NUMO International Technical Advisory Committee
Short Record of the ITAC-11 Meeting
Tokyo, 27 - 29 November 2007

General Remarks

President T. Yamaji welcomed ITAC and summarised some major developments at NUMO since ITAC-10. Key aspects included a concerted effort on building relationships with local communities and development of plans for TRU disposal, making use of experience available from other countries. The justification for closure as a special topic for this meeting was explained, noting the need to initiate staged development of site-specific closure concepts as an important component of guiding site selection and preparation for eventual licensing. The impact of the withdrawal of the Toyo-cho application and the resulting change in Government policy, moving towards a more active solicitation process, was highlighted and the planned R&D forum (January 17th 2008) was mentioned.

The special focus of the meeting was an examination of processes associated with repository closure (Block 4), which is a topic of considerable interest in Japan at present in the light of discussions of the regulatory requirements for licensing. The extensive information resulting from this session illustrates how NUMO is making effective use of ITAC. The input given by ITAC may be of wider interest in Japan and thus could be made available to other interested parties (e.g. JNFL, regulators).

A further special session covered relevant topics outside of NUMO's direct remit (Block 3). ITAC considered these presentations valuable to put the NUMO work in context. In particular, the link between the Rokkasho L1 project and NUMO's expanded requirement to include geological disposal of TRU will inevitably lead to a certain degree of coupling of these projects and so this status review was very timely.

A general question involved technical publications: there seems to be a need for NUMO to consider more active distribution of external reports from their R&D programme – although it was noted that NUMO produces many papers at conferences. This is an area where ITAC may be able to help with review (and such documents would help ITAC to be well informed about progress in key areas). Although the effort of producing quality external publications is considerable, it can be very cost-effective in terms of establishing credibility. Kitayama indicated that NUMO would produce interim reports periodically, which would document the progress of such studies.

Block 1: National news from HLW / SF / TRU programmes

As in the last ITAC, the meeting commenced with short overviews of recent news from the ITAC members.

Block 2: Highlights of NUMO activities since ITAC 10

Current Status of NUMO R&D (K. Kitayama)

The presentation considered 3 items:

- TRU disposal; now included in NUMO's remit by an amendment to the Nuclear Law. The definition of this waste is effectively LLW that requires deep geological disposal although present focus is on arisings from reprocessing and MOX fabrication. Emphasis is on bringing the level of TRU repository concept to a level equivalent to that of HLW.
- Regulatory developments (NB also presentation by Yoshizawa below)
    - Fundamental regulatory concept – framework is developed which does not formally involve review of the siting process, but this is encouraged
    - Regulatory process is also being defined which includes safety reviews, procedures for closure and process of ending regulatory control. More active involvement of the regulator throughout the siting process is recommended, as is the formation of a special review board
- R&D programme, which is complicated in Japan by the number of R&D organisations involved, includes
    - Emphasis on advanced planning
    - Operational and post closure safety assessment
    - Long-term evolution of the plan, with technical standards being reviewed at regular intervals
    - Implementation philosophy – NSA. Report issued during the summer (07-02) which summarises how NUMO can in a flexible and transparent manner tailor its entire programme to the sites that come forward. This also produces, as output, an R&D plan that is updated at regular intervals.
    - Present goals include
        - Testing characterisation plans (PIMM, PIPM) in the field
        - Developing of disposal technology; practicality and operational safety
        - Establishing the process of repository closure
        - Extended technical public information programme

Subsequent discussion included planning of R&D; need for stronger NUMO role on Coordination Council for R&D on Geological Disposal seemed important, but the exact composition and working process of this organisation was rather unclear.

Direct R&D to establish the tools to support the site selection process was not clearly shown; this is incorporated within the NSA, but it is not very clear how the priorities for work are established. The need for studying repository closure is justified, but its relative weighting compared to other input that is needed earlier is still unclear.

Publication of R&D; only small numbers of reports are produced in 2006 and 2007 in the NUMO-TR series –ITAC believes that this should be expanded to improve credibility. Post-closure monitoring; requirements are uncertain internationally and hence flexibility may be needed (as accepted by the NSA).

