2018 Status of "Requirements for Low Power and Shutdown Probabilistic Risk Assessment", Low Power and Shutdown PRA Standard

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Abstract: The American Nuclear Society in cooperation with the American Society of Mechanical Engineers working through a Joint Committee on Nuclear Risk Management (JCNRM) has been developing for more than a decade a standard titled "Requirements for Low Power and Shutdown Probabilistic Risk Assessment", ANSI/ANS-58.22, hereafter referred to as the Low Power and Shutdown (LPSD) Standard. This LPSD Standard sets forth requirements for low power and shutdown probabilistic risk assessments (PRA) and also requirements for shutdown qualitative risk assessment (QLRA) that can be used to support risk-informed decisions for commercial nuclear power plants. This Standard also prescribes a method for applying these requirements for specific applications. The LPSD standard was approved for trial use in March of 2015. Its 3-year trial use period has now been extended to December of 2018. Comments from initial pilot studies have been received. These comments are now being responded to and the LPSD Standard adjusted accordingly. The plan is to have the revised LPSD standard completed and ready for a new ballot soon after the end of the extended trial use period; i.e., in early 2019.

Keywords: PSA, LPSD, Shutdown, Low Power, Standard.

1. BACKGROUND

The American Nuclear Society (ANS) in cooperation with the American Society of Mechanical Engineers (ASME) working through JCNRM has been developing for more than a decade a standard titled "Requirements for Low Power and Shutdown Probabilistic Risk Assessment", ANSI/ANS-58.22, hereafter referred to as the LPSD Standard. The authorization for the development of this LPSD standard was first formally approved in October of 2003. During this time, early drafts of the standard were reviewed by ANS's Risk Informed Standards Committee (RISC) members informally, in late 2003, 2004, and in early 2005. Formal ballots have been conducted by RISC on different occasions; i.e., in 2005, 2008, 2009, and again in 2013. Each ballot failed to achieve a consensus for approval and numerous comments were received for improvement during each ballot process. Since the completion of the ballot in 2008, the LPSD writing group, working on a volunteer basis responded to more than 1,000 comments received and revised the LPSD Standard accordingly. The large number of comments received was taken in part as an indication of a lack of consensus within the PRA community as to the need for such a LPSD Standard and for what its scope and hence requirements, should be. A revised version of the LPSD Standard was finally balloted and approved by the JCNRM for trial use and pilot applications in 2014 [1]. The trial use period was set for 3 years. In September of 2017, the trial use period was extended until December 2018 for reasons that will become clear later in this paper.

In parallel to this effort on low power and shutdown, the ASME Board on Nuclear Codes and Standards and American Nuclear Society Standards Board mutually agreed in 2004 to form a Nuclear Risk Management Coordinating Committee now known as the Joint Committee on Nuclear Risk Management.

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This committee was chartered to coordinate and harmonize standard activities related to PRA between the standards development organizations. A key activity was the development of a PRA Standard structured around the Levels of PRA (i.e., Level 1 [core damage frequency], Level 2 [offsite release frequencies], and Level 3 [consequence assessments]) to be jointly issued by the two societies. On February 2, 2009, the ASME/ANS RA-Sa-2009 (Addendum A) of this combined standard was formally approved by the American National Standards Institute; i.e., [2]. The combined standard, published as Addendum A, includes technical requirements for performing a Level 1 PRA for commercial nuclear at-power conditions. Both internal events (reactor trip) and external events (e.g., high winds, earthquakes, and internal plant fires) are included in the current Addendum A standard's scope of assessment. A further refinement of this combined standard for at-power conditions (i.e., Addendum B) was approved by the American National Standards Institute on July 1, 2013 [3].

Level 2 and Level 3 technical requirements were also developed by different JCNRM writing groups. The Level 2 standard was approved for trial use and pilot applications in 2014 [4] and the Level 3 standard was approved for trial use and pilot applications in 2017 [5]. A longer range plan is to incorporate these standards for Level 2 and Level 3 analysis requirements into a future version of the combined standard.

Following the completion of the LPSD Standard trial use period, the next revision of the LPSD Standard is intended to closely follow the requirements as worded in the next version of the combined standard for at-power conditions, i.e., the "Next Edition" [6]. The "Next Edition" is the colloquial name given to the next version of the combined standard for at-power operating conditions. It is a combined standard in that it incorporates requirements for both internal events and for all external events. Versions of the combined standard were previously published as [2] and [3]. The next edition is currently scheduled for ballot and, if approved, for publication in February of 2019.

