PSA Update Procedures, an Ultimate Need for Living PSA

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SUMMARY

Nuclear facilities by their complex nature, change with time. These changes can be both physical (plant modification, etc.), operational (enhanced procedures, etc.) and organizational. In addition, there are also changes in our understanding of the plant, due to operational experience, data collection, technology enhancements, etc. Therefore, it is imperative that PSA model must be frequently up-dated or modified to reflect these changes.

Over the last ten years, there has been a remarkable growth of the use of Probabilistic Safety Assessments (PSAs). The most rapidly growing area of the PSA Applications is their use to support operational decision-making. Many of these applications are characterized by the potential for not only improving the safety level but also for providing guidance on the optimal use of resources and reducing regulatory burden.

To enable a wider use of the PSA model as a tool for safety activities it is essential to maintain the model in a controlled state. Moreover, to fulfill requirements for "Living PSA", the PSA model has to be constantly updated and/or monitored to reflect the current plant configuration. It should be noted that the PSA model should not only represent the plant design but should also represent the operational and emergency procedures. To keep the PSA model up-to-date several issues should be clearly defined including:

- **Responsibility should be divided among the PSA group,**
- **Procedures for implementing changes should be established, and**
- **QA requirements/program should be established to assure documentation and reporting.**

1. Introduction

To assure efficient performance and coordination within the PSA groups the Responsibilities should be clearly defined for each of the member of the PSA team. The Responsibilities are divided into three broad categories, including:

- **Safety Assessment Manager,**
- **Lead Safety Assessment Engineer, and**
- **Safety Assessment Engineer.**

The **"PSA Update Procedures"** should provide Guidance to the PSA group for reviewing and evaluation of the plant changes, and of related documents with respect to the impact on the existing PSA model. Guidance should provide step-by-step manual for keeping the PSA model up-to-date to reflect all plant design changes and possible changes in the operational and emergency procedures.

Furthermore, the **"PSA Update Procedures"** should include so-called **"Calculation Procedure"** which provides guidance for the performance, review, approval and control of calculations and analysis performed by the PSA team. This **Procedure** should be designated for frequent (day-to-day) use.

2. Responsibilities

The first task in establishing the **"PSA Update Procedure"** is to assure acceptance of the Procedures and Responsibilities by the PSA group. As the PSA group change with time in size and staff the pre-defined appropriate forms have to be filled and signed by the appropriate personnel.

The Responsibilities should be divided into following three broad categories:

2.1 Safety Assessment Manager

The responsibilities of the Safety Assessment Manager (SAM) include reviewing, approving and signing the following documents:

- The **"PSA Update Procedures"** and any revisions to them,
- The **"Post-refueling PSA Update Report"** which should be defined, described and established within **"PSA Update Procedures"**,
- The **"PSA Update Report"** which should be defined, described and established within **"PSA Update Procedures"**,
- The **"PSA Detailed Analysis Report"** which should be defined, described and established within **"PSA Updated Procedures"**,
- The **"PSA Change Report"** which should be defined, described and established within **"PSA Update Procedures"**, and
- Any Project contract initiated by Lead Safety Assessment Engineer (LSAE) with external Consulting organizations.

The responsibilities of the Safety Assessment Manager also include managing of the PSA group with respect to assures necessary resources (i.e., schedule and budget) for performance of the PSA group activities defined within Procedures.

2.2 Lead Safety Assessment Engineer

The Responsibilities of the Lead Safety Assessment Engineer (LSAE) include maintaining and updating of the **Procedures** to assure their technical accuracy and adequacy. The responsibilities of LSAE are as follows:

- LSAE performs initial screening and assigns review of the plant change documents,
- LSAE assigns and, if necessary, reviews the plant change evaluations which are related to the PSA model,
- LSAE assigns responsibilities for a calculation or analysis work which are needed to be performed,
- LSAE assigns responsibilities for a **"Post-refueling PSA Update Report"** which has to be issued following each refueling outage and which should be requested by the **Procedures**,
- LSAE assigns responsibilities for a **"PSA Update Report"** which has to be issued every four years (IAEA recommendation, time frame is optional) and which should be requested by the **Procedures**,
- LSAE assigns responsibilities for a **"PSA Change Report"** which has to be issued following every major change of the PSA model and which should be requested by the **Procedures**,
- LSAE assigns responsibilities for a **"PSA Detailed Analysis Report"** which has to be issued following every major analysis performed, as necessary,

- LSAE assigns responsibilities for all necessary changes (minor) of the PSA model that resulted from **"Calculation Procedures"**,
- LSAE assigns responsibilities for all necessary changes (major) of the PSA model that resulted from **"PSA Based Change Analysis"**, and
- In addition, it is LSAE's responsibility to initiate reviews and, if necessary, evaluations of the changes that may come from future sources for which pre-defined categories may be incomplete.