In general, there is uncertainty about the overall balance of both NUMO's science and technology strategy and the Japanese national R&D plan supporting deep geological disposal (in house and carried out by other organisations). NUMO has presented highlights of ongoing work, but not illustrated an integrated programme. This could reflect external constraints imposed on NUMO's S&T work and the imbalance in the size of the R&D budgets for different organisations.

ITAC could function more effectively if the S&T implementation strategy and the way in which this leads to specific R&D programmes (1 year, 5 year, longer?) could be explained.

ITAC could potentially help review and suggest improvements to develop an optimised R&D programme via:

- Direct interaction with experts from the government side
- Intensive workshop (NUMO & external) on the R&D programme
- Interdisciplinary, multi-organisation working groups
- Special session on safety assessment strategy and associated R&D needs
- Identify NUMO R&D projects that can run independently from siting efforts

Current siting and public information activities (M. Futakuchi)

The presentation showed the future activities to promote the public understanding of HLW geological disposal, based on the experiences of activities in Toyo-cho etc., to get volunteers for the literature survey. As for the future activities, based on their experiences in each nation, ITAC members made constructive advices to NUMO, and the members and NUMO exchanged opinions.

Requirement Management System (H. Ueda)

The presentation started with an overview of the background to the RMS and its place within the NSA. The advanced "N-RMS" as implemented in the computerised tool is tailored to NUMO's particular needs and has particular focus on supporting decision making. The current trial system intends to illustrate:

- Management of decision-making
- Change management
- Efficient feedback to project planning (e.g. R&D)
- Structured record keeping

As spin-off, it may help presentation of projects to stakeholders and education of new NUMO members. The trial is applied to general management of technical projects, development of repository concepts and site evaluation / selection. Coding has commenced in the first two areas. At the end of the FY, the system will be assessed in terms of practical application.

In general, it was considered that:

- The basic idea is good and it is certainly valuable to clearly record decisions
- Emphasis should be on applications rather than software, e.g. considering the eventual need to tailor concepts to sites - which needs a wider viewpoint than the tight focus on EBS components
- ITAC would like to see more about practical applications and how it handles realistic decision-making (e.g. in a dynamic system where change management is important)
- Safety assessment could be represented more explicitly in the process
- Exact relationship between this work and the very closely related information flow system for geosynthesis (JAEA) might be worth clarifying

In any case, this project could be important and may be worth ITAC spending more time on this at a future meeting.

Government and ministerial ordinances; progress of institutionalization for TRU waste disposal (Y. Yoshizawa)

The presentation traced the evolution of laws and associated regulatory procedures since definition of HLW as specified waste, through expansion to cover TRU and also the expected development until repository licensing. In particular, the contents of the NISA regulatory framework for geological disposal report were outlined. This complements the law on regulation of nuclear material – which moves towards more consistent treatment of different disposal projects. Some key issues arising from such developments for NUMO are:

- QMS development and implementation
- Post-closure safety confirmation
- Role of monitoring
- Periodic reviews
- Safety case content.

In terms of the overall TRU programme (including input from the R&D presentation):

- Formal allocation of responsibility for this waste to NUMO is sensible, allowing opportunities for optimisation of deep disposal activities
- Terminology for TRU and other long-lived ILW is confusing and needs to be rationalised for all use in Japan
- TRU has technical overlaps with, but is more technically challenging than, HLW
- This requires increased staffing and budget; opportunities to optimise use of limited resources should be considered, which may require structural changes
- ITAC could provide more detailed technical support in this area

Block 3: Non-NUMO activities relevant to deep geological disposal

Summary of Niigata Chuetsu Offshore Earthquake (T. Oouchi)

The summary of this event was placed in the context of regional setting, explaining why this earthquake – which was not particularly large or destructive by Japanese standards – caused such concern. The fact that a large earthquake could occur in a site extensively characterised for NPP siting clearly raises concerns in any potential siting community in Japan.

