United States Nuclear Regulatory Commission

Standardized Plant Analysis Risk (SPAR) Model

Quality Assurance Plan

Revision 1

June 19, 2013

Probabilistic Risk Assessment Branch
Division of Risk Analysis
Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Revision History

Revision 0: Original Document, September 15, 2006, ML070640360

Revision 1: June 1, 2013

- Added Revision History
- Added Table of Contents
- Background, revised to bring up to date.
- Added section on Relationship of the SPAR QA Plan to the Risk Assessment of Operational Events Handbook (RASP) Handbooks, and
  - references commitments related to OIG-06-A-24, *"Evaluation of the NRC's Use of Probabilistic Risk Assessment in Regulating the Commercial Nuclear Power Industry"*
- Added section on SPAR model ASME/ANS, "Standard for Probabilistic Risk Assessment for Nuclear Power Plant Applications, Peer Review"
- Moved References towards end of document, changed the name to General References and revised to bring up to date.
- Responsibilities and Authorities, revised to align with current RES organizational structure.
- Added section on Model Users
- Defined: SPAR Model of Record, Test/Limited Use Model, Temporary Model Changes
- Added Figure 2: SPAR Model Feedback, Error Tracking, and Model Change Process
- Added Attachment 1: SPAR Model Project Manager Review Checklist

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STANDARDIZED PLANT ANALYSIS RISK (SPAR) MODEL QUALITY ASSURANCE PLAN

1. PURPOSE

The purpose of the SPAR Model Quality Assurance (QA) Plan is to describe the policies, assign responsibilities and authorities, and provide the specific instructions for the performance and assessment of the SPAR model development quality related activities. The main objective of the SPAR QA Plan is to ensure that the NRC's independent SPAR models represent the as-built, as-operated nuclear plant to the extent practical.

2. BACKGROUND

The U.S. Nuclear Regulatory Commission (NRC) established the SPAR model program to support NRC reviews and independent evaluations of risk-related issues. SPAR models are the risk analysis tools used by staff analysts in many regulatory activities, including the Accident Sequence Precursor (ASP) Program and Phase 3 of the Significance Determination Process (SDP). The SPAR models have evolved from two sets of simplified event trees that were used initially to perform precursor analyses in the early 1980s to the more comprehensive Level 1[1], internal events full power operation Probabilistic Risk Assessment (PRA) currently in use. Further enhancements of the SPAR models to add additional hazard categories and scope additions are being undertaken in response to various user needs.

The Level 1 SPAR models consist of a standardized, plant-specific set of risk models that use the event tree/fault tree linking methodology. They employ an NRC-developed standard approach for event tree development, as well as standard approach for input data for initiating event frequencies, equipment performance and human performance. These input data can be modified to be more plant- and event-specific when needed. The system fault trees contained in the SPAR models are generally not as detailed as those contained in licensees' probabilistic risk assessments (PRAs), though there are some areas where SPAR models are more advanced (e.g., support system initiating events, electrical power recovery modeling). The current set of SPAR models was benchmarked against licensee PRAs during onsite reviews of the SDP risk-informed inspection notebooks in 2005[2]. The results of the benchmarking indicate that, in general, the difference observed between the SPAR model and the plant PRA is not very significant from an overall risk standpoint. For example, about 80% of the SPAR model core damage frequencies (CDFs) are presently within a factor of 2 of licensees' internal events model CDFs. Most of the differences are well understood and are due to the use of plant specific versus industry-averaged performance data. In some cases, a few key modeling assumptions account for large differences between licensee PRA and SPAR model results.

In 2009, peer reviews of one Boiling Water Reactor (BWR) and one Pressurized Water Reactor (PWR) SPAR Model were performed in accordance with the ASME PRA

1 A Level 1 PRA models system and operator responses to various initiating events that challenge plant operation to identify sequences (combinations of system and operator action successes and failures) that result in either the achievement of a safe state or the onset of core damage. The estimated frequencies of those sequences that result in the onset of reactor core damage are summed to calculate the total core damage frequency (CDF) for the analyzed plant.

