

THE PERIODIC SAFETY REVIEW OF ANSTO'S OPAL REACTOR

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ABSTRACT

This paper describes the process by which the first Periodic Safety Review (PSR) of ANSTO's OPAL reactor was performed and documented. Emphasis is given to the methodology adopted and the practical means of actually doing a PSR with the aim of providing advice and guidance to other research reactor operators intending (or required) to perform a PSR. A summary of the results is also provided, including an overview of the recommendations. Feedback received from the Australian Nuclear Regulator ARPANSA and the subsequent preparation of a PSR Supplement is discussed.

1 Introduction

This paper describes the process by which the first Periodic Safety Review (PSR) of ANSTO's OPAL reactor was performed and documented. It describes the licensing requirement that required a PSR to be performed, the basis and guidance under which the PSR was done, the work plan and process and a summary of the results. It also describes the initial feedback received from the Australian nuclear regulator ARPANSA (Australian Radiation Protection And Nuclear Safety Agency) and the resultant response in the form of the production of a Supplement to the PSR. Lessons learned will be identified as will suggestions and advice for other organisations that are required or consider it appropriate to perform a PSR of their facility.

2 Licensing Requirement

As part of the granting of a Facility Licence, Operating Authorisation for the OPAL reactor in July 2006, the Australian nuclear regulator ARPANSA imposed a number of licence conditions. One of these (Licence Condition 1) related to the need for ANSTO to perform Periodic Safety Reviews as follows:

Periodic Safety Reviews

- 1.1 *ANSTO must submit to the CEO of ARPANSA a periodic safety review that it a detailed re-examination of the safety of the OPAL reactor taking into account operating experience and international best practice in radiation protection and nuclear safety.*
- 1.2 *The first such review must be completed no later than two years after the completion of commissioning of the OPAL reactor and must include revision of the Safety Analysis Report to the satisfaction of the CEO of ARPANSA.*
- 1.3 *Reviews thereafter are to be conducted at intervals of no more than ten years.*
- 1.4 *ANSTO must arrange for the periodic safety reviews to be subject to international peer review.*

The Facility Licence, Operating Authorisation for the OPAL reactor was subsequently re-issued in February 2013 as part of an internal ARPANSA process of rationalising and standardising all the facility licences issued to Australian commonwealth entities. The above licence condition was accordingly revised as follows:

Periodic Safety Review

- 13 *The licence holder must submit to the CEO of ARPANSA a detailed review that re-examines the safety of the OPAL reactor taking into account operating experience and international best practice in radiation protection and nuclear safety, and that has been subject to international peer review. The first such*

review must be completed no later than two years after the date of completion of the commissioning of the OPAL reactor and thereafter at intervals agreed to by the CEO of ARPANSA.

As can be seen, the revised licence condition is more flexible in that it excludes the requirement to revise the SAR and doesn't set a specified time limit on performing subsequent PSRs. The revised condition gives the CEO of ARPANSA the option to vary the timing of performing a PSR for individual facilities based on their assessed risk. Thus, the same licence condition may be imposed on any or all nuclear facilities with only minor wording changes.

3 PSR Guidance

No formal international guidance on what a periodic safety review of a research reactor should consist of was identified, although there are some national guides reflecting the specific legal and regulatory regime of those countries. ARPANSA has also been developing a Regulatory Guide for the Period Safety Review of Nuclear Installations but to date, that document has not been formally issued for review by all stakeholders, including ANSTO.

As such, ANSTO selected to use IAEA Safety Standards Series No. NS-G-2.10: Periodic Safety Review of Nuclear Power Plants as guidance for the PSR of the OPAL reactor. This was on the basis that NS-G-2.10 is considered to provide a structured and comprehensive framework for such a review of a high powered and highly utilised reactor like OPAL. It was supported by the statement in paragraph 1.5 of this standard that "*The review process described in this Safety Guide is valid for nuclear power plants of any age, but may have a wider applicability, for example, to research reactors and radioactive waste management facilities*". However, ANSTO considered that it was appropriate to modify the requirements of NS-G-2.10 to address the fact that the OPAL reactor had (at the time of the PSR) been operating for less than five years, during one of which OPAL was effectively shut down whilst a problem with the fuel was resolved.