The effects of this earthquake on the plant were very small considering that the peak accelerations were well above design specs. Despite this very positive news, the handling of public communication by Tepco appears to have been poorly managed – contributing to the negative reporting worldwide of this event.

In context, NUMO considers that such an event would cause concerns only during the operational phase – when it could be handled by conventional seismic design. The assumption of an ability to detect active faults is not compromised by this event and thus they could still be avoided during siting. This event has, however, caused initiation of a lot of new research, which will be followed by NUMO. This fits in with NUMO's own work on dating fault movements and the general work by the ITM group and illustrates also the advantages of the high density of seismic data / dense GPS network in Japan.

Such detailed technical analysis, including a critical evaluation of vertical seismic profiles, was considered by ITAC to be valuable and demonstrates NUMO capability to react in a professional way to questions by both the general public and international partners, which is an important aspect of technical confidence-building. Presentation could, however, also emphasise survival of properly engineered structures.

Status of the Rokkasho L1 project (TEPCO K. Kato)

The valuable update of this project was useful to illustrate its coupling to their TRU remit – which needs to be carefully followed by NUMO staff. This was appreciated by ITAC, who are looking forward to visiting this facility at some time

Block 4: Planning repository closure

This session comprised 3 components

- an international review of the situation in national programmes by ITAC members focusing on requirements for closure and the processes associated with transfer of liabilities and any other responsibilities, for example with regard to monitoring and retrievability (much of which is not well documented in the open literature)
- a summary of the NUMO position on this topic
- a structured open discussion.

a) The international presentations are summarised in the appended matrix and key points raised by the similarities and differences involved are integrated into the discussion of the situation in Japan as presented in (b) below.

b) The NUMO position

Status of NUMO considerations of the topic (Y. Takahashi)

The amended act requires that a closure plan should be developed by the implementer and approved by METI before repository closure – unfortunately the definition of closure is rather vague. This is important because the current operational plan foresees construction, operation and closure processes going on in parallel in different panels.

NUMO currently defines closure as the process after all waste has been emplaced; the backfilling and sealing of individual panels is considered to be part of "operations". Confirmation of safety before closure is a key issue – already identified in NUMO TR-04-03 as requiring an extensive, focused monitoring programme.

The requirements of the closure plan have been outlined by NISA (based on IAEA), considering both contents (processes and confirmation procedures) and the procedures for submission and review of the plan – including confirmation by the regulators that it is properly implemented.

NUMO plans a specific closure phase after emplacement ends, which may include extended monitoring. Retrievability will be required during the operational phase, but it is not yet decided how long this requirement is needed.

The final decision on closure is based on assurance of safety. This may be based on the results of safety reviews, assurance of the efficiency of the sealing system and safety assessment based on experience gained during operations. The latter may need a special consideration of differences between the safety case at the time of licensing and the final case for closure. Here the RMS may provide a very valuable record of such development.

Considering NUMO's upcoming programme milestones, generic closure concepts will be gradually tailored to sites as information increases during LS, PI and DI stages. The effectiveness of the sealing system will be an important part of the evolving site specific safety cases – as specified in the NSA.

Retrievability is not considered in Japan based on potential future value of the waste – it is only needed to allow a response to possible safety concerns identified during monitoring and thus is needed only until closure – although it is acknowledged to be possible thereafter.

Monitoring pre-closure is an essential part of QA, assuring operational safety, guiding responses to accidents and building a post-closure safety case. Post-closure monitoring may be needed for public acceptance; this is not linked to possible waste retrieval – which could occur only for other reasons (e.g. technological advances). The option of a small amount of waste being intensively monitored specifically to support closure has not yet been discussed beyond the possibilities of appropriate technology development for such monitoring in the DIA URL.

Extended discussion on monitoring technology (with reference to the Japanese work carried out by RWMC) noted that a lot of progress is being made in this field, although there are still open questions when the focus is on long-term safety confirmation.

