Meeting of NUSSC volunteers to discuss the draft TECDOC:
Considerations on the Application of the IAEA
Safety Requirements for Design of Nuclear Power Plants
Vienna, 3rd July 2015

NUSSC Chair summary report

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1. Participants
Algeria, Austria, Canada, China, Czech Republic, Finland, France, Germany, Hungary, Israel, Japan, Rep. of Korea, Mexico, The Netherlands, Slovakia, UK (partial), USA, ENISS, EUR, WNA
IAEA representatives, NUSSC chair

2. Context
- The draft TECDOC (rev 9, May 2015), with a list of a few still “debated” topics addressed in this draft, was made available on NUSSC website prior to NUSSC meeting.
  It was agreed with IAEA that, the day following the NUSSC meeting, these topics would be discussed by volunteering members/observers of NUSSC.

- IAEA reminds that:
  - the TECDOC purpose it to provide insights for the clarification of some “new” key topics introduced in SSR-2/1. The TECDOC has therefore to be consistent with SSR-2/1;
  - the TECDOC is addressing new NPPs. Member States (MS) may however also use it for existing NPPs, e.g. within PSR process;
  - the TECDOC could be used as the basis for a future Safety Guide. The TECDOC content may or not be consensual and may or not include several MS’ practices/views;
  - the TECDOC will later help IAEA drafters in the ongoing update of some Safety Guides related to NPP design (containment, safety assessment…).
IAEA’s goal is to publish this TECDOC in the short term.
3. **Presentations (ppt) delivered**

Some presentations, available on NUSSC website, were used to provide background information:
- Presentation by NUSSC Chair,
- Presentation by IAEA (Safety Assessment Section),
- Presentation by ENISS.

4. **Purpose of the TECDOC and status of the document**

- Some participants wonder whether a TECDOC is the appropriate format and whether a Safety Guide would be preferable. IAEA reminds that TECDOCs normally describe potential or special solutions of MS, ideas, best practices and other approaches to foster discussion. TECDOCs are not usually consensus document.

  Having a TECDOC presenting a collection of practices or approaches which may not be (fully) consistent but are not inconsistent with SSR 2/1 is an option. However, for NUSSC chair, having a consensual document would be the preferred option, if achievable.

- In the latest version of the draft TECDOC, some sentences not quoting or corresponding to requirements in SSR 2/1 seem prescriptive. This may not be appropriate for a TECDOC. IAEA acknowledges that and such sentences not originated by SSR 2/1 will be corrected.

5. **Association of plant states with levels of DiD and levels of defence in depth (DiD)**

- Section 4 of the draft TECDOC addresses the levels of DiD, considering both the INSAG-10 (1996) and SSR-2/1 (2011) publications.

  IAEA stresses that INSAG-10 does not make an explicit link between DiD level and plant states.

  A participant underlines that section 2 of SSR-2/1, including the description of DiD levels (§2.13), is not formally establishing requirement but is rather introductive. However, Requirement 7 (The design of a nuclear power plant shall incorporate defence in depth. The levels of defence in depth shall be independent as far as is practicable) is a requirement…

- Considering the 5 main levels of DiD defined in INSAG-10, two options have been considered:
  1) Subdividing level 3 of DiD: DBA in level 3a and DEC without core melt in level 3b (DEC with core-melt in level 4). This option is the one currently described in the draft TECDOC, also indicating that some countries are making use of the other option;
  2) Subdividing level 4 of DiD: DEC with core melt in level 4b and DEC without core-melt in level 4a. This option was in the draft TECDOC until December 2014.

  NUSSC chair personal view is that having 6 main levels of DiD would have avoided this issue.
A participant also highlights that, in SSR-2/1 §2.13, level 3 provisions aim at “preventing damage to the reactor core … and returning the plant to a safe state” and level 4 provisions aim at “The purpose of the fourth level of defence is to mitigate the consequences of accidents that result from failure of the third level of defence in depth. This is achieved by preventing the progression of the accident and mitigating the consequences of a severe accident.” NUSSC chair personal view is that the draft TECDOC, as currently written, is in line with SSR-2/1.

