Nuclear Waste Management Organization of Japan

Mita NN Bldg. 2F, 1-23 Shiba 4-chome,
Minato-ku, Tokyo 108-0014, JAPAN
http://www.numo.or.jp/

Record of the 3rd NUMO Technical Advisory Committee (TAC) meeting

Tokyo, 6-8 February 2017

Background

Since the 2nd meeting of the Technical Advisory Committee (TAC), NUMO has used the input provided by TAC to refine the "pre-selection, site-specific" safety case (the NUMO Safety Case) and, in particular, improve the assessment of post-closure safety and synthesis of the safety case, which are a special focus of this third meeting. The list of participants of the meeting is given in Appendix 1 (TAC members), while the programme of the meeting is included as Appendix 2.

This record provides brief documentation of discussions at the meeting, following the "Chatham House Rule" of not attributing comments to specific participants.

Day 1: Monday 6 February

Block 1 Introduction & welcome

The welcome was given by Dr Shunsuke Kondo, the president of NUMO, who highlighted the developments in Japan following the Government initiative of May 2015 to identify a scientific site screening process and its subsequent review by NEA. It is hoped that this will be followed up by more decisive action soon. NUMO is actively communicating the basis for safety of geological disposal via a range of workshops and seminars; he expressed his gratitude to TAC for support of the seminar last year. As preparation for initiation of siting, the NUMO safety case will play a key role by providing a generic source of information to interested stakeholders and TAC's review role here is very important.

An overview of the goals, programme and logistics by Group Manager Tetsuo Fujiyama (NUMO TAC coordinator) provided guidelines for the rest of the meeting. He provided an overview of safety case documentation and the current status of production and review and a list of all supporting reports. He also thanked international TAC for the input received on the summary of Chapters 1-5 and explained how this will be handled, thus forming an introduction to Block 2. Discussion considered:

- Better title – replace site-specific with something like: "NUMO pre-siting, SDM (Site Descriptive Model) -based safety case"
- Goals should specify preparation for challenges
- Will TAC review the full main report in English?: considered to be a good idea if logistically possible
- NEA International Review aims – should not include confirming feasibility, as this is premature
- Could NEA review be based on a summary rather than main report?

…these points were considered further in Block 3 and the TAC closed session.

Block 2 Progress since TAC#2 and reviews of the English summary report

Mita NN Bldg. 2F, 1-23 Shiba 4-chome,
Minato-ku, Tokyo 108-0014, JAPAN
http://www.numo.or.jp/

International TAC members were provided with an English summary of Chapters 1-5 of the safety case and provided their comments in electronic form. In the first part of this session, these chapters were briefly summarised and then TAC input was solicited, in particular in terms of key issues where a consensus position was desired.

2.1 Safety strategy, approach and boundary conditions – Chapters 1 & 2 (Tetsuo Fujiyama)

This presentation summarised responses to TAC#2 comments. Additionally, it may be worth considering including a succinct executive summary. Also make reference documentation. Is the H12 EBS (Engineering Barrier System) concept sufficient to cover all options? This is a point to clarify. Short background at beginning of Chapter 1 recommended.

2.2 Site Characterisation & SDM development – Chapter 3 (Kunio Ota & team)

This presentation included progress since TAC#2 and responses to international TAC review of the Summary report. TAC commented that the presentation clarified many of the issues raised, so material from this could be taken into the summary chapter (mainly the figures). Also pointed out that flow rates may be more useful than Darcy flow times for some assessments.

It should be recognised that that getting a lot of detail on fracture variability will be obtained relatively late in a siting programme, but this is a key aspect for crystalline and this needs to be communicated to design and safety assessment teams. Emphasis should be on specifying requirements for workable sites – so an overarching RMS (Requirement Management System) may be useful. Discussion of choices of source for panel-scale SDM for Neogene provided clarification. The Pre-Neogene migration-scale model was admitted to be extremely simple.

Spatial scales: maybe consideration also of micro-scales especially for sediments is useful, e.g. to help define chemistry. Should also explicitly note near-field model scale.