Post closure monitoring – a summary of national positions:

- Switzerland – not by Nagra; open for the Government, but not planned
- USA/WIPP – carried out, but only for public acceptance. The only safety critical monitoring here is assurance of no intrusion.
- France –no monitoring planned as yet, but some may think that it could be needed for PR (as such monitoring is carried out for 300 years in the case of surface disposal). In any case, closure must be approved by law (therefore after the "at least 100 years" reversibility period) and at this time, it will be decided.
- UK – no need identified by regulator, but accepted that may be needed for public acceptance (under the boundary conditions in the future when this happens)
- Sweden – not required by regulations, but left open by SKB (until time of closure)
- USA/YMP – no safety requirement by regulator but a commitment by DoE (surface based) although details left open
- Germany – no regulatory requirement
- Canada – regulator allows for monitoring being part of the safety case (needed for mill tailings) and left open for other types of waste and may be a societal requirement
- Finland – no specific decision, up to Government that may order a one-time payment to cover costs.
- NUMO – monitoring for 300 years already decided for Rokkasho and this leads to a Government budget for this PR work of 100M JPY / year for 300a (calculated using a 3% interest rate).

Retrievability; in Japan discussed only at a technical level by regulators, but social aspects already considered by NUMO. There is a wide range of requirements worldwide and different weightings on the PR aspects. It should, however, be emphasised that all waste is retrievable in the concepts considered – the only differences involve the costs and risks involved. There are also arguments for the benefits of irretrievability – certainly for types of waste that are not potential resources in the future (strong distinction between SF and HLW).

The debate on retrieval for social reasons should maybe concentrate more on the total picture of the operation of the repository – which may mean that emphasis should be on the wide spectrum of options available. Special emphasis could be on options that allow inspectability. There are ranges of pros and cons even for technical aspects (retrievability of spent fuel), which again argues for maintaining a range of options and variants.

Liabilities – a summary of national positions:

- Finland – Posiva / waste producers have responsibility until closure; thereafter it is not clear, but some kind of transfer to the Government is expected
- Canada – not clear for HLW; NWMO has responsibility for repository operation & closure but ownership of waste is unclear as is any process after closure

- Germany – ownership of the waste is transferred from the utilities to the government for disposal and government has all subsequent liabilities
- USA/YMP – DoE will take liability for waste and, when land is transferred, also all repository structures
- Sweden – utilities own waste but responsibility for repository with SKB and final transfer of liability after closure unclear
- UK – 'legacy' waste from old nationalised industry is the responsibility of the government; responsibility for operating the repository with the site licensing company, but situation with future waste from private utilities not decided: a special fund may be established.
- France – ownership & liability with waste producer for all time; land (for surface installations) held by Andra.
- USA/WIPP – all liabilities with DoE
- Switzerland – accepting the closure of the repository to their specifications immediately transfers all liabilities from the implementer to the Federal Government
- Japan – producer has responsibility to dispose of radwaste (including all costs); implementer responsible for safety of disposal and liable for any damages; situation after closure is still uncertain, it is presently a responsibility of the producer, but is expected to involve some kind of transfer to the government at some point.

An interesting related point is the extent of land that has to be owned by the implementer: is probably the minimum in the case of Switzerland and maximum for the USA. An interesting case is SKB (maybe also Finland) – ownership not required, but is considered to simplify legal processes. In Japan, it seems that it will be necessary to own the footprint – but this is not yet completely clarified.

Process of backfilling and sealing: a growing consensus in ITAC was that this is a very important part of RC development which has been rather neglected in the past. When examining different EBS designs, the sealing system should be included – potentially in a sequential manner that considers the stepwise process.

Concepts developed for sealing (seals as such, grouts, backfills, etc.) need to be demonstrated – maybe first in generic URLs and then in a DIA URL. This needs full scale tests of all system components under realistic conditions (first tests in laboratory, but move underground as quickly as possible). A timescale of 30 years may be quite short in this context, as such experiments may run for a very long time. Borehole seal tests can also be important – and relate to the planning of the site characterisation programme. Also site specific sealing concerns should be identified as early as possible (e.g. permafrost and glaciation in Scandinavia). Functions of seals have been studied in some programmes – may be balances between performance of buffer, backfill and seals; can be very site / concept specific (and waste – NB special case of TRU).