WENRA published its report on the Safety of New NPP Designs (March 2013), with the 3a/3b option and the explanation for this choice. ENISS supports this option. However, this is not the only view: CNRA is drafting a green booklet on DiD, currently favoring, according to some participants, the 4a/4b option. More generally, various MS favor one option or the other. IAEA believes the TECDOC could be rewritten without clearly subdividing level 3 or level 4 of DiD, instead emphasizing the main objective of the different DiD levels (independence) and making reference to different approaches in MSs.

Both options try to accommodate with the 5 main levels established by INSAG-10 in 1996, as their goal is to insert DEC without core melt in one of the 5 level of DiD.

The workgroup acknowledges that, currently, the only publication available is the one of WENRA but that some countries or some other international organization have a different view. The IAEA may, obviously, have its own view. The workgroup view is that the TECDOC should stress on commonalities and not on differences. Both options may be shortly presented.

6. Accident categories

6.1. Design basis accidents (DBA)

SSR-2/1 defines DBA: “design basis accident: An accident causing accident conditions for which a facility is designed in accordance with established design criteria and conservative methodology, and for which releases of radioactive material are kept within acceptable limits.”

There was no discussion when developing SSR-2/1 on this concept as it was already well established. No “novelty” was introduced in SSR-2/1. Current definition is robust and well-understood by the industry and the regulators.

The workgroup view is that there is no need to further elaborate on DBA in the TECDOC.

6.2. List of DECs (without fuel damage)

- SSR-2/1 establishes a definition of DEC “Design extension conditions: Postulated accident conditions that are not considered for design basis accidents, but that are considered in the design process for the facility in accordance with best estimate methodology, and for which releases of radioactive material are kept within acceptable limits.”
  - Design extension conditions comprise conditions in events without significant fuel degradation and conditions in events with core melting

SSR-2/1 requirement 20 requires that “A set of design extension conditions shall be derived on the basis of engineering judgement, deterministic assessments and probabilistic assessments”.

On page 13 of the draft TECDOC is introduced a list of DEC without core-melt: “The list, that in some countries is also referred to as deterministically identified, may include…” After this short list of DEC, the draft TECDOC adds that: “In addition to these DECs commonly agreed by regulatory bodies that are systematically addressed in several reactor designs, there are other DECs that are more technology dependent and can be derived on the basis of probabilistic considerations.”

The draft TECDOC, as written, is acceptable to the workgroup.
7. Concept of practical elimination

- The concept of practical elimination is discussed in section 7 of the draft TECDOC. Requirements 2.11, 4.3, 5.27, 5.31 of SSR-2/1 mention practical elimination. The draft TECDOC mentions: “The demonstration of practical elimination is based on and assessment of such provisions, that would necessarily include engineering, deterministic and probabilistic judgement”… “There is a quite large consensus on the fact that the “practical elimination”, even involving probabilistic considerations, should always be based on solid design provisions and supported by deterministic assessment and engineering judgement.”

- A participant stresses that the sentence “sequences/situations/accidents that could lead to large or early releases” would be more appropriate. IAEA agrees.

   ➡ There is an agreement in the workgroup to amend the wording as suggested.

- A participant highlights that “It will be the decision of the safety authorities to identify the conditions to be practically eliminated and to assess if the measures implemented are satisfactory for the purpose.” may not be fully appropriate as regulators review the licensee’s submission.

   ➡ There is an agreement in the workgroup to amend the wording as suggested.

- The on-going work by CNRA also addresses practical elimination and IAEA is aware of this on-going work. A participant believes that the concept is better presented in the CNRA draft but the IAEA is not convinced of that. For example, according to IAEA, the draft doesn’t use the definition in SSR 2/1 and it introduces terminology that is not used in the IAEA Safety Standards. Most of the participants do not have a detailed knowledge of the CNRA draft.

   ➡ No conclusion from the workgroup.

