PANEL DISCUSSION AND RECOMMENDATIONS

Panel Members:

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Points suggested for the discussion:

a) Sources of uncertainties in Level 2 PSA
b) Methods to quantify uncertainties
c) International guidance on uncertainty treatment
d) Current practice in Level 2 PSA: qualitative vs. quantitative, how to present results
e) Practical issues confronting PSA analysts
f) Future development and challenges, e.g. SAM, new plant licensing, risk-informed applications etc.

Key points raised in the discussion:

(i) Role of uncertainty analysis

1. Full-scope PSA is desirable in order to understand the impact of uncertainty and to suitably address it. Documents have been developed (e.g. at the USNRC) on what is meant with appropriate quality in PSA. Treatment of uncertainties is a major element of PSA quality.
2. The focus should be on uncertainties that impact the decision-making. A scoping exercise to decide where further investigations should be directed would be very useful. There is a need to formalise treatment of uncertainties in the context of decision making in order to increase consistency and transparency.
3. Understanding uncertainties is important for PSA and for defining the direction of future R&D. It can also be useful for plant improvements or for the design of new plants. For a good (PSA-based) assessment of the benefits, uncertainty is important.
4. Emergency planning can benefit substantially from Level 2 PSA and related uncertainties.
5. The credibility of PSA resides in robustness of methods and in code prediction credibility. Code prediction also depends on user, i.e. on parameter input and/or model selection. In this context (as for experts judgment), the issue of human reliability comes into the picture.

(ii) Sources and nature of uncertainties

6. An uncertainty has both aleatory and epistemic components and a clear separation between them and their relative contribution is difficult to make. With an epistemic component additional information could be obtained (e.g. experiments, observations etc) and this uncertainty can be reduced with new knowledge and its influence can be reduced accordingly. With an aleatory component, there may be a need to modify the design (including procedures) , if it is shown to be significant. They are both important and can influence the quality of PSA and the decision making process.

7. Important epistemic (state-of-knowledge) uncertainties should be identified. This can be helpful for devising new joint international research projects. Common understanding of R&D needs is a priority.

(iii) Severe accident code analysis

8. Parameter sensitivity analyses of code predictions are useful to understand uncertainty propagation. However, one should be cautious about interpretations of the scatter of predictions, as scatter may not correctly represent uncertainty.

9. SA code analysis is a significant part of a Level 2 PSA. For their correct use, it is necessary to have an appreciation of the qualification limits these codes have – and where code limitations are relevant for overall PSA.

(iv) Expert judgement/opinion

10. Experts' opinion is useful, for example, for eliminating phenomena when they are not relevant. This, however, may be plant-specific.

11. Expert judgement is needed, but transparency is essential in this context. Right issue decomposition and sound overall experience are needed in order to ask the right questions. ROAMM are becoming more widely used: also in this context, problem decomposition is important.

12. Expert judgment is a point that requires attention. As an example, steam explosion depends on expert judgment, but this may not be strongly based. There is a concern on the burden posed on experts. A benefit of uncertainty analysis is to reduce the burden on experts.

13. There is a need to precise what expert judgment is, when it comes into essence, the basis for judgment etc. A prescription on how expert judgment should be used and how limitations are accounted for does not exist today.

(v) Future development

14. One should aim to achieve consensus on uncertainty methods. Since all sources of uncertainty are link together, consideration must be given to the Level 1 – Level 2 PSA interface.

15. Level 2 PSA is common practice now, some general guidelines on how it should be carried out have been put forward, e.g. in Germany. However, a generally agreed and well-established prescription for how it should be performed and in particular on how uncertainty is accounted for, is lacking. In reality, there are appreciable differences on how Level-2 PSA's are carried out.

16. For the future, efforts should be put on trying to harmonise the way Level-2 PSA is to be carried out, or at least to identify the most important items to be addressed. A suitable approach may include the following points:
    a) Compile and review what has been done so far and based on this
    b) Extract what can be considered good practice
    c) Agree on common areas where further activity needs to be performed

17. There is not a single method suitable for every situation and assessment. Increased international co-operation on methods and guidance regarding uncertainty analysis would be desirable, where guidance should incorporate a certain amount of flexibility. However, full harmonisation on methods may not be necessary as there can be merits on some degree of differentiation.

18. Should one conduct benchmark of PSA teams? A grouping of NPPs and a comparative exercise for similar (existing) NPP could be considered.

Recommendations:

I. Update the OECD Report on "Level 2 PSA Methodology and Severe Accident Management" [NEA/CSNI/R(97)11], i.e. a chapter on uncertainty and parts where uncertainty is relevant, to include:
   - Proceedings from this workshop
   - Benefit of uncertainty analysis for e.g. improving PSA quality, risk evaluation

II. Development of a guidance document or handbook to reflect good practices on treatment of Level 2 PSA uncertainties. Examples of issues to be dealt with can be:
   - Benefit of uncertainty analysis
   - Choice of issues to be considered in the uncertainty analysis
   - Characterisation of uncertainty
   - Information update from R&D programs

III. Guidance on expert judgment process – from expert consultation to formal elicitation, with emphasis on rationale documentation

IV. Development of plant specific importance measures and ranking for phenomenological issues in Level 2 PSA for decision making (e.g., research prioritisation, regulatory and utility applications). To include the impact of uncertainty on the use of results.

V. Other issues:
   - L1/L2 PSA interface
   - Shutdown fault uncertainty
   - Comparison studies

VI. Consideration should be given to conducting an international benchmarking exercise, comparing outcome from different teams on Level 2 PSA for similar (existing) NPPs, with emphasis on uncertainty treatment

Summary of discussion

From the discussion, there is good agreement that Level 2 PSA is now a commonly used key tool for many NPP applications and the uncertainty analysis forms an integral part of it. Uncertainty analysis is used to confirm robustness of results with respect to any acceptance criteria and therefore serves to underpin the quality of a Level 2 PSA. Increasing demand for in-depth treatment in current and future applications include for example:

- SAM (e.g. IVR strategy for high power reactors)
- Risk-informed decision making
- New reactor licensing

It is also clear that there are different views, emphasis and priorities on a number of issues reflected by the key points raised during the discussion (see summary above). From the discussion, a number of recommendations were made, including the development of guidance documents, as a way forward.