A joint NUMO / JAEA project is looking at requirements for backfilling and sealing related to disturbed zones; this appears to be a sensible experiment and good be a good place to utilise a requirements management system (SKB might be interested in

collaboration; indeed this area might be a general focus for wider international cooperation). No related experiments are currently planned, but may be possible in Horonobe; may also be options abroad – e.g. the Canadian URL.

Seal designs tend to be rather simple and old; may be worth assessing potential problems (e.g. bentonite/cement interactions and designing around these with a bit of lateral thinking. Requirements for the designs then need to be well specified (in terms of both performance levels and timescales).

Choice of seal involves showing

- Seal can be built
- Long-term performance can be assured
- Role in total system performance can be adequately assessed to clearly define requirements.

Open questions for the future are:

- Legal and administrative issues
- Technical issues
    - Sealing
    - Monitoring
    - QA of waste emplacement (NB retrieval)
    - Safety assessment
- Social issues (retrievability).

The requirement for credibility means that technology demonstration should allow illustration of awareness of latest technology and its implication. A key question is "adequacy" – which may be very dependent on the site involved. There were divergences in ITAC opinion, but many justifications for early consideration of this aspect were provided. It was directly noted that, in some cases, difficulty of closure may be a factor that distinguishes between sites and may be a relevant issue in site selection.

NUMO clarification emphasised the key, stepwise development of the general closure plan (which is idealised, but site specific) and its relationship to concept development and demonstration, monitoring, etc. under NUMO's tight development timescale.

Discussion of retrieval / remediation associated with QA problems during emplacement were noted still to be at an early conceptual stage and hence have not yet considered practical constraints like reference emplacement rates.

Relationship of the work to the safety case was not made evident in this presentation, but even if this is implicit – it is valuable to emphasise such links to allow priorities to be identified.

The RMS appears to be static; the example of operational monitoring is an example where feedback is important to refine ideas – and could be a useful test case to check that the needed flexibility is built in.

c) Synthesis:

This session provided a good status overview of the position in leading programmes. It was interesting to hear that considerations during RMS development led to identification of this topic as a critical topic by NUMO. Topics that emerged as key issues included:

- Concepts of Closure; there is some confusion and inconsistency in the terminology of "closure" – here the NUMO terminology that emphasises the final closure block is taken over.
    - The closure plan should be developed in step with the repository concept
    - Integrated assessment of safety requirements for all components are needed and should guide designs
    - To be integrated within the entire repository programme (leading from initial characterisation work and including any possible monitoring period between end of emplacement operations and final closure)
    - The stepwise implementation can be emphasised, in effect "operational" sealing of emplacement tunnels and panels contribute to safety case supporting the total closure concept
    - Should be discussed and agreed with stakeholders (especially local public)
- Technical feasibility of repository closure (backfilling and sealing) and the associated closure strategy, including both engineering and demonstration of safety

  Overall, this appears to be a rather neglected area worldwide (with some exceptions, e.g. salt), but is now being given higher priority. This offers potential for collaboration in special large scale, long duration experiments in relevant environments. There also needs to be development in safety assessment methodology to allow backfilling and sealing requirements to be quantified (site- and concept-specific).

  For NUMO, it appears that it would be valuable to:

    - ⇨ Initiate /continue backfilling and sealing studies related to closure; integrate with general repository concept development and associated safety assessment to identify site- and concept-specific performance requirements. Possibly include active involvement in large-scale, in-situ collaborative projects.
    - ⇨ Agree broad concepts (site, host rock and waste specific) and discuss with potential volunteers
    - ⇨ Identify constraints on site characterisation and construction that the closure concept may impose
    - ⇨ Prepare a defensible concept based on technology at the time of licensing
    - ⇨ Recognising that closure methods will evolve over future decades and license conditions will need to be updated (NSA); this needs to be communicated to regulators to ensure that regulations are not overly rigid or prescriptive.
- Monitoring

- Pre-closure

This is agreed to be essential in all programmes and should be planned in an integrated manner, running from the start of site characterisation until closure. This includes applications for safety and environmental impact (including guiding response to accidents) and quality management during construction and operational, which need the methods and data handling to have assured quality. This may provide feedback to optimise procedures and to guide corrective actions in the case of perturbations or non-conformity with specifications.