NS-G-2.10 recommends that the review be undertaken against fourteen Safety Factors under five Subject Areas as follows:

- i. Plant:
 - (1) Plant Design.
 - (2) Actual Condition of SSCs.
 - (3) Equipment Qualification.
 - (4) Ageing.
- ii. Safety Analysis:
 - (5) Deterministic Safety Analysis.
 - (6) Probabilistic Safety Analysis.
 - (7) Hazard Analysis.
- iii. Performance and Feedback of Experience:
 - (8) Safety Performance.
 - (9) Use of Experience from Other Plants and Research Findings.
- iv. Management:
 - (10) Organisation and Administration.
 - (11) Procedures.
 - (12) The Human Factor.
 - (13) Emergency Planning.
- v. Environment:
 - (14) Radiological Impact on the Environment.

For each Safety Factor, NS-G-2.10 provides an objective for the review, a description of the background to the Safety Factor and expectations for the assessment process, and a list of

generic review elements which are recommended for inclusion in the assessment. In addition, the Safety Guide recommends a global assessment be performed and documented to integrate the results of the review of individual Safety Factors.

4 PSR Implementation

The standard Reactor Operations project management process was applied to the PSR of OPAL with a Project Plan, Project Quality Assurance Plan and Task Briefs prepared by a Project Manager in conjunction with appropriate experts.

4.1 Project Management

The Project Manager was the former Engineering Manager and Assistant Project Manager during the construction of OPAL. As such, he was very familiar with the design of OPAL and the Reactor Operations operating organisation and also very experienced in project management. As Project Manager, his responsibilities were to:

1. coordinated the overall PSR project;
2. arranged for the collation and production of the overall PSR report based on inputs from the individual expert reviewers;
3. coordinated the review of the PSR report;
4. drafted an Action Plan based on the recommendations identified by the individual Safety Factor reviewers; and
5. provided support and advice to individual Safety Factor reviewers.

The Project Manager was supported by a professional technical writer who collated the inputs from the various Safety Factor reviewers and prepared the complete PSR report, including a single collated list of recommendations identified by the expert reviewers. As part of this function, the technical writer aimed at ensuring a consistent approach to English and terminology throughout the PSR report, thus ensuring that the end result formed a single report rather than a mismatch of independent reports. The technical writer, whilst not an expert in PSRs or nuclear reactor design and operation, was able to provide early feedback to the expert reviewers with respect to obvious errors or inconsistencies within their reviews or between their reviews and other Safety Factors.

4.2 Project Plan and Task Briefs

The Project Plan identified the relationship between the Safety Factors, the Objective of that Safety Factor and the proposed approach adopted in the PSR of OPAL. It also identified an expert to lead and coordinate the review of that Safety Factor. This approach was further refined through Task Briefs for each Safety Factor that addressed the following:

1. Objective: as defined in NS-G-2.10.
2. Background: based NS-G-2.10 but adapted to the OPAL context, referencing to OPAL source documentation as appropriate.
3. Requirements: based NS-G-2.10 but adapted to the OPAL context, again referencing to OPAL source documentation as appropriate.
4. Generic elements to review: as defined in NS-G-2.10
5. Suggested approach: as implied, a suggested approach the expert adopt in relation to the specific safety factor.
6. Deliverables: the specific deliverables required and the timescale for delivery. Note that deliverables were staggered so as to facilitate the technical writer's job of putting the full report together and the internal review of the individual deliverables.

The review against Safety Factor 1 was slightly different to that for the other Safety Factors in that it had experts identified in relation to the three different areas covered by the Safety

factor. This was because it was not possible for a single expert to complete the review of all three areas (compliance with current codes and standards, the current design of the plant and documentation of supporting modifications, including configuration management and document control) in the timescales required.