- The draft TECDOC suggests a definition: “for the “conditions practically eliminated: The possibility of certain conditions occurring that could result in high radiation doses or early or large radioactive releases is considered to have been practically eliminated if it is physically impossible for the conditions to occur or if the conditions can be considered with a high degree of confidence to be extremely unlikely to arise because of the rigorous prescriptive and deterministic measure adopted.”

The concern is on the last words of the definition (“because of the rigorous prescriptive and deterministic measure adopted.”)

   ➡ The workgroup view is that the definition should not be modified compared to the one established in SSR-2/1 (footnote 30 of SSR-2/1). The TECDOC can elaborate on the definition but not modify it.

8. Design basis (of the plant)

- In section 5 (general plant design) of SSR-2/1, Requirement 14 adresses the design basis of items important to safety: “The design basis for items important to safety shall specify the necessary capability, reliability and functionality for the relevant operational states, for accident conditions and for conditions arising from internal and external hazards, to meet the specific acceptance criteria over the lifetime of the nuclear power plant.”.

In addition, SSR-2/1 states that “5.28 The design extension conditions shall be used to define the design specifications for safety features and for the design of all other items important to safety that are necessary for preventing such conditions from arising, or, if they do arise, for controlling them and mitigating their consequences.”

   ➡ The workgroup agrees that, when designing a new plant, both DBA and DEC will be assessed to determine the needed capabilities of items important to safety.

   ➡ The work group concludes that the below figure is consistent with SSR-2/1 intent. The draft TECDOC could introduce a term such as “general plant design” or “plant design envelope” (preferably the second).
On the above figure, the right part (beyond plant design envelope) may be removed. Practically eliminated conditions do not need to be inserted in this figure which is appropriate to give an overview of the plant design envelope.

IAEA Safety Glossary (2007): “**design basis.** The range of conditions and events taken explicitly into account in the design of a facility, according to established criteria, such that the facility can withstand them without exceeding authorized limits by the planned operation of safety systems.

Such as a noun, with the definition above. Also often used as an adjective, applied to specific categories of conditions or events to mean ‘included in the design basis’; as, for example, in design basis accident, design basis external events and design basis earthquake.”

The definition in the Safety Glossary should have been modified when SSR-2/1 (2011) was developed as the definition, which was consistent with NS-R-1, is not any more appropriate.

The workgroup view is that the definition of “design basis” in the Safety Glossary should be updated whenever possible. The definition of “plant design envelope” should also be introduced whenever possible.

The work group suggests that, from now on, “design basis” is systematically linked to the design basis of a structure, system or component (“design basis of a SSC”).

9. **Use of non-permanent equipment for DEC**

Section 10 of the draft TECDOC addresses the use of non-permanent equipment for accident management to elaborate on requirements 6.28b, 6.45a and 6.68 of SSR-2/1. The draft TECDOC states that: “The design should be such that all conditions considered in the design are taken care by safety systems and safety features installed at the unit. There should not be any need for additional equipment to comply with the acceptance criteria established for each plant state.

Non-permanent equipment may be considered as complementary ‘essential means’ to facilitate accident management.”

In addition, the draft TECDOC adds: “According to the safety approach of the IAEA, the non-permanent equipment should be considered as robustness provisions to cope with conditions exceeding those considered for the design.”

During review of updated SSR-2/1, there was debate on how to find a balance between the plant ability to cope by itself on DEC and the possibility for a plant to benefit from off-site support. The consensus was to add requirement on connection points.

The workgroup view is that, for new plants, safety features for DEC should be implemented by permanent equipment as far as practicable.

However, connection points to accommodate non-permanent equipment are required by SSR-2/1, this implies that non-permanent equipment can’t be a priori ruled out. For the workgroup, non-permanent equipment should only be considered as additional equipment that may be valuable in unexpected circumstances (i.e. circumstances not considered in DEC assessment).

10. **Conclusion**

NUSSC chair thanks all the people who attended this meeting.
A way forward was found on all the issues on the agenda.
- IAEA indicates that the draft TECDOC will be updated according to the work group conclusion. IAEA current intent is to finalize the TECDOC and to present it the next NUSSC meeting.