas vs ‘their’ technical agendas
- Out of control vs Control
- No confidence vs Confidence



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Also applies to all of us too – work/home

We are people too!

How to reconcile these considerations?

- Solid science/technology and independent…
- Good regulatory framework
- Available when wanted and how wanted
- Provide clear information at different levels so can be accessed by all to whatever level is needed (KM)
- Updated regularly
- Decisions making is clear and transparent (majority view or concensus?). ('We know best' style appears outmoded?)
- Rapid reaction to questions
- Listens and takes note of other experiences
- Proactive, interesting, intelligent, transparent (everyday language)
- Variety of established and new communications (web, mobile phone, TV, YouTube, magazines etc)
- Different languages
- Human
- Personal

Aim: Consensus? Or Majority?

Communication tools to consider

INNOVATE WITH PLYMOUTH UNIVERSITY

- Ideas developed by Prof Iain Stewart (Plymouth), Prof Julia West (BGS) and Dr Nick Smith (NNL).
- Iain is a well known BBC presenter.
- Ideas developed in the UK context but can be adapted to Japan.

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- BBC Climate Wars http://www.youtube.com/watch?v=BuKzapuDbq8&list=PL5EE022B896CC6BD5
- BBC Radio Home Planet – French nuclear energy policy http://www.bbc.co.uk/radio4/science/homeplanet_20050315.shtml
- BGS 175th anniversary at the Royal Institution, London http://www.bgs.ac.uk/about/bgs175/presentations.html

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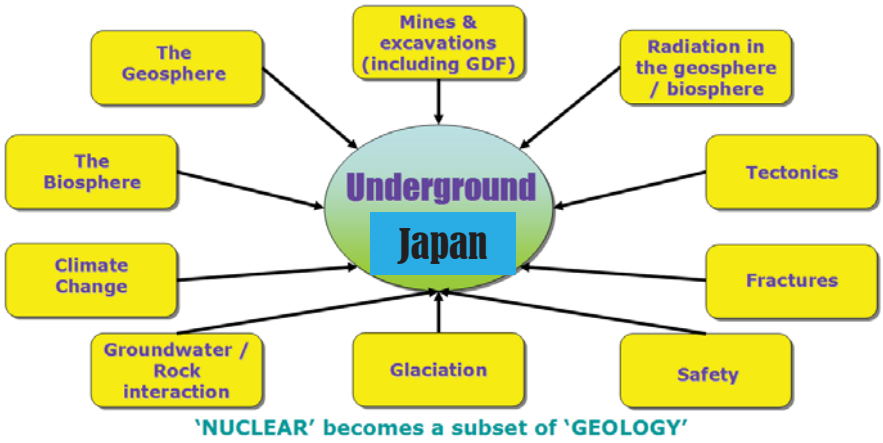
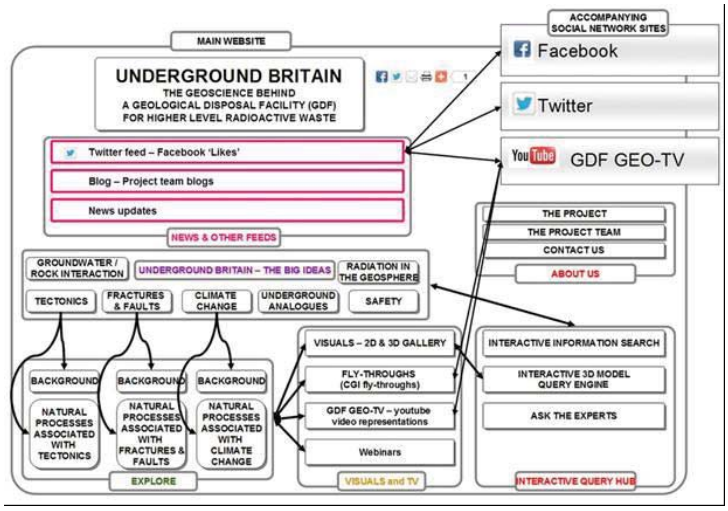
A communication approach

- Culture of Geoscience.
- Big Ideas concept.
- The ‘Land below Ground’.
- The use of the subsurface becomes part of land use.
- Nuclear and Cs clean up become part of ‘Radiation in the geosphere/biosphere).



Media methods

- Showcasing the geological.
- Science and Visitor Centres (Geofuture reused?).
- Geoparks.
- Schools e.g seismic surveys.
- Website/blogs/social media, interactive information hubs (CoolRep).
- Using analogies (natural and man-made).
- Using existing underground facilities e.g Tono.
- Other underground locations e.g. mines?



To summarise

- Decades of experience has created a long established negative perception of ‘nuclear’ in most people (global perception).
- The enemies of good communication: secrecy; reactive and defensive behaviour; poor science and poor management.
- Fukushima clean-up is an opportunity to change strategy and to start changing perceptions.
- Many new methods are being pioneered internationally. Also use the persuading professions.