4.3 Project Implementation

The Project Manager arranged regular project review meetings at which the overall status of the project was assessed and areas where additional effort was required identified. These meetings also enabled the Project Plan to be revised in the light of feedback from the expert reviewers and advice from ARPANSA. One example of this was that the original intention to only review Safety Factor 6: Probabilistic Safety Analysis in a simplified form was revised such that a more thorough review was done. Since these meetings involved all the experts, they also gave an opportunity for issues and topics that affected more than one Safety Factor to be identified and discussed. There was also an opportunity for “cross-fertilisation” between experts and Safety Factors to try and ensure that the overall approach to the PSR was generally as consistent as possible across all Safety Factors.

In general, the Project Manager did not actually perform any of the reviews against the individual Safety Factors but did review the deliverables provided by the experts. Where appropriate, the Project Manager also coordinated the review of the deliverables by a second expert. Due to having reviewed all the individual reviews of Safety Factors, the Project Manager was also able to contribute to the Global Assessment in conjunction with the General Manager, Nuclear Operations.

Once all the individual deliverables were collated into a single report, it was subject to review by all the experts in relation to their contributions in order to verify that their contributions had been correctly incorporated into the overall report. The Reactor Operations senior management team also reviewed the whole of the PSR report as part of the usual line management review and approval. This review considered the overall adequacy of the PSR as well as consistency across the Safety Factors.

4.4 International Peer Review

The original licence condition required that ANSTO arrange for the PSR to be subject to international peer review. Initially, consideration was given to requesting the IAEA to arrange for such an international peer review but due to resource and time issues, it was decided that ANSTO Reactor Operations would arrange this review directly. As such, informal contacts were made with a number of experts from various research reactor facilities worldwide. The Peer Review Team consisted of the Commissioning Manager and the Project Manager from NRG/PALLAS, the Netherlands, the Head of Division, CEA, Centre de Cadarache, France and the Executive Director, HFIR, Oak Ridge Nuclear Laboratories, USA. The report of the Peer Review Team was incorporated into the PSR report as a separate section.

4.5 ANSTO Safety Committees Review

The complete PSR report, including the international peer review, was subject to independent internal ANSTO review through the ANSTO Safety Assurance Committee (SAC) and the Reactor Assessment Committee (RAC), a sub-committee of the SAC that contains specialised expertise in reactor and nuclear safety. This review by the SAC and RAC is normal practice within ANSTO for documents and reports that constitute a significant safety submission to ARPANSA.

5 Results of PSR

The PSR of OPAL determined that there was a high degree of conformity with current international safety standards and practices and that the licensing basis remains valid. The review identified no safety shortcomings which pose an immediate or significant risk to health and safety for workers or the public but it did identify a number of areas where improvements/further assessments need to be made as well as a number of areas where improvements/further assessments could be beneficial. A total of 124 recommendations were identified, although it should be noted that many of these are detailed recommendations for activities that were already planned or identified in existing scheduling (e.g. the maintenance and replacement strategy for the reactor protection systems). The international peer review concurred with these recommendations and noted that in the opinion of the peer reviewers, the OPAL PSR met the requirements of the IAEA safety guide and that OPAL staff had performed a critical self-evaluation with sufficient rigor. The international peer review also identified a number of additional recommendations and observations that were considered and addressed by ANSTO.

6 PSR Supplement

Following the submission of the PSR report to ARPANSA towards the end of 2011, ARPANSA performed a preliminary review and advised ANSTO of a number of issues and comments, including suggested improvements, that they requested ANSTO take into consideration. These issues were discussed between ANSTO and ARPANSA and are summarised as follows:

1. the accuracy of statements in the individual Safety Factors;
2. the supporting evidence/references or justification for statements made in the individual Safety Factors;
3. the provision of overall assessments of performance of systems or processes identified in the individual Safety Factors;
4. the supporting evidence/references or justification for some recommendations; and
5. the provision of an overall assessment of common themes and root causes.

A PSR Supplement was prepared to address these issues. This was done through a review of the original PSR report by OPAL staff knowledgeable in the PSR but not directly involved in the review against the Safety Factors to address items 1, 2 and 4, additional work by the original experts to address item 3 and an independent review of the recommendations to identify themes and root causes that were common to multiple Safety Factors to address item 5.