2 Handling and Protecting of Significance Determination Process Notebooks as Sensitive Unclassified Documents - ML053270273

Standard, along with the NRC clarifications provided in Regulatory Guide 1.200.
The industry, specifically the PWR and BWR Owners Groups, and the Senior Reactor Analysts from the Regions provided much needed support for this endeavor. As a result, RES believes that the SPAR models were subjected to an independent peer review consistent with industry peer reviews conducted in accordance with the ASME PRA Standard. As stated in the reports, *"A single overall Capability Category associated with the PRA Peer Review process is not the focus or intent of the process. The primary benefit of the peer review process is in the identification of recommendations in which the PRA can be improved as may be needed to support future applications."* The peer review teams concluded that; *"Within the constraints on Idaho National Laboratory regarding access to data and resources, the SPAR models are found to be an appropriate tool to provide a check on the utility PRA and to prompt questions on the utility maintained and peer reviewed PRA*." Therefore, RES concluded that SPAR models are an efficient tool for obtaining qualitative and quantitative insights for Significance Determination Process evaluations, inspections, event assessments and other agency risk informed applications[3].

The SPAR models include uncertainty analysis capability through the propagation of uncertainties at the equipment and human performance levels. The SPAR models use results from NRC-sponsored studies (e.g., see http://nrcoe.inl.gov/resultsdb/) to provide an independent check of input parameters used in a licensee's PRA. These studies include system and component reliability studies, initiating event studies, and a human reliability analysis method.

In addition, the NRC is developing modules for external events during power operation including internal flooding, fire, seismic, and other events. Modules are also under development for low power and shutdown operation, as well as for the assessment of large, early release frequency (LERF). These modules are planned to be integrated into the at-power internal events SPAR models in the near future.

2.1 Relationship of the SPAR QA Plan to the Risk Assessment of Operational Events Handbooks (RASP Handbooks)

In 2006, the NRC Office of the Inspector General conducted an evaluation of the NRC's use of PRA models to assess, in part, if the agency followed prevailing good practices for PRA methods and data. The results of this evaluation were documented in Evaluation Report OIG-A-24, "Evaluation of the NRC's Use of Probabilistic Risk Assessment in Regulating the Commercial Nuclear Power Industry*".* This report included three recommendations:

1. Develop and implement a formal, written process for maintaining PRA models that are sufficiently representative of the as-built, as-operated plant to support model uses;
2. Develop and implement a fully documented process to conduct and maintain configuration control of PRA software (i.e., SAPHIRE, GEM); and
3. Conduct a full verification and validation of SAPHIRE version 7.2 and GEM.

In response to Recommendation 1, the staff performed the following actions:

- Issued Revision 0 to the SPAR QA Plan (ML063070084); and
- Revised the Risk Assessment Standardization Project (RASP) Handbook.

The SPAR Model QA plan provides reasonable assurance that the SPAR models used by NRC risk analysts and senior reactor analysts (SRAs) represent the as-built, as-operated plants to the extent intended within

3 Status of Standardized Plant Analysis Risk (SPAR) Model American Society of Mechanical Engineers (ASME)/Regulatory Guide 1.200 Peer Review - ML100770568

the scope of the SPAR models. The RASP Handbooks implement a formal, written process for maintaining SPAR models that are sufficiently representative of the as-built, as-operated plant to support model uses. The RASP Handbook includes four volumes, designed to address Internal Events (Volume 1), External Events (Volume 2), SPAR Model Reviews (Volume 3) and Shutdown Events (Volume 4). Volumes 1 and 2 update the staff guidance on the use of the SPAR models. Volume 3 provides analysts and SPAR model developers with additional guidance to ensure that the SPAR models used in the risk analysis of operational events represent the as-built, as-operated plant to the extent needed to support the analyses.

Collectively, the SPAR QA Plan and the RASP Handbooks are the staff's response to Recommendation 1 of the OIG report.

Recommendations 2 and 3 in OIG-A-24 were addressed by issuance of a SAPHIRE QA program compliant with NUREG/BR-0167, "Software Quality Assurance Program and Guidelines" (INL Reports PDD-13610, "Software Quality Assurance Program," and LWP-13620, "Software Quality Assurance") and release of SAPHIRE Version 8, which included an independent verification and validation.

