

# THE SAFETY REVIEW AND UPDATE OF THE SAFETY ANALYSIS REPORT FOR THE