The Trial Use and Pilot Application (TUPA) version of the LPSD Standard was developed consistent with the supporting requirements in the Addendum A [2] version of the combined standard for at-power conditions. The LPSD Standard and the combined standard requirements were being changed quickly enough that it was not possible to make the TUPA version of the LPSD Standard consistent with the Addendum B version of the combined standard [3]. The Next Edition [6] is a substantial revision to the Addendum A [2] and B [3] versions of the combined standard for at-power conditions. A number of consistency issues are being addressed along with many other comments received since the addendum B version was published in 2013 [3]. Since the LPSD Standard utilizes many of the requirements listed in the at-power standards with modifications so that they apply to LPSD conditions, it was decided to delay the ballot for the next version of the LPSD Standard until at least 6 months after the successful ballot of the Next Edition [6].

This paper describes the scope of the LPSD standard and highlights some of the LPSD standard requirements. It also reviews some of the most significant comments received to date during the trial use period. The opinions expressed herein are those of the author and not of ANS/ASME. The author is current chairman of the Low Power and Shutdown Standard writing group

2. SCOPE

The types of risk-informed PRA applications contemplated under the LPSD Standard are very broad. Both regulatory risk-informed applications involving the U.S. Nuclear Regulatory Commission (NRC) and applications not involving those regulations are contemplated. While the NRC does not require the use of the LPSD Standard for any specific risk-informed applications for existing light water reactors (LWR), its use is expected to be common in such applications. The PRA requirements in the LPSD Standard are intended to be used together with other PRA standards that cover different aspects of PRA scope; i.e., standards [4], [5], and [6].

The PRA scope covered by the LPSD Standard is limited to the analysis of accident sequences initiated by "internal hazard events" (e.g., reactor trip, loss of coolant accidents, losses of service water, losses of offsite power, and internal flooding) or "external hazard events" (e.g., earthquakes, high winds, external flooding, etc.) excluding only the sequences involving internal fire hazards. Although requirements for internal fires have now been incorporated into the combined standard for at-power conditions (i.e., [2], [3], and [6]), it was concluded after a review that these should not be developed at this time for low power and shutdown conditions due to the many changing plant operating states (POS) and the impact these changes would have on the complexity of the analysis. The only other initiators explicitly excluded are accidents resulting from purposeful human-induced security threats; e.g., sabotage.

While the LPSD Standard title includes the phrase "low power and shutdown conditions", the standard is written primarily to address shutdown conditions only. Originally the authorization for this standard was intended to address all conditions not already covered in the combined standard first drafted and which is still undergoing revision. More recently it's become apparent that low power conditions which do not involve a plant shutdown, are better represented using the at-power sequence models. There are other interface issues between the LPSD Standard and the combined standard which will eventually have to be thought about and addressed. The addressing of these interface issues, which would also effect the combined standard has been delayed until after publication of the Next Edition.

This Standard's PRA technical requirements are primarily presented in support of a quantitative PRA for annual average risk. For applications involving a specific outage (e.g., a specific refuelling outage), where time-dependent risk measures are of interest, changes to the technical requirements to meet such applications are noted.

The quantitative PRA requirements in the LPSD Standard are further restricted to requirements for: (a) a full Level 1 analysis of the core damage frequency (CDF), and (b) a limited Level 2 analysis sufficient to evaluate the large early release frequency (LERF). For non-regulatory applications, alternative risk metrics may be used so long as they can be evaluated as events per year. The LPSD Standard scope is also limited to the analysis of accident sequences involving fuel while it is in the reactor vessel. Events involving fuel while it is in the spent fuel pool are not covered.

This LPSD Standard also sets forth requirements for shutdown QLRA that can be used to support risk-informed decisions for commercial nuclear power plants; e.g., to support configuration risk assessments during shutdown conditions. Qualitative risk models for shutdown risk are in widespread use in the USA. The shutdown QLRA technical requirements are applicable to hot standby, hot shutdown, cold shutdown, and refuelling modes of operation (Modes 3 to 6 for pressurized water reactors [PWR] and Modes 3 to 5 for boiling water reactors [BWR], based on the mode definitions for improved Technical Specifications).

This Standard applies to PRAs used to support applications of risk-informed decision-making related to operating LWR nuclear power plants. They may be used for plants under design or construction, for advanced LWRs, or for other reactor designs, but then revised or additional requirements may be needed.