3. GENERAL APPROACH

The NRC has developed processes for ensuring that SPAR models are used in a manner that ensures regulatory are based on modeling assumptions that reflect the as-built, as-operated plant. These processes include the following key elements:

- RASP Handbook – The RASP Handbook provides instructions for the staff on how to apply appropriate procedures and methods for risk assessment of inspection findings and reactor incidents.
- Internal Reviews – Both ASP and SDP evaluations have procedures that require a thorough, structured review by a second qualified reviewer. Additionally, it is the policy of the Office of Nuclear Regulatory Research (RES) to encourage formal, objective peer reviews of its research products consistent with the nature, importance, and timeliness of the information to be disseminated (MD 3.17). Peer review fosters confidence in the research products and helps maintain high standards of competence in research programs. It is expected that peer reviews will provide critical assessments regarding those research products, will help in judging the technical adequacy of the results for the proposed solutions, and can aid in bringing the widest and best knowledge available to bear on the quality of the research products. The results of peer reviews of RES research should be made visible whenever possible through discussions in professional meetings.
- Licensee Reviews – When appropriate, the staff interacts with licensees to identify and resolve issues associated with SPAR modeling assumptions. Significant ASP analyses are transmitted to licensees to ensure that the evaluation appropriately reflects the design and operation of the plant. Similarly, the licensee perspective is requested for SDP evaluations that result in a greater than green risk characterization.
- Use of Qualified Analysts – The Senior Reactor Analyst (SRA) qualification program requires candidate SRAs to have an acceptable level of knowledge and experience in PRA technology and SDP methodology before becoming certified (e.g., see Inspection Manual Chapter 1245, Appendix C-9). Other agency risk analysts and contractors are also required to possess the requisite skills and experience to perform assigned functions. To this end, it is also the policy of the NRC to plan, develop,

establish, implement, evaluate and fund training and development programs designed to improve the quality and performance of the workforce (MD 10.77). In particular, agency risk analysts are required to complete formal classroom and on-the-job-training before independently performing risk analyses.

4. DEFINITIONS

Configuration Control of Model - the process of identifying and controlling the SPAR model throughout its development and use. These include the identification and establishment of baseline models; the review, approval, and control of changes; the management of SPAR model release and delivery activities; and the control of important interface documents.

Peer Review - a form of deliberation involving an exchange of judgments about the appropriateness of methods and the strength of the author's conclusion. Peer review occurs when a draft product is reviewed for quality by expert(s) who was not involved in producing the draft.

Internal Peer Review - a peer review within the primary organization producing the product. External Peer Review - a peer review performed by expert(s) outside the primary organization producing the product.

Validation - the process of determining that the requirements and final as-built model or software product fulfills its specific intended use.

Verification - the process of determining that the final as-built model or software product was developed correctly.

Limited Scope Peer Review - a peer review based on less extensive assessment of the accuracy and completeness of the final as-built model or software product than the norm.

Limited Scope Validation & Verification – a validation & verification of the final as-built model or software product using a much more restrictive set of data, information, or benchmarks for comparative purposes.

SPAR Model of Record - The SPAR model of record is the most current model. This model is the most accurate representation of the baseline as-built, as-operated plant and has been subjected to the appropriate quality assurance reviews. These models can be obtained by staff via the SAPHIRE web site maintained by INL. These are the models that should be used by the analyst to perform an MD 8.3, SDP or ASP analysis.

Test/Limited Use SPAR Model - Test/Limited Use SPAR Models are models that have been modified for a specific risk analysis by INL at the request of an NRC risk analyst or at the direction of the NRC SPAR Model project manager (PM) and/or technical monitor. Although these models are available on the SAPHIRE web site maintained by INL, these test or limited use models should <u>not</u> be used by other analysts.

Temporary SPAR Model Changes - Temporary SPAR Model Changes are changes or corrections made to the SPAR model by the risk analyst. These changes do not affect the current SPAR model of record. If the change was due to an error in the SPAR model, the risk analyst should request a correction to the SPAR model via the Request Model Change link on the SAPHIRE web site. Other changes that the risk analyst believes should be incorporated into the SPAR model of record should also be submitted via the Request Model Change link on the SAPHIRE web site. See Section 8.3 for additional discussion relative to temporary SPAR model changes.

5. RESPONSIBILITIES AND AUTHORITIES

5.1 Director/Deputy Director, Division of Risk Analysis (DRA) - Ensures that the SPAR Model Quality Assurance Plan is implemented consistent with agency policy.

5.2 Chief, Probabilistic Risk Assessment Branch - approves/disapproves the recommendations of the Project Managers with reference to the appropriate level of peer reviews. Establishes periodic review and revision schedule of the Plan.

5.3 PRAB Project Managers (PMs) and Technical Monitors (TMs) - responsible for determining the appropriate level of peer reviews and submitting recommendation to the Branch Chief based on the importance of the models and their applications.