LSAE maintains files of the plant change document reviews and of the plant change evaluations. LSAE maintains files and documentation of all changes and implementations made to the PSA model.

Since that the PSA activities are usually worked on both at PSA group and at consulting organizations (contractors), it is LSAE's responsibility to initiate necessary Project contracts related to PSA. **It is Contractor's responsibility** to follow all **Procedures** and it is LSAE's responsibility to check and review procedural forms issued by Contractors.

2.3 Safety Assessment Engineer

The responsibilities of the Safety Assessment Engineer (SAE) include performance of the tasks assigned by the LSAE.

- The responsibilities of the SAE include reviewing the plant change documents and the evaluations of plant changes. In addition, the responsibilities of the SAE include filling and signing appropriate forms (which should be defined, described and established within **Procedures**) for each of the assigned tasks by the LSAE.
- The SAE performs evaluation of potential impact on the PSA model, results or conclusions. The responsibilities of the SAE include filling and signing appropriate forms (which should be defined, described and established within **Procedures**) for each of the evaluations assigned by the LSAE.
- The SAE performs calculations or analysis assigned by the LSAE. The responsibilities of the SAE include filling and signing appropriate forms (which should be defined, described and established within **Procedures**) for each of the calculations or the analysis assigned by the LSAE.
- The SAE performs development and issuing of the **"Post-refueling PSA Update Report"** which has to be assigned by LSAE.
- The SAE performs development and issuance of the **"PSA Update Report"** which has to be assigned by LSAE.
- The SAE performs development and issuance of the **"PSA Change Report"** which has to be assigned by LSAE.
- The SAE performs developing and issuance of the **"PSA Detailed Analysis Report"** which has to be assigned by LSAE.

3. Calculation Procedure

3.1 General Consideration

The use of this **Procedure** is intended to provide assurance that calculations and analyses are performed in a logical, consistent manner, so that a competent individual can review the work without recourse to the originator. The **Procedure** should address the extent and form of verifications and validations. **Verification** involves a check that the calculations are performed correctly; i.e., numerical accuracy. **Validation** involves a check that the model(s) accurately reflect the plant/system phenomena.

Specific calculations and/or analyses may be performed in accordance with the requirements of codes, standards, design criteria, specifications, instructions, procedures, etc. which differ from those defined

in the **Procedure**. In such cases, originators may use an alternate documentation format and should identify and reference the requirements and their sources.

3.2 Procedure

Calculations and analyses will be assigned and identified as follows:

- A Lead Safety Assessment Engineer should designate originators,
- The originator should establish and maintain a work file with which the calculation or analysis can be identified. All pertinent documents accumulated in the work file, as part of the work activity, should be included in the calculation documentation, and
- To assure ready reference and retrieval of work, the calculation or analysis should be assigned a title that will allow the work to be identified with the plant, project or request for which the work was initiated.

The format and content of a calculation or analysis should conform to the following requirements:

- The title page should contain the work activity title, the name of the applicable project and the calculation number. This page should also contain the signatures and dates indicating performance (or revision) and review of the work as required for the calculation by a Lead Safety Assessment Engineer.
- The Lead Safety Assessment Engineer who is responsible for assignment of the task should determine the need for, or level of review of the calculation or analysis. The level of review should be assessed based on complexity of the problem.
- Successive pages including attachments should contain the calculation number and page number.
- All numerical calculations and analysis should encompass the following:

    1. A problem description which includes the objective of the analysis or calculation.
    2. The intended method of solution.
    3. Any references (such as drawings, specifications or instructions) required to complete the activity.
    4. Analyses of more than two pages should contain an executive summary or abstract that briefly states a summary, conclusions and/or recommendations.
    5. Sources of equations and the unit of parameters should be identified, except where the equations and units are common engineering knowledge and are thus not taken from a specific reference.
    6. Any design inputs used in the calculation or analysis, including specific references and resources. Design input obtained orally or by other informal means should be promptly confirmed in writing in the work file.
    7. Assumptions used to perform the calculation and their sources should be clearly stated or referenced in enough detail to allow competent and independent review.
    8. The actual calculation or analysis. If a computer code is used, the originator should consider the appropriateness of the code, and input values to it for the intended use, and that the results obtained appear to be within the bounds of expected values. Data extracted from computer codes should be identified and reference should be made to the computer code used.
    9. A summary of the results or conclusions. The originator should be responsible for stating that the objective of the analysis or calculation is achieved.
    10. Appropriate "Review form" is required.

Calculations or analysis should be, if required, reviewed according to the following instructions:

- A Lead Safety Assessment Engineer should designate reviewers.
- The depth and method of review should be determined by the reviewer in accordance with the level of review designated, considering the complexity, degree of standardization, state-of-the-art,

and similarity to previous work. When alternate calculation are performed, the appropriateness or assumptions, input data, code or other calculation method used in the original calculation should be addressed.