The LPSD Standard is not a guidance document for performing a LPSD PRA. Instead it presents the requirements that must be fulfilled but does not specify exactly how they are to be addressed. This is consistent with the scope addressed by the combined standard [6] for at-power events.

Both the quantitative PRA requirements and the qualitative risk assessment requirements are included in this one LPSD Standard.

3. FORMAT OF LPSD STANDARD REQUIREMENTS

An abbreviated table of contents from the trial use LPSD Standard is presented in Table 1. Those familiar with Addendum A, or Addendum B, of the Combined Standard will recognize that the outline largely follows that of Reference [1]. This is intentional. The same general outline and naming conventions for high level and supporting requirement identifiers were chosen to allow ease of integration of the LPSD Standard with the Next Edition of the combined Standard [6]. Importantly, the requirements are presented for different hazard groups in separate Parts, as did the outline adopted in [2]. The requirements for external events in the LPSD Standard use the format and very similar numbering to the format and numbering in Addendum A of the combined standard [2]. This approach will be continued when the next version of the LPSD Standard is revised to match the outline in the Next Edition [6].

Table 1: Abbreviated Outline of Current Low Power and Shutdown PRA Methodology Standard

Section	Title
1	General Requirements for an LPSD PRA and QLRA
2	Plant Operating State Analysis
Appendix 2.A (Non-Mandatory)	Plant Operating State Analysis Methodology for LPSD PRA
3	Requirements for Internal Events LPSD PRA
Appendix 3.A (Non-Mandatory)	Risk Metric Methodology
4	Requirements for Internal Floods for LPSD
5	Seismic Analysis
6	Requirements for Screening and Conservative Analysis of Other External Hazards during LPSD Conditions
7	High Wind Analysis
8	External Flood Analysis
9	Other External Hazards Analysis
10	LPSD Quantitative Risk Assessment for a Specific LPSD Evolution
11	Shutdown Qualitative Risk Assessment
Appendix 11.A (Non-Mandatory)	Shutdown QLRA Methodology
12	References

The definitions and acronyms in the trial use LPSD Standard rely heavily on those already defined in [2]. Instead or repeating those from [2] only the additional terms needed for the LPSD Standard are included in Section 1.2 of the trial use LPSD Standard.

One important difference from Addendum A of the combined standard, in the trial use version of the LPSD Standard is that all quantitative high level and supporting requirements are preceded by an "L" as compared to those defined for at-power conditions in [2]. For qualitative risk assessment requirements presented in Part 11, the identifiers for the high level and supporting requirements that are similar to those in [2] are again adopted for use but this time preceded by a "Q". These conventions were followed in an effort to allow users to easily trace back from the LPSD Standard's requirements to the equivalent requirements in [2]. This approach will also be continued when the next version of the LPSD Standard is revised to match the outline in the Next Edition [6].

Supporting requirements in the trial use LPSD Standard [1] that were unchanged, simply referenced the reader back to the requirement of the same name in the combined standard rather than repeating the text. Only supporting requirements with changes were fully written out. This approach is to be changed in the next version of the LPSD Standard; i.e., to instead include the full text of all requirements.

The LPSD Standard requirements in Part 2, for Plant Operating State analysis, are all new compared to the combined standards. As explained earlier, the requirements for internal fires LPSD PRA are omitted until a much later date. Part 10 of the LPSD Standard [1], is new compared to the combined standards versions. Part 10 was first included in the trial use version of the LPSD Standard. Part 10 is a largely a repeat of Parts 2 through 9 except that the supporting requirements are modified as needed to address time-dependent risk applications rather than this applications requiring time-averaged risk metrics. Only the supporting requirements that change are written out. Time-dependent applications are often used for pre-planning and monitoring the risks for specific refueling outages.

The three Capability Category format for supporting requirements presented in [1], [2], and [3] were retained in the trial use LPSD Standard [1]. This approach is being changed for the at-power Next Edition [6] and so will also be changed in the next version of the LPSD Standard. When different requirements for the two capability categories are identified for the same supporting requirement subject, this will be clearly stated.

An example excerpt of three supporting requirements for the second high level requirement (LPOS-B) of the Plant Operating State technical element, is shown as Table 2 for illustration; i.e., from Part 2. The three capability category format used in the trial use LPSD Standard for each supporting requirement is illustrated. In this example, the supporting requirements for LPOS-B5 and LPOS-B7, for Capability Category II are made the same as for Capability Category III. For supporting requirement LPOS-B6, the same supporting requirement is made for all three capability categories. For the next version of the LPSD Standard, the requirements for Capability Category III will all be removed.