5.4 Model Users – model users generally include Senior Reactor Analysts or other NRC or contractor staff that have shown proficiency in the use of SPAR models by way of experience and/or training. The model users are responsible for entering errors or improvements to a model using the SPAR Model Change, Design Review Database. Additionally, model users are responsible for ensuring that the model represents the as-built, as operated plant when performing an analysis and providing feedback to the model development process when errors or changes to the model are identified.

5.5 Model Developers – The model developers are responsible for developing an accurate model representing the as-built, as operated plant including the accurate documentation of the model to include any limitations. The model developers shall develop the models in accordance with section 6.1, 6.4, 6.6, 6.7, 6.8 and 6.9 of this QA Plan. The model developers shall track model errors that have the potential to measurably impact the risk profile or quantitative results until such time as the error is corrected or disposition as being insignificant. Final resolution of errors shall be documented.

6. INSTRUCTIONS

6.1 Model Development

The SPAR Model Quality Assurance process is shown in Figure 1. SPAR models should be developed consistent with generally accepted best practices for PRA. To the extent possible, the model developer should follow applicable ASME and ANS PRA standards. An ASME PRA Standard[4] Category I shall be the general objective of the SPAR models. However, because of the standardized nature of the SPAR model, it is recognized that not all elements of a Category I can be achieved. Major deviations from ASME PRA Category I shall be noted, either for individual models or collectively.

Each SPAR model should largely reflect actual plant design. Significant differences between plant design and the SPAR models shall be clearly denoted and tracked for potential future model updates.

Each SPAR model should reasonably reflect plant operating procedures. Abnormal, off-normal, and emergency operating procedures that are important to the development of the general risk profile should be reflected in the SPAR model. Significant differences shall be denoted.

System success criteria shall be clearly denoted. Where the success criteria in the SPAR model significantly differ from the licensee's PRA model, these differences shall be clearly denoted. Sensitivity studies should be performed to quantify the impact of major differences in success criteria.

4 ASME/ANS RA-Sa–2009 Addenda to ASME/ANS RA-S–2008 Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications, February 2, 2009

The SPAR model shall be developed using a standardized set of initiating event and basic event data. Exceptions are expected to be infrequent and shall be highlighted. Where the SPAR model data and licensee's PRA model data differ significantly, these will be denoted. Sensitivity studies may be performed to quantify the impact of major differences in data, either individually or collectively (see also Section 9.3).

The SPAR models shall be documented commensurate with the relative importance of each element of the model. Major assumptions shall be clearly denoted. The objective is that an experienced analyst not affiliated with the model development should be able to substantially reconstruct the risk profile and dominant sequences and cut sets with a reasonable amount of effort.

6.2 Training and Qualification of Model Developers and Users

SPAR model developers shall have substantial experience in PRA and risk assessment software tools including SAPHIRE. The general qualification of model developers and users may include one or more of the following:

- formal courses,
- self-paced learning,
- on-the-job training,
- mentoring and tutoring,
- equivalent experience.

The degree of oversight of the model development shall be commensurate with the level of experience of the developer.

6.3 Determination of Level of Peer Review

The NRC project manager (PM) and/or technical monitor for the SPAR model shall recommend the level of peer review and model validation & verification for each SPAR model, aspect of the model, or suite of models. The Chief of the Probabilistic Risk Assessment Branch shall have final approval of the recommended level of review. Internal events models will generally be subjected to a more intensive review consisting of internal peer review, external peer review, and validation & verification (V&V). External events models, low power/shutdown models, and LERF models will generally be subjected to limited scope reviews and limited scope V&V.

6.4 Internal Peer Review

The primary SPAR model contractor shall have an established Quality Assurance program for model development, review, and testing. Each element of the model including event trees, fault trees, basic event data, phenomenological model, and human reliability and recovery shall have the review and testing requirements specified. The internal peer review shall be documented and include, at a minimum, the following information:

- model name and completion date,
- preparer's name,
- reviewer's name(s),
- reviewer's comments and responses to comments.

The internal peer review should include a checklist or table that summarizes each important element for review.

6.5 External Peer Review

For SPAR models subjected to external peer review, the NRC project manager and/or technical monitor shall make a recommendation as to the level of review and the organization(s) to perform the review. This recommendation shall be subject to approval by the Chief of the Probabilistic Risk Assessment Branch.

6.5.1 By NRC PM and/or Staff

In general, the NRC PM, technical monitor, or designated staff shall perform an acceptance review of each model. The level of review should be commensurate with the degree of change of the model, the uniqueness of the model, and other considerations.