DFN (Discrete Fracture Network) model representations should be discussed in terms of realism and great benefit from experience actually carrying out site studies should be emphasised. Uplift and erosion can be of considerable concern, so may need further considerations – with some representative scoping calculations.

Colloids noted as missing at present, and also microbes – although there are measurements at URLs. Maybe note only in text.

2.3 Repository design – Chapter 4 (Yoichi Yamamoto & team)

This presentation gave an introduction to the design work, including both responses to TAC#2 comments and an overview of recent progress, with emphasis on plug and backfill design and layout in the 3 SDMs. The explanation in terms of functional requirements was useful and could be included in the summary.

A detailed comment was on the potential requirements for hydraulic plugs at the end of emplacement tunnels and the difficulty of using mixtures for backfill. May need to be mentioned as an open question.

Figures (throughout report) should be better to improve credibility, reflecting the high quality of illustrations readily obtainable by modern software and the expectations of the audience for clear and unambiguous images.

Mita NN Bldg. 2F, 1-23 Shiba 4-chome,
Minato-ku, Tokyo 108-0014, JAPAN
http://www.numo.or.jp/

When solutions are presented, storyboards for implementation would help build understanding, especially when they note potential problems – e.g., microbes. R&D plans should not be over ambitious – focus on key studies that impact feasibility and worry about optimisation later (as technology may develop considerably in coming decades).

In terms of the waste packages, especially for TRU, it would be worth discussing assumptions and uncertainties (especially if important post-closure safety functions might be considered in the future). In terms of temperature limits, reconsideration of specified limits may be useful: documented arguments about 100C indicate that this is an extremely conservative assumption. The 1000 year overpack lifetime goal was set predominantly to avoid transients after emplacement. TAC has concerns that focussing on demonstrating this represent lack of knowledge of an extensive knowledge base of supporting arguments to support very much longer containment, e.g. 17,000 years (should be presented in Ch. 7).

Assigning safety functions: clarification of goals in terms not only performance, but ease of safety assessment. Concerns of some TAC members about vulnerability of designs to poor conditions reflects lack of presentation of wider range of repository concept options. Some background on H12 and other work since may be needed for audiences with no knowledge of the past Japanese programmes.

Over-conservative treatment of TRU EBS within the post-closure assessment should be explained and improvements to move towards realism considered, allowing requirements on the EBS design to be better specified.

Testing technology in-situ can be considered premature, but very important to determine key issues influencing practicality – which is very important due to NUMO's huge inventory and ambitious emplacement timescale.

Ca-bentonite – needs to be better justified (is data for simple Ca-exchanged material or is it at high pH); high pH altered bentonite is probably more relevant.

Mention separation of construction & operation, in terms of layout and structures (e.g., access).

Seismic shear – should be considered or explained with reference to old JAEA work. Note that the particular impact of major, active faults is treated in Chapter 6 in a very pessimistic manner and more probable perturbations should be used as the basis of safety case assessments.

Treatment of gas – missing and mention needs to be added, especially for TRU (operational & post-closure). Should be focus for future R&D. Material maybe needs to be mentioned in English summary as this is identified as a key issue in many national programmes.

Co-location, maybe needs more discussion, including justification of respect distances between HLW and TRU disposal areas. Note that the distance considered is probably conservative, given the likely timescale for possible changes in hydraulic gradient – which needs to be specified for each SDM in Chapter 3.

Links between Chapters 4 & 5 involve discussion of unanticipated accidents. Responses to operational accidents are mentioned in Chapter 5, but requirements in Chapter 4 focus on post-closure.

2.4 Pre-closure safety assessment – Chapter 5 (Kazuhisa Yamashina & team)

Mr Yamashina´s short presentation included responses to TAC#2 comments and recent developments – particularly associated with the hazard sheets – and proposed future R&D. Some material from this should be taken over into the English summary.