Table 2: Example Excerpt from Trial Use LPSD Standard

Table 2-2(b) Supporting Requirements for Plant Operating State Analysis – High Level Requirement B (Cont'd) The POS analysis shall justify all screening and grouping of POSs or LPSD evolutions to facilitate an efficient but realistic estimation of CDF and LERF and to support subsequent requirements to be evaluated by a POS or group of POSs (HLR-LPOS-B).			
	Capability Category I	**Capability Category II**	**Capability Category III**
LPOS-B5	GROUP or DELINEATE POSs that involve initiating events that are "demand-based" with initiators that are time-based (see SR LIE-C5 and LHR-K4).	**EVALUATE the need to create separate POSs that are used for those brief time periods involving activities (test-, maintenance-, and evolution-related) that lead to initiating events that are "demand-based" from those that are time-based.** **If necessary, DELINEATE such POSs to avoid averaging the short duration of the demand over an entire POS duration or, if needed, to ensure that the representative plant conditions defined for the POS apply at the time of the "demand-based" initiating events** (see SR LIE-C5 and LHR-K4).	
LPOS-B6	If POSs from an LPSD evolution are combined into groups, ENSURE that the most severe or constraining of the representative plant conditions is selected for the group (with respect to core damage or large early release) and that the type and frequency of applicable initiating events of any POS within the group are chosen for the combined group.		
LPOS-B7	No re-evaluation required.	RE-EVALUATE the POS grouping scheme, including possible subdivision of the grouped POSs, if a review of the initial quantitative results indicates that the POS groupings mask significant contributors or risk insights.	

4. WRITING GROUP ACTIVITIES FOR NEXT VERSION OF LPSD STANDARD

4.1. Accommodate Changes in Next Edition Standard

The LPSD Standard approved for trial use is based on and compatible with Addendum A of the combined standard [2]. The plan is to make the next version of the LPSD Standard compatible with the Next Edition [6] once it is successfully balloted. Some editing and formatting changes are therefore required. The need for including a capability Category III set of requirements was debated and it was agreed to remove them. It was also recognized that some actions verbs previously used in the supporting requirements have not been approved and so should be replaced. ASME and ANS are striving to make such verbs clear for users for which English is a second language. It's also noted that supporting requirements appearing in the standard parts for external events often refer to other supporting requirements in the requirements for internal events. An effort is being made to explicitly identify the earlier supporting requirements when back referencing them.

There are a set of consistency issues that may differ for different hazard groups that are being resolved in the Next Edition for at-power standard. They must be accommodated in the next version of the LPSD Standard. Since the Next Edition is addressing them, most of these will already be resolved for revisions to the LPSD Standard. These include the following, as examples:

1. There is to be a correspondence between the objectives (or goals) of a technical element and at least one high level requirement of that technical element.
2. Requirements for only two capability categories are to be offered. They may differ in the level of detail required but both must address the objectives of the high level requirements.
3. The action verb "shall" is only to be used in high level requirements.
4. For supporting requirements, the actions verbs "shall" or "should" will never be used.

5. If the action verb "Justify" is used in a supporting requirement, the supporting requirement must explain what an acceptable justification is.
6. Unclear words such as: appropriate, basis, significant, dominant and important must be clarified when they appear in the supporting requirements.
7. The requirements for non-internal events should point to the internal event supporting requirements when considering human reliability analysis dependencies.
8. The purpose of any walkdowns required is to be clearly discussed.
9. If the action verb "identify" is used, the supporting requirement must point to what is to be identified.
10. If the adjective "realistic" is used the supporting requirement should explain what is meant by this term.
11. Vague language is not be used; e.g. "reasonably complete identification".
12. "No requirement" is not acceptable text for any supporting requirement even for Capability Category I.
13. Definitions are to be the same for all terms in the different ASME/ANS standards.
14. Notes are only to be included as cautions to the user, or to note applicable references.
15. No supporting requirements are to be offered in notes.
16. More expansive commentaries about the requirements are only to be included as non-mandatory appendices.
17. Sources of model uncertainty and assumptions are not the same. Assumptions can also relate to study scope or to the level of modeling detail. Only the sources of model uncertainty are to be assessed for their effects on the model.
18. Model completeness issues are to be addressed by either screening or to be addressed outside the scope of the PRA. The uncertainties associated with model completeness are not to be quantitatively propagated.
19. Guidance documents are not to be referenced in the supporting requirements

4.2. Comments Received during Trial Use Period

The previous drafts of the LPSD Standard went through several rounds of reviews by the JCNRM members, and all comments were addressed in the version approved for trial use. While the comments were resolved, there are remaining technical issues that are best demonstrated by testing this standard for different actual applications. Examples of pilot applications might include a gap analysis for an existing LPSD PRA model, or the development of new LPSD PRA models meeting the requirements of this standard. The LPSD Standard writing group project team identified the following seven potential issues, for which feedback during the trial use, pilot application period was especially solicited.

