

Summary of the 11th Technical Advisory Committee (TAC) Meeting

Date:	May 20 – 23, 2019
Place:	Nuclear Risk Research Center (NRRC), Central Research Institute of Electric Power Industry
Participants:	
TAC:	Mr. Stetkar (Chair), Mr. Afzali, Dr. Chokshi, Mr. Miraucourt, Prof. Takada, Prof. Yamaguchi
NRRC:	Dr. Apostolakis (Head), Experts of the Nuclear Risk Research Center
Industry:	Experts of TEPCO Holdings, Shikoku EPCO for respective topics

Proceedings

All the topics were discussed in full session. In addition, an open discussion session took place on research for “Low power shutdown PRA and SFP PRA” as well as “RIDM Phase 2 action plan”.

May 20 (Mon.)

Topic 1: Overview of NRRC’s Activities

- NRRC presented “Overview of NRRC’s activities”.
- TAC members commented as follows:
 - In the next TAC meeting, the R&D status of Multi-Unit PRA (MUPRA) should be included. In addition, for MUPRA, not only Level 1 PRA, but Level 2 PRA should be included.
 - As for seismic PRA, a very important point is how the current regulations would be changed to rational ones.
 - As for the completed R&D items, the outcome and how to utilize the research should be included in overview papers.
 - Two areas for possible consideration as future R&D items are dynamic PRA and guidance for the evaluation of human errors of commission.

Topic 2: Utilization of fire PRA and history of fire protection regulation, and Current status of Fire PRA draft guide

- NRRC presented “Utilization of fire PRA and history of fire protection regulation, and current status of Fire PRA draft guide”.
- TAC members commented as follows:
 - As a Fire PRA (FPRA) is an effective tool to demonstrate the safety of a nuclear power plant in a quantitative manner, the FPRA should have a sufficient level to identify vulnerabilities of the fire protection measures. If NRRC can provide

a good technical basis for the FPRA, the PRA should be feasible in Japan to get key risk insights.

- In the U.S., when a new requirement is enforced, a back-fit analysis is conducted including costs and benefits based on the FPRA. So, it is a good strategy to inform the Japanese utilities about the usefulness and necessity of the FPRA for relaxation of back-fit issues and to support more rational potential future enforcement of the fire protection requirements.
- TAC would like to know if NRRC needs a formal review of the FPRA Guide.

May 21 (Tue.)

Topic 3: Development of technical foundation for good Level 2 and Level 3 PRA

- NRRC presented “Development of technical foundation for good level 2 and level 3 PRA”.
- TAC members commented as follows:
 - In the last TAC meeting, we specifically requested that the technical basis for the Phenomenological Relationship Diagram (PRD) method should be explained during this meeting. It was not. We ask you for the explanation again.
 - For the source term uncertainty analysis method, be sure to fully understand the Sequoia case studies conducted by NRC's State-of-the-Art Reactor Consequence Analysis (SOARCA) project.
 - The uncertainty of the parameters is not only that which can be obtained as a smooth curve. When you determine the distribution of uncertainty in a physical parameter, the opinion of experts in the field should be reflected.
 - It should be noted that the specific parameters selected in the Level 3 PRA WinMACCS uncertainty analysis may vary from site to site.

Topic 4: PRA Pilot Projects (Ikata Unit 3)

- NRRC presented Updated Ikata Unit 3 PRA Pilot Project Status.
- TAC members commented as follows:
 - Systems Analysis (SY), Data Analysis (DA), and Quantification (QU) should be in the scope of the 5th Ikata review, because these elements have important points which are unique to the shutdown PRA model.
 - In human reliability analysis (HRA), qualitative analysis for human failure events (HFEs) is extremely important before quantification with the HRA Calculator, so it is necessary to properly perform that according to the latest method based on the HRA guide.
 - It is necessary for utility engineers and staff to maintain, modify and utilize PRA models in-house as soon as possible.

- A PRA model should be able to evaluate not only internal events but also flooding, fire, seismic, tsunami, etc. with a single model or models which are consistent to each other.
- The Ikata project team should make it clear that the current expert reviews are not a formal peer review when asked by NRA.
- Integrated thermal-hydraulic and neutronic analyses are important for the risk of re-criticality in the core during zero-flow in the RCS, refueling, etc.