As a result of this work, editorial and technical errors were identified and incorrect or missing supporting evidence/references were incorporated. Four additional recommendations were also identified, although two of these should have been identified in the original PSR and one from an inaccuracy in the original PSR. A number of themes and root causes were also identified as follows:

1. Changing requirements in standards.
2. Opportunities for improvement.
3. Asset management.
4. Business processes.
5. OLC/SAR/SPI update.
6. Time limitations in completing the PSR.

Note that the fourth of these, business processes, was further sub-divided into five secondary themes covering the OPAL Business Management System, the maintenance management system, the event reporting and management system, staff training and development and status of plant documentation.

These themes and root causes were discussed in a supplementary global assessment as it was acknowledged that the identification, review and assessment of common themes and root causes was not an area that was explicitly considered in the original PSR. The identification of themes and root causes also contributed to the strategic planning of the follow-on actions that address the recommendations arising from the PSR. For example, the application of a more generalised Asset Management approach addressing all the recommendations identified as being part of the asset management theme is consistent with not only ANSTO's strategic objectives but also with best international practice. In particular, it is aimed at ensuring that the OPAL Reactor is not only safe over its lifetime but also that it is usable and that its capabilities are maintained.

7 Lessons Learned

A number of lessons were learned from the experience performing the OPAL PSR that other organisations may wish to take into consideration if and when they also need to perform a PSR. They are (in no particular order of importance):

1. Treat the PSR as a project and use normal project management tools to manage its planning and implementation. This includes the preparation of a formal project plan, project QA plan and task briefs for individual technical experts that clearly identify the scope and deliverables of the work.
2. Appoint a good Project Manager to manage the project, preferably one with experience with the facility being subject to the PSR.
3. Provide appropriate supporting resources, such as a technical writer or specialist administrative officer, to collate the inputs from the technical experts actually performing the PSR. This ensures that the technical experts concentrate on the PSR itself and not on producing an end report.
4. Encourage communication between the technical experts through regular team meetings and one-on-one discussions to maximise "cross-fertilisation" across Safety Factors.
5. An international peer review is highly beneficial not only as an independent review of the PSR but also as a focus for the review team to aim at completing their work. Arranging and coordinating an international peer review may be done through the IAEA although the operating organisation can arrange such a review themselves if it has the appropriate contacts and experience to do so.
6. IAEA Safety Standards Series No. NS-G-2.10: Periodic Safety Review of Nuclear Power Plants was considered to be an extremely useful starting point for developing the PSR process for a research reactor, although care should be taken to ensure an appropriate graded approach is adopted relevant to the specific facility.
7. The PSR process and its outcomes were considered very useful by the OPAL line management as a way of identifying safety and operational issues and priorities for the reactor independent of the views of the International Peer Review Team, the ANSTO internal safety committees, or the Australian nuclear regulator ARPANSA. As such, the operational and organisational benefits of performing a PSR should not be underestimated.
8. The systematic identification of themes and root causes common to a number of Safety Factors through the review of recommendations can be beneficial in the strategic planning and prioritisation of follow-on actions arising from the PSR.

8 Conclusions

The Periodic Safety Review of OPAL constituted a comprehensive assessment of the nuclear safety and radiological protection aspects of the operation of the OPAL Reactor. It identified a high degree of conformity with current international safety standards and practices and confirms that the licensing basis remains valid.

The PSR of OPAL identified no safety shortcomings that pose an immediate or significant risk to health and safety for workers or the public, i.e. it identified no issues for which operating restrictions or temporary shutdown of the reactor should be considered pending the resolution of the issue. However, it did identify number of areas where improvements/further assessments need to be made as well as a number of areas where improvements/further assessments could be beneficial. Provided the necessary improvements are carried out, suitable arrangements are in place to maintain safety of the facility for the next 10 years until the next Periodic Safety Review.

The subsequent PSR Supplement generally supported the conclusions of the original PSR although the assessment of the plant documentation process did identify some areas for improvement in relation to managing plant configuration information and a new recommendation has been raised to address this. The PSR Supplement also identified themes and root causes common across more than one Safety Factor that facilitated the strategic planning and prioritisation of follow-on actions arising from the PSR.