Mita NN Bldg. 2F, 1-23 Shiba 4-chome,
Minato-ku, Tokyo 108-0014, JAPAN
http://www.numo.or.jp/

The hazard sheets seem a good advance, in particular capture of experience from the past. For a repository with a 100 year implementation timescale, this needs to extend over a much longer time than the 50 years considered at present (note as goal for future work). More advanced technology may be useful (e.g. knowledge engineering expert systems, as currently under development in many safety-critical industries) to capture tacit knowledge from past accidents. Maybe need to consider emphasising differences in boundary conditions between Japan and other countries.

Note that the hazard sheets do not capture black swans / common mode failure / cascades of accidents and thus cannot learn from WIPP. May required completely new assessment. Should be identified and, if required, modify design to minimise.

Fire concerns – really an aim should be to eliminate main risks by design, e.g., exclude diesel vehicles. Also for drops – try to reduce maximum drop heights. In all case, ensure that identified risks contribute to design optimisation. Also increased communication with waste producers (learning from WIPP). Should also explicitly consider specific wastes- e.g., bituminised material.

In addition to black swans, the basic assumptions associated with the consequence analysis should be checked, especially for the very high emplacement rates considered.

When referring to lack of nuclear waste disposal regulations (from the beginning), emphasise all the rest of relevant regulations available.

Retrieval: how well are requirements defined? Very active area of discussion in Japan. Presentation in documentation should be careful.

General: preface

Inventory is large – not very large (e.g., compared to USA). Geo-complexity noted in preface but favourable sites only in main text. Make introduction to preface more positive. Acknowledge safety is a critical issue – and NUMO would be prepared to walk away if volunteer site was clearly unsuitable.

Safety strategy – quantification of safety emphasised, but note also supporting arguments for all components of the safety case. Even if mentioned in Chapter 7, mention should come forward, with emphasis on large safety margins, before negative aspects are presented.

Day 2: Tuesday 7 February

Block 2 Progress since TAC#2 on post closure safety and safety case synthesis

Post-closure safety was not included in the English summary materials provided and was overviewed in detail in seven presentations in order to facilitate capture of input by TAC – a procedure that seemed to work well. This was followed by an outline of the safety case synthesis, which is still in the process of finalisation.

2.5 Post-closure safety assessment – Chapter 6 (Performance assessment group)

2.5(1) Basic framework and systematic methodology of safety assessment (Kiyoshi Fujisaki)

Mita NN Bldg. 2F, 1-23 Shiba 4-chome,
Minato-ku, Tokyo 108-0014, JAPAN
http://www.numo.or.jp/

The first presentation in this block overviewed the aims of the entire chapter, its contents and the questions to be addressed by TAC. A key question was capture of understanding and requirements in some kind of storyboard. It was also asked if a better definition of how "likelihood" could be specified, i.e. summarise the arguments used to define probabilities.

2.5(2) Scenario development and setting of calculation cases (Kiyoshi Fujisaki)

The second presentation was noted not to cover storyboard development and hence there is no true storyboard or other method of describing system evolution over time (e.g. Chapter 10 of SR Site, Posiva PA report on phenomenological assessment etc.). NEA post closure safety case report notes this explicitly as a prerequisite before scenario development and it is actually noted as box in NEA safety case flow chart. Needs to be considered in 4D, taking into account all coupling. It was noted that this was already done about a decade ago by NUMO, so it may be worth including some of this material.

Some aspects are included in bottom-up approach, but treatment is certainly not comprehensive and some key aspects are missing – e.g. assessment of buffer stability in dilute groundwater. Would be useful to illustrate expected case, which may help develop arguments for more realistic treatment. Consider use of argumentation models to capture key issues (basically as done in the UK). Need to consider top-down also for communication to a wide range of audiences – with identification of critical arguments for robustness.

Definition of unlikely scenarios should be done in a structured, top-down method. Misses a lot of issues associated with QA failures, uplift uncertainty, functions of plugs, etc.

The safety function approach is effectively bottom up, so a real top-down approach is needed, which helps to show the limitations of assumptions made. Needs to be developed for different sites and concepts. Check for completeness and take care that that reserve FEPs are truly positive in all cases. This may be helped by formal description of uncertainties and an associated sensitivity analysis.