Topic 5: PRA Pilot Projects (KK Unit 7)

- NRRC presented “PRA Pilot KK7 Projects- Progress Report”.
- TAC members commented as follows:
 - What is the difference between the "As-is" model and others?
 - The equipment configuration is fixed, but the modification work is still on going and the detail has not been finalized. "As-is" model will be developed based on fixed information (as-built, as-operated). (TEPCO)
 - When you have the peer review conducted, what will the peer review team use as the basis of the PRA standard?
 - We are going to be reviewed by international experts, so we will have the peer review based on ASME/ANS PRA standard perspective. (TEPCO)
 - Is seismic PRA included in the SAR?
 - Seismic and tsunami PRA will be included in the SAR. (TEPCO)

May 22 (Wed.)

Topic 6: Fragility development of equipment based on seismic experience data

- NRRC presented “Fragility development of equipment based on seismic experience data”.
- TAC members commented as follows:
 - Floor responses of buildings are required in fragility estimation. Response analyses of the buildings are needed to overcome a shortage of earthquake motion records.
 - It is desired that the outline of the EPRI fragility estimation method be shared with TAC members.
 - Systematic estimation of seismic experience data is good activity. There is an apprehension that formal inspection reports of utilities do not include every case of equipment damage. Additional survey of equipment damage is desired.
 - Failure modes of electrical components should not be considered only as the loss of support function, but the loss of active function (electrical function) also. Further organization of a way of thinking about failure modes of equipment is

desired. Required functions of the same type of equipment might be different at different plants. Even if the same physical damage occurs to two electrical components, it is possible that the damage may produce different judgments about functional failure from a PRA viewpoint (e.g., effects from open circuits, spurious signals, etc.). Careful attention must be paid for descriptions and examples of failure conditions.

- Failure distribution among plants is very important. If equipment failures are concentrated in a specific plant, it is required to take the specific condition of the plant into account. Bayesian methods can be used to account for plant-to-plant variability in the experience data.
- Installed numbers and locations of equipment should be efficiently collected in cooperation with the plant-specific data collection project and the fire PRA project of NRRC.
- Loss of offside power (LOOP) must be evaluated in consideration of various elements. Current experience data seems to be insufficient for entire evaluation of LOOP.

Topic 7: Progress of Tsunami PRA project

- NRRC presented “Progress of tsunami PRA project”.
- TAC members commented as follows:
 - Current status of Tsunami PRA (Hamaoka-4) should include the utilization of the outcome and the degree of uncertainties of Tsunami PRA.
 - To keep in mind when showing quantitative results of the tsunami PRA for Hamaoka-4, those results may be misinterpreted as a general recommendation of NRRC regarding the concept of model development and screening criteria, etc. It should be emphasized that the screening analyses and results apply only to Hamaoka, and different site-specific models may be needed for other sites.
 - The screening analyses should account for the tsunami effects on the Level 2 PRA, in addition to the Level 1 PRA.
 - In the explanation of the overview model, it is better to clarify and justify what you are evaluating, rather than emphasize the screening process. The explanation should emphasize the viewpoint of using the PRA to find and examine site-specific issues in the plant design and operation, not only as a tool to screen out items.

Topic 8: HRA application method in Hamaoka Tsunami PRA

- NRRC presented “HRA application method in Hamaoka Tsunami PRA and the effectiveness of HRA improvement in PRA results”.

- TAC members commented as follows:
 - In 2014, TAC suggested that THERP is not a correct way to assess human reliability. Cognitive performance should be assessed, and considerations of human characteristics are important to define and evaluate PRA scenarios. The 2017 NRRC HRA guide was developed to reflect those concepts. However, the 2018 HRA guide has removed most of them.
 - TAC asks NRRC to re-examine the 2018 HRA guide. Individual TAC members have comments on the 2018 HRA guide. NRRC should consider those comments, and, in the next TAC meeting, we should discuss them.

May 23 (Thur.)

Topic 9: Trial of risk information utilization exercise

- NRRC presented “Trial of risk information utilization exercise”.
- TAC members commented as follows:
 - During the course program, when explaining a case, it should be shown again many times where it corresponds to the Figure A.1 (Three-ball diagram) in the Strategic plan.
 - RIDM templates help to identify issues in implementing RIDM. The important thing is that they not checklists. It should be clearly explained in the course that the RIDM process has not been completed until all the template items have been covered.
 - Among the pre-tasks are the reading of white papers and the review of US cases, but also the RIDM strategic plans should be included.
 - Treatment of uncertainty and expert evaluation are key factors in decision-making. It should be emphasized and demonstrated in the course that they cannot always be determined quantitatively.

Topic 10: Exit Meeting

As the result of discussion by the TAC members, they decided not to create a TAC report on any specific research topics at this time.

TAC and NRRC had a discussion on how to organize future meetings.