1. Whether the required number of POSs needed to satisfy the requirements of the standard are so excessive as to make the analysis impractical.
2. Whether POSs are suitable when defined at a level of detail consistent with plant configurations sufficient to evaluate time-dependent risk metrics, as opposed to just considering the attributes listed in LPOS-A3.
3. Whether the requirements for at-initiator human actions analysis are reasonable and effective (at-initiator actions are human failure events that cause an initiating event; see Section 1.2.2 of Reference [1]).
4. Whether the methods for human error probability quantification are suitable for shutdown conditions.
5. Whether the approach to external hazards adequately captures the needed requirements for LPSD PRA for those hazards, for which only a few applications are available in the literature.
6. Whether the use of basic event risk significance obtained by summing over all POSs is a suitable measure for ranking importance for establishing modeling fidelity, or, since some models change the basic event evaluation in different POSs, whether other measures must be found.
7. Whether the analyst can screen out the entire category of external hazards (e.g., earthquakes) on the basis of POS duration combined with external hazards initiating event frequencies.

To date, comments have been received from the PWR Owner's Group [7], the BWR Owner's Group (BWROG) [8], ENERCON (i.e., Mr. Ross Anderson) [9], non-LWR pilots who also considered the LPSD Standard, and comments from the ABWR Pilot in the United Kingdom [10]. These comments originated from a combination of gap analyses on existing LPSD Models and from new model development attempting to apply the requirements in the trial use LPSD Standard [1].

Nearly all of the 130 comments received to date are concerned with Parts 2 (Plant operating states), Part 3 (Internal Events), and Part 11 (Shutdown Qualitative Risk Assessment). Part 2 (Plant Operating States) received the most comments. Within Part 3, the most comments are related to technical elements LIS (initiating events analysis), and LHR (human reliability analysis). Only 10 comments were received on the technical elements in Part 3. Minimal comments have been received so far on the LPSD Standard Parts associated with external events. This limited number of comments on the external event parts is seen as a reflection of the scope of the trial applications, rather than successful application and acceptance of the supporting requirements.

Of the 130 comments received, over half of them are associated with Part 11; i.e., Shutdown Qualitative Risk Assessment. The number of comments received on this section reflects a thorough review performed by the BWR Owner's Group [8]. The writing team is thankful for their efforts.

4.3. Significant Comments Received

Significant comments were identified in [7], [8], [9], and [10]. A brief summary of those comments provided for the LPSD Standard is provided below. For the quantitative risk supporting requirements:

1. The supporting requirements related to the identification and quantification of human errors which cause an initiating event (i.e., at-initiator human error probabilities) were found to be problematic due to the lack of accepted methodology guidance and publicly available historical evidence that would allow one to bound the scope of the effort to meet these supporting requirements. Electric Power Research Institute (EPRI) [7] has recommended research to address this topic.
2. Most of the available equipment performance data used on past LPSD models is adapted from at-power experience with limited justification, including for common cause factors. This is particularly important for the development of initiating event frequencies during shutdown. EPRI [7] has also recommended research to address this need.
3. Some commenters assert that the definition for core damage used for LPSD conditions may differ from the definitions typically used for conditions more typical of those seen at-power; i.e., due to the lower decay heat levels well after plant trip and for periods when the reactor coolant system (RCS) is open. Reactivity issues during LPSD may also differ. EPRI [7] has also recommended research in this area. Thermal-hydraulic evaluations performed to date for shutdown conditions, especially for Level 2 consideration (e.g., RCS closed while on residual heat removal cooling), are very limited in scope.
4. The BWROG [8] also recommended that alternative methods for meeting the supporting requirements for POSs be developed and accepted by the LPSD Standard. This issue arises in part because models needed for applications requiring time-dependent risk evaluations differ from those models used for time-averaged risk evaluations. Another source of concern is the concept of evolutions which are needed to address time-averaged models but are not generally needed for time-dependent models that only evaluate refuelling outages.