At a technical level, there were some concerns about a non-perforated shell PEM although these may not be critical for the NUMO reference overpack – justification to counter-arguments may be worth developing prior to NEA review.

2.5(3) Performance assessment model (Keisuke Ishida)

The third presentation was complemented by additional information covering layouts and nuclide transport parameters. Initially this covered far-field RN migration analysis to respond to a question from TAC#2.

It was noted that the assessment needs to consider alteration of materials with time (e.g. bentonite).

EDZ permeability 100x larger than rock – needs to be justified. Common assumption in the past, but not generally observed in URLs.

DCFs (dose conversion factors) low compared to other programmes and could be a concern for NEA – so needs to be well justified (especially for C and I as these are reduced further).

Calculations – do they derive only dose rate? Generally alternative indicators are considered (e.g. RN flow paths, identification of factors contributing to dose reduction). This seems not possible due to model simplifications, but may be a driver for next generation models.

Mita NN Bldg. 2F, 1-23 Shiba 4-chome,
Minato-ku, Tokyo 108-0014, JAPAN
http://www.numo.or.jp/

Migrations models used and extraction of flow-path details are over-simplistic and not state of the art. Will need to be very carefully presented. Ideally present an example of a 3D model calculation.

Dissolution rates very different to French case; needs to be justified – e.g. extremely fast glass dissolution variation.

2.5(4) Calculation of 'likely scenario' and 'less-likely scenarios' (Keisuke Ishida)

The forth presentation was complemented by a handout with all the release curves (near field and repository scale) for plutonic and Neogene rocks. It was noted that there were relatively small safety margins despite very low DCFs. Makes any claim about robustness difficult to justify. It also makes any comparison of rocks impossible to justify.

Near-field assessment seems to be too simplistic, so cannot show differences between H12Vertical emplacement & PEM.

Assuming iodine in glass needs consideration, discussion should note how conservative this is (carryover fraction to glass).

As presented, variations look more like sensitivity analysis than anything to do likelihood. In any case, comprehensive sensitivity analysis would be very useful to identify the key factors indicating performance.

For HLW in the UK, Cs-135 dominates so it would be useful to have justification of NUMO differences. Kd value was discussed, but clearly not very transparent. Difference between H12Vertical emplacement and PEM actually due to layout – so it is critically important to understand the factors that contribute to performance.

Confusion over transmissivity distributions used – needs to be clarified.

2.5(5) Calculation of 'very unlikely scenarios' (Keisuke Ishida)

The fifth presentation presented some very pessimistic scenarios, especially for the faulting case, which is worth considering in a more credible manner. Need also consideration of secondary fault movements – with clear justification of ignoring Swedish/Finnish cases (at least for NEA).

Calculation of total probabilities from components needs to be clarified (e.g. for volcanism, explain "occurrence probability of scenario"). The minimum time for forming very large faults should also be considered and scenarios like this labelled "what if?"

2.5(6) Calculation of 'human intrusion scenarios' (Keisuke Ishida)

The sixth presentation was followed by an explanation of dose calculation for the open borehole case. The gradient up the hole should be defined / explained. This requires artesian conditions, which may be quite rare in Japan and any data from these might provide some basis for setting a value.

Worth also noting which RNs contribute to doses in the different cases.

The doses to drillers calculated seem low by comparison with other programmes, so may need some further discussion (especially for NEA).

It is of interest to NUMO how communicate such scenarios to other stakeholders. Generally human actions are treated differently to all other scenarios.

Mita NN Bldg. 2F, 1-23 Shiba 4-chome,
Minato-ku, Tokyo 108-0014, JAPAN
http://www.numo.or.jp/

NUMO would also like input on other intrusion scenario descriptions by other programmes. In WIPP, human intrusion is the critical scenario; treatment is defined by the regulator. Here the impact of drilling may extend quite far beyond the area of the borehole, so this may also need discussion for an international audience.