Elements of review should include one or more of the following:

- major model input changes including event trees, fault trees, success criteria, and/or data,
- overall risk profile including dominant sequences and important cut sets,
- relevant comparisons or benchmarks with sister plants, licensee PRAs, or other sources.

This review should be documented. An example of a checklist that satisfies these requirements is provided in Attachment 1.

6.5.2 Third Party Contractor

At the recommendation of the NRC PM and/or technical monitor, and subject to approval by the Chief of the Probabilistic Risk Assessment Branch, SPAR model review by an independent third party contractor may be performed. Such reviews may be undertaken for one or more of the following reasons:

- to obtain an additional level of expert judgment on the accuracy and completeness of the SPAR models,
- because of major changes in the methodology, modeling assumptions, success criteria, or technical issues necessitating an independent peer review,
- because of resource constraints on the part of NRC staff.

This review, if performed, shall be thoroughly documented. Response to comments by the primary contractor shall also be documented.

6.6 Validation & Verification

The purpose of the V&V is to ensure that the SPAR model is accurately reflecting the important risk contributors at the plant in question, and that the models have been developed correctly. V&V can be undertaken in several ways including:

- literature review, e.g., phenomenological models,
- testing against known cases with known outcomes,
- comparison with the SDP notebooks[5],
- onsite visits and benchmarking,
- comparison of results for a particular SPAR model with those of a sister plant or class of plants,
- a validation consisting of cut set by cut set and sequence by sequence comparisons with the licensee's PRA model.

To the extent possible, metrics should be used to provide quantitative measures of the degree of agreement between the SPAR model in question and other risk models of that plant.

6.7 Limited Scope Peer Review

As discussed above, the NRC PM and/or technical monitor may deem that it is more appropriate that the SPAR model or aspects of the model receive a limited scope peer review. A limited scope review may be chosen because the state-of-the-art is less advanced (e.g., shutdown) than for internal events at power, the phenomena are less certain (e.g., thermally induced steam generator tube rupture), or data are less available (e.g., high energy line break frequency).

The peer review(s) may be performed by the primary contractor and/or an NRC staff member. The review will in general be less thorough than for internal events at power, and may consist of • review of overall methodology and major assumptions

- review of a limited set of event trees and fault trees,
- spot checking of input data,
- review of reasonableness of results.

The extent of the review and the results of that review shall be documented.

6.8 Limited Scope Validation & Verification

For many of the reasons that a limited scope peer review is chosen, the NRC PM and/or

5 The SDP Notebooks have been phased out and have been replaced with Plant Information e-Books (PRIBs).

technical monitor may choose to perform a limited scope V&V. In many cases, there are limited, obsolete, or no industry models for comparisons against. NUREG reports, or PRAs for sister plants or classes of plants may be used for comparative purposes. In extreme cases, the analyst(s) may need to rely on expert judgment to assess the reasonableness of results. The V&V effort shall be documented.

6.9 Configuration Control of Models

The primary contractor shall have a Configuration Control Program (CMP) for the SPAR models. The CMP shall describe the process and controls in place for the development and use of the models. These include the identification and establishment of baseline models; the review, approval, and control of changes; the management of SPAR model release and delivery activities; and the control of important interface documents (e.g., most current RCP seal LOCA model).

At any given time, there shall be only one SPAR model of record for any plant, and this model shall have a model numbering scheme that clearly delineates this as the baseline model. This baseline model may contain only internal events at power, or may also include various external events, low power/shutdown conditions, and LERF modules. The baseline model will be posted on the appropriate web site or file server for download. Versions of the model that differ in assumption, logic, success criteria, or data shall have a unique identifier to distinguish it from the baseline model. Previous baseline models shall be documented and archived.

SPAR models that are changed for the purpose of sensitivity studies or regulatory analyses shall be given unique identifiers or file names separate from the baseline.

The primary contractor shall maintain a log of baseline models that are released to outside organizations (e.g., utilities, other contractors, national labs). Such log shall list the organization, contact, baseline model identifier, and date of release.

7. FEEDBACK FROM MODEL USERS

7.1 Creating Feedback Reports

The primary contractor shall maintain a log of corrections and potential model improvements as suggested by model users. The log shall designate how the suggestion was finally dispositioned (e.g., enacted, rejected).