- All reviews should be documented as follows:

  1. If a second party review is performed in accordance with above, and the reviewer's comments are readily resolved with the originator, the reviewer should document his/her review by signing and dating the appropriate "Cover form".
  2. If extensive or major comments are involved, or if a method other than second party review is involved, the results of the review and the method used should be documented on appropriate separate form. After resolution of comments, the reviewer should sign and date the appropriate "Cover form".

- When multiple reviewers are involved, the reviewers of each part should be clearly identified.
- If, after consultation with the originator, a reviewer determines that the appropriateness of a calculation or an analysis is in question and that resolution can not be reached with the originator, he/she should issue a memorandum to the Lead Safety Assessment Engineer explaining his/her objections. The issued memorandum should be included in the work activity file.
- The originator should incorporate or resolve all comments by reviewers. In the case when resolution is not possible, the Lead Safety Assessment Engineer should provide resolution. Resolution should be documented on the appropriate "Review form" and signed by the involved individuals.
- If a calculation or analysis has already had a design analysis review performed, check or review is not required, but may be performed on an "as-needed" basis.
- Upon completion of the review process, including final approval, the calculation or analysis should be returned to the LSAE who should file it.

After completion of a calculation or analysis and its review process, the LSAE who assigned the task should sign the approval on the appropriate "Cover page" acknowledging the completion of the work and its review as designated.

Calculations or analysis that have been completed and have been filed may be revised or supplemented, provided the revisions are reviewed and approved in accordance with **Procedure**.

Deficiencies with **Procedure** should be reported by memorandum to the Safety Assessment Manager for determination and implementation of corrective action.

4. Procedure for PSA Based Change Analysis

The **"Procedure for PSA Based Change Analysis"** should provide Guidance to the PSA group for evaluation and implementation of the plant modifications and of related documents with respect to the potential impact on the existing PSA model. This **Procedure** should be designated for consideration and/or implementation of the major changes to the PSA model. The major changes to the PSA model may be the following:

- **Implementation of plant design modification,**
- **Consideration of additional initiators or hazards (internal or external), and**
- **Consideration of other plant operational modes (e.g., Shutdown and Low Power PSA, Mid-loop operation, etc.).**

Documents describing major plant changes should be reviewed for impacts on PSA model, documents and results. Any impact should be evaluated, as required, to determine the nature and extend of impact. Any formal updating of the PSA model should be included on the appropriate form. All

evaluations and quantification should be documented and all documentation should be filed and maintained.

A **"PSA Change Report"** should be issued for every major change to the PSA model to summarize all important changes to the PSA model, results and conclusions.

5. Discussion

Probabilistic evaluations should be undertaken for any significant plant changes or any significant considerations of additional initiators or any significant considerations of other plant operational modes. The evaluations should be documented using appropriate form, and should include: a Statement of Problem or Proposed Plant Change, Summary of Safety Review, Impact on PSA model, results and conclusions and Conclusions and Recommendations.

Detailed reports and/or analyses, which may be required as a part of the detailed analysis/evaluation process, should be prepared as either a memo/report (there is no need for additional forms) or a calculation (appropriate form), as appropriate, according to the length and impact of the analysis.

The Evaluations should address effects on frequency of accident sequences or equipment malfunctions, as well as consequences from accidents or malfunctions. Uncertainty in the analysis should be addressed by quantitative uncertainty analysis as warranted by the impact of the change.

The analysis should also describe modeling and simplifying assumptions, and limitations in the model that affect the evaluations (e.g., systems or components not modeled, conservative assumptions, etc.).

6. Conclusions and Recommendations

The analysis should include conclusions with regard to comments on plant change documentation, plant safety and system or plant reliability. The analysis should also include the bases for the conclusions. The recommendations may include additional plant modifications, enhanced surveillance or maintenance, or additional, more detailed analyses to be performed at a later date. Where the conclusions and recommendations are based primarily on "engineering judgment", sufficient supporting information should be included to confirm the judgment.

7. REFERENCES AND OTHER SOURCES

7.1 References

1. "An Approach to the Assurance of Technical Adequacy in Probabilistic Risk Assessment of Light Water Reactors", EPRI, 1983.
2. "Requirements and Applications of Living PSA", IAEA TECDOC (working material), 1996.
3. "Safety Assessment Group Procedure 1-14", Yankee Nuclear Services Division, 1996.

7.2 Other Sources

Information from the following sources has also been used in the preparation of this document:

1. On Westinghouse practice and experience: private communications between Mr. D. Hegeduš and Mr. M. Sladović.
2. On US practice and experience: private communications between Mr. D. Hegeduš and Mr. B. Lydell.