2.5(7) Summary and R&D needs (Kiyoshi Fujisaki)

The final presentation also considered handling Pre-Neogene sediments and coastal sites. It was noted that conclusions and R&D topics need to be modified to take into account discussions in previous sessions.

Key points from previous sessions include capture of knowledge prior to scenario development, consideration of colloid formation and evolution of the entire buffer / backfill system. Should consider not only low salinity, but also high salinity case (or any other special chemical conditions in Japan).

The R&D list is long and needs to be prioritised (taking advantage of the international knowledge base available).

Integration may consider the key role of focusing by a RMS. This should however be introduced carefully, without over-rating the capacity of this tool and realising that it supports but does not replace the role of experienced generalists.

Summary claim of robust demonstration of safety would require development of more credible models and data, together with more extensive, project-specific supporting evidence. Wording should reflect this.

H12 / TRU-2: maybe worth providing a more detailed list of changes (along with clear justification of these).

Maybe needs more clarification of future aims for quantification of Pre-Neogene safety.

Improvement of TRU assumptions are particularly important, as a step towards removing over-conservatism. Maybe also more on gas (TRU & HLW).

Retrieval – should be assessed somewhere. Maybe mainly design / pre-closure (Chapters 4 & 5), but possible long term impacts of any steps taken to ease retrieval should be carefully considered (maybe mainly to support international peer-review).

Very unlikely scenarios should be credible in terms of representation and time at which something develops. Impossible scenarios should explicitly noted as “what if?” and generally consequences represented in a form other than doses. ICRP terminology in terms of targets should be considered, for credible but very unlikely scenarios. In any case, doses should be discussed carefully.

Maybe note that risks and consequences of very low probability and intrusion scenarios less for sub-sea.

2.6 Synthesis of the safety case – Chapter 7 (Tetsuo Fujiyama)

Fujiyama-san´s presentation presented the concept for this chapter. This needs to be modified to capture some of the key issues noted and, in particular, scientific framework of understanding needs to be taken over. Wording needs to be careful that it does not over-estimate capabilities.

Day 3: Wednesday 8 February

Block 3 NEA review plans

Plans and solicitation of TAC input (Satoru Suzuki)

Suzuki´s presentation included an overview of both domestic and international review plans and an overview of the communication tool CYPHER.

A key question was if documentation be updated after review of Japanese documents, before English documentation is finalised. All key changes should be taken over, bearing in mind different needs of the Japanese and international audiences. It was noted that it would help if the objectives of different reviews are clearly specified and if the domestic review comments could be passed to NEA (and TAC).

It is important to define who are "stakeholders" for the main report (domestic and international) – especially if including regulators. May be useful to note this in the introduction of the report.

The tool seems good for record keeping, but many reviewers would like to work outline: is there an option? SKB uses a simple word table, for example. Offline comments might be managed using an off-line excel template.

Hyperlinks – are these really coupled – especially between supporting reports and main report? Maybe some key supporting reports may be needed as reference so all should be consistent and compatible. It is very important that QA checks (e.g. data- and model-management processes. Clear ontology and use of units and abbreviations is important.

There may be limits to direct use of the communication tool by individual NEA reviewers as they will develop a collective opinion. Possibly the chairman or secretary could use it for synthesis – or NUMO uses the tool to follow the process of the review. For both options, it must be able to handle very general comments in such cases.

En passant, it was noted that it would be useful if international TAC members could receive a translation of the Japanese TAC member comments on the Japanese language materials as background.

Block 4 TAC closed session & wrap up

TAC proposals with respect to the NEA review are summarised.

Next meeting: this was provisionally set as week of 22 Jan 2018, with week of 5 March as backup …to be reconfirmed by NUMO when AESJ review delivery date is known.

Closing address by Executive Director Umeki emphasised how important the NEA review is for NUMO and thanked all participants for their valuable input and commitment to support further review of material before submission to NEA. He also greatly appreciated TAC's encouragement of young staff, which is a very important aspect of NUMO's long-term planning.

Appendices
1. TAC Participants list
2. TAC meeting programme