7.2 Error Tracking, Reporting, and Resolution

The model users are responsible for entering errors or improvements to a model using the SPAR Model Change, Design Review database. The database can be accessed via the SAPHIRE web site by choosing the Request Model Change icon on the SAPHIRE Users Group homepage (https://saphire.inl.gov/). The SPAR Model Feedback, Error Tracking, and Model Change Process is shown in Figure 2.

SPAR model errors that have the potential to measurably impact the risk profile or quantitative results shall be tracked until such time as the error is corrected or disposition as being insignificant. SPAR model users shall be notified of significant model errors. Final resolution of errors shall be documented.

8. MODEL CHANGES

SPAR models changes are made for a variety of reasons. Changes made by a model user to realign the model to more accurately reflect the status of the plant while performing an analysis are not considered changes, while changes to the model that correct a logic error or to more accurately reflect the design and operation of the plant usually do result in a change to the model.

8.1 Model Updates

The ASME PRA Standard defines PRA maintenance as an update to reflect plant changes such as modifications, procedure changes, or plant performance (data). For SPAR, there are practical limits as to the capability to be in tune with evolving plant changes for over 100 plants and 79 models. (The NRC staff expects to evaluate options in the future by which licensees could possibly provide information voluntarily to assist in SPAR model updates.) At a minimum, the SPAR model documentation shall provide the approximate effective date of the plant design modeled in SPAR. Plant changes known to the developers or NRC staff that have the potential to impact the overall risk profile and that have not been incorporated into the SPAR model shall be logged and tracked for interim risk applications and future update (e.g., installation of a station blackout diesel generator).

8.2 Model Upgrades

The ASME PRA Standard defines an upgrade as the incorporation of a new methodology such as a new human error analysis method, new data update method, or new treatment of common cause failure that has not been peer reviewed. For SPAR, model upgrades shall receive internal and external peer reviews commensurate with the importance of the new model to the overall risk profile. Written approval from the NRC PM or technical monitor shall be required for major upgrades.

8.3 Temporary SPAR Model Changes

It is occasionally necessary that model changes be made to a SPAR model for the purposes of performing a specific risk assessment or risk analysis. The typical NRC SPAR model user is highly trained and experienced. SRA's, who perform most of the risk analysis using SPAR models, also complete a rigorous qualification program. Additionally, provisional changes made to a SPAR model accomplished to support an analysis or regulatory activity receive significant oversight and review through established regulatory processes. These reviews ensure that the models used in support of an analysis or regulatory activity ensures the models are sufficiently representative of the as-built, as-operated plant. However, these model changes have not been subjected to the SPAR Model Quality Review process; therefore the model user is responsible for ensuring that these temporary changes reflect the as-built, as-operated plant.

Therefore, only SPAR model changes that have been implemented under the SPAR Model Quality Review process and are included in the released SPAR model (i.e., the model of record) are considered formal SPAR model changes for the purposes of this document.

8.4 Criteria for Using Plant-Specific Performance Data *in lieu of* Industry Averaged Data

The standardized nature of the SPAR models necessarily implies a consistent set of initiating event frequencies, human error probabilities, and equipment failure rates. As noted in Section 6.1, sensitivity studies may be performed to assess the potential impact of data differences on overall results. On some occasions, it is expected that there may be unique engineering design or performance characteristics in which the licensee's data differ substantially from those in the SPAR model and which could have a significant impact on the risk profile.

Such occasion is expected to be infrequent. No re-base lining of the model shall be undertaken without the explicit approval of the NRC PM and/or technical monitor. Deviations from the standard data set shall be visibly documented within the model.

9. GENERAL REFERENCES

9.1. Management Directive 3.17, “NRC Information Quality Program”, Office of Information Services, Information and Records Services Division, USNRC, April 9, 2009.

9.2. Management Directive 10.77, “Employee Training and Development”, Office of Human Resources, USNRC, revised February 8, 2005.

9.3. Regulatory Guide 1.200, Revision 2, “An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities,” Office of Nuclear Regulatory Research, USNRC, March 2009.

9.4. American Society of Mechanical Engineers, ASME/ANS RA-S–2008, “Standard for Probabilistic Risk Assessment for Nuclear Power Plant Applications,” 2008, and Addenda, ASME/ANS RA-Sa–2009, February 2, 2009.

9.5. Institute of Electrical and Electronic Engineers, IEEE 730-2002 Standard for Software Quality Assurance Plans, IEEE 828-2012, Standard for Configuration Management in Systems and Software Engineering, and IEEE 1012-2012, Standard for System and Software Verification and Validation.