For the QLRA portion to the LPSD Standard (i.e., Part 11), three recommendations of the BWROG [8] specifically identified areas for further research.

1. One issue is the requirement to consider multiple plant changes (e.g., actual plant modifications and procedure changes) within the QLRA models as part of the model configuration control. The question is how to narrow down those changes whose impacts must be considered cumulatively whereas the impacts of the individual changes do not warrant inclusion in the models.
2. The QLRA models whose supporting requirements are listed in Part 11, are to evaluate multiple end state metrics addressing different safety functions. The question is how to best to combine the evaluated metrics. There is a need for research to identify how to draw an overall risk conclusion from the set of multiple metrics.
3. The supporting requirements for qualitative end state metrics are described in Part 1. However, no list of acceptable risk metrics is provided. Research is suggested as to the best set of risk metrics to use and, for example, how risk metrics which address the quantity of radioactivity potentially released may be considered.

5. INTERFACE ISSUES WITH THE NEXT EDITION OF THE COMBINED STANDARD

The at-power combined standard and the LPSD Standard development have proceeded in parallel for the last 15 years. Initially the LPSD Standard was to include those scope items not considered in the at-power standard; e.g., low power and shutdown conditions and the added plant configurations associated with recovering after a plant trip and returning to power operation. A list of issues identified but not yet addressed in the LPSD Standard nor to be addressed in the Next Edition standard for at-power is provided below. These issues will likely only be addressed after the next versions of both standards are published.

1. Include hazard group internal fires for shutdown conditions.
2. Include hazard group heavy load drops.
3. Include risks of fuel while in the spent fuel pool, dry storage, or in transit.
4. Controlled shutdowns are treated in the at-power combined standard as manual trips but may need to be considered as plant evolutions (where lower power modes may have an increased likelihood of reactor trip, but it is not guaranteed).
5. Determine which standard is to include requirements for sequences involving plant power swings.
6. Determine how to avoid overlapping coverage for sequences initiated at-power, ending in a stable state, but then requiring maintenance and restart to return to power.
7. For some external events, the reactor will likely be shutdown prior to the impact from the hazard; e.g., most external-flooding scenarios and some high-wind scenarios. These hazards are currently being addressed in the combined standard's Parts 7 and Part 8 and to be rewritten for the Next Edition version. The question is whether it is sufficient to address these hazards with models that only account for the first 24 hours after the hazards impact, or whether the subsequent time periods must also be addressed by shutdown requirements.
8. The POS technical element is included in the LPSD Standard but not in the at-power combined standards. The question is whether the POS technical element should be added to the at-power combined standard; i.e., for maintenance conditions or if power swings significantly change the risks of at-power operation.
9. Part 10 of the LPSD Standard explicitly and separately documents the requirements for time-dependent risk models. The question is whether such an explicit listing should also be added for time-dependent at-power models.
10. Part 1 of the LPSD Standard [1] explicitly recognizes that alternate risk metrics (e.g., frequency of boiling) may also be used for risk applications. For non-regulatory applications, this allowance for alternative risk metrics may also apply to at-power conditions.
11. During development of the Next Edition for at-power conditions [6], it is recognized that requirements for multi-unit risk may be needed. This may also be the case for shutdown

conditions because the unit shutdown can affect the available resources and systems availability for other units on the same site.

6. CONCLUSIONS

The Low Power and Shutdown Methodology Standard has gone through 15 years of development and four different writing group chairmen in search of a successful ballot as an American National Standard. In this process, many comments were received and resolved. The JCNRM approval of the trial use version of the LPSD Standard [2] in 2014 represents a milestone in that process. As part of the trial use and pilot project period, a number of new comments have already been received. This comment and resolution process is still on-going. More comments are expected by the time the extended trail use period is over, at the end of 2018. The LPSD Standard writing group is now actively resolving the comments received and modifying the LPSD Standard to be compatible with the format and content of the Next Edition [6] that was recently provided for ballot to the JCNRM. This approach is complicated by the continuous balloting and resolution of comments on the Next Edition. Some parts of the Next Edition are substantially new as compared to the earlier combined standard [2]. Currently the LPSD Standard writing group is only addressing the comments on requirements for internal events. Once a successful ballot of the Next Edition is accomplished, the plan is to ensure compatibility of the next version of the LPSD Standard with the successfully balloted Next Edition for at-power conditions. The incorporation of the next approved version of the LPSD Standard into a subsequent revision of the combined standard is planned, but is still years away.

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