Performance confirmation is also important; here aims need to be clear and the risks of the monitoring process interfering with safety functions carefully assessed.

Development of remote sensing technology is now an area of interest in several national programmes.

- Post-closure

The safety cases for deep geological disposal are based on passive safety barriers and do not require monitoring following backfilling and sealing. There is less consensus on whether it would be needed for other purposes and this is either undefined or not directly required by most regulators. Nevertheless, in some cases, it is envisaged by implementers as a contribution to public acceptance. In such a case, it should be assured that this does not impact safety. As this is far in the future, such monitoring should not be specified in detail (or prescribed) to allow flexibility to respond to stakeholder demands and technology at that time.

- Retrievability (pre- / post-closure)

All agree that the capability to reverse emplacement of one (or a few) packages in the case of operation problems is an essential component of the operational plan. This should be illustrated and demonstrated.

There is less consensus on the need to show (or demonstrate) a capability to retrieve all waste packages; this is often identified more as a response to public concerns (taken over into political decisions). In principle, waste is always retrievable – the differences involve the costs and risks involved. Some programmes explicitly require demonstration of retrieval before closure; there is less obvious requirement for ease of retrieval (or demonstrated retrieval) post closure. It may be worth noting that ease of retrieval probably gives a conflict with the requirement for closure, which should inherently make access much more difficult.

- Transfer of liabilities

The national examples show different cases;

- the implementer is the government, who retains liability
- the implementer / waste producer transfers liabilities to the government at the time of closure
- the implementer / waste producer retains liability (although this appears actually to hide an eventual transfer to the government, which has not yet been discussed explicitly)

This is a political issue, but every implementer should be able to explain the position in their country to interested stakeholders.

Block 5: Wrap up

For ITAC 12, the date was set provisionally as the week of 27th October 2008. It was hoped that this could be combined with a visit to Rokkasho.

The format for future ITAC meetings should be reconsidered. Potential topics for future meetings could include:

- As report from ITAC members (or workshop):
  - repository construction and operation logistics (converting idealised designs to engineering reality)
  - current hot topical areas in national programmes
- Further report on the application of the NSA and RMS in siting and repository concept development
- S&T programme timescales and planning
  - Linking SI, PA and design; how these will be integrated as the siting process develops
  - R&D activities in all relevant organisations

A programme should be established well in advance to allow any preparations required by ITAC members. For very technical NUMO presentations, it could be useful to have these distributed electronically to ITAC in advance.

Appendix: Simplified summary of national closure concepts

	Canada	Finland	France	Germany	Sweden	Switzerland	UK	USA/YMP	USA/WIPP
Regulatory guidance on closure process	no	yes	yes	draft	yes	Yes- in new law and sectoral plan	Revised regulations out for consultation in early 2008	yes	yes
Pre-closure monitoring	yes	yes	yes	yes	yes	Yes - especially in special pilot facility	yes	yes	yes
Post-closure monitoring	optional	optional	To be set by a future law at closure time	no	no	No	Likely to be determined at closure	yes	yes
Pre-closure demonstrated retrieval	yes	yes	Yes, during 100 years	no	yes	Not required - but illustrated by Nagra	open	no	Yes
Post-closure demonstrated retrieval	no	possibly	To be set by a future law at closure time	no	Possibly	No	open	No	Yes
Defined liabilities post closure	Unclear (govt.)	Govt.?	Waste producers	Govt.	Unclear (govt.)	Yes - federal Gov.	Government?	Yes - DoE	Yes - DoE
Established sealing technology	no	concepts	concepts	yes	concepts	concepts	No	Yes	concepts