9.6. G20070143 - Supplementary Response to Recommendations in OIG-06-A-24, "Evaluation of the NRC's Use of Probabilistic Risk Assessment in Regulating the Commercial Nuclear Power Industry - ML070990040

9.7. OEDO-2008-0511 - Stephen D. Dingbaum Memo, re: Status of Recommendations: Evaluation of the NRC's Use of Probabilistic Risk Assessment in Regulating the Commercial Nuclear Power Industry (OIG-06-A-24), ML081910312

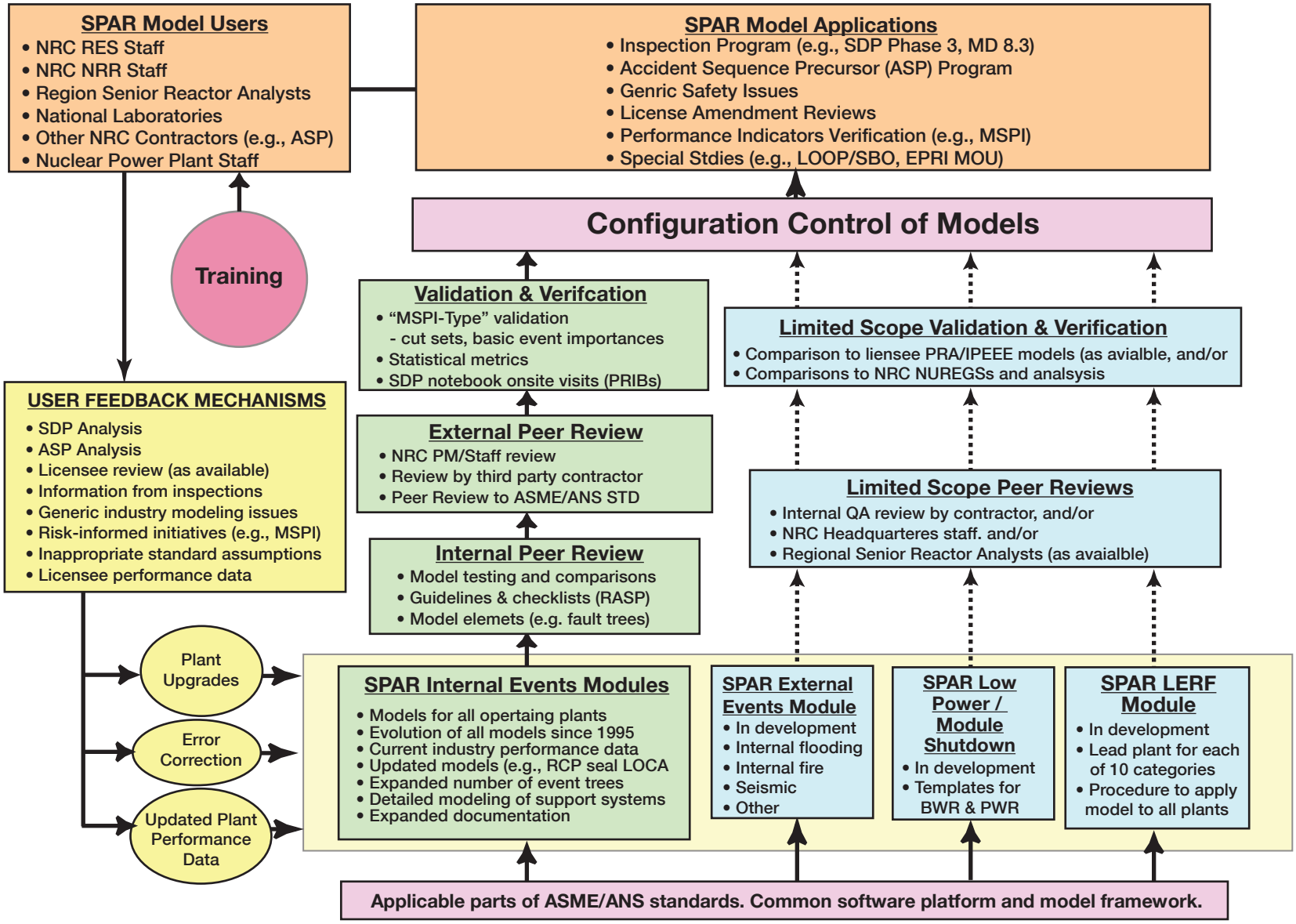

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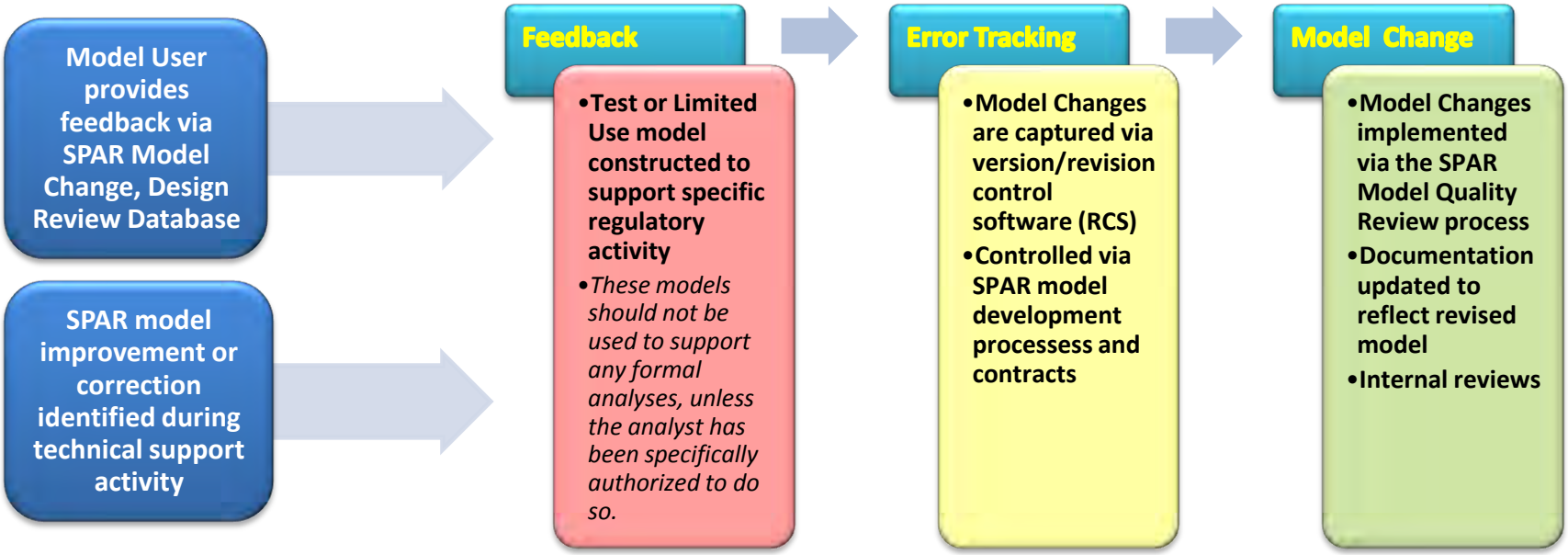
FIGURE 1. SPAR MODEL QA PROCESS

Revision 1

Figure 2: SPAR Model Feedback, Error Tracking, and Model Change Process



Attachment 1: SPAR Model Project Manager Review Checklist

SPAR Model Project Manager Review Checklist

PLANT NAME: _____

MODEL NAME: _____ **VERSION:** _____

1. **Documentation:**

   - ☐ Verify all documentation is included
   - ☐ Perform quality review of documentation (legibility, formats, etc.)
   - ☐ Reports reviewed IAW SPAR Model Program QA procedures
   - ☐ Review model changes
   - ☐ Review and Verify Excel Spreadsheets
   - ☐ Review Acceptance Criteria

   Documented Baseline CDF: _____

2. **Model**

   - ☐ Open model with correct version of SAPHIRE
     - ☐ Verify Usage Limitation screen is there and updated
     - ☐ Quantify Model and verify Baseline CDF: _____
     - ☐ Compare the Current versus Base Case

       OR Compare and verify

       - ☐ Top 50 cut sets, AND
       - ☐ Top 50 Birnbaum Measures

3. **Other PM Reviews Completed**

	Yes	No	NA
External Events	☐	☐	☐
Low Power / Shutdown	☐	☐	☐
Level 2 (LERF)	☐	☐	☐
Data	☐	☐	☐

SPAR Model Project Manager Review Checklist

PLANT NAME: _____

MODEL NAME: _____ **VERSION:** _____

4. Issues identified, corrections need, other concerns:

Project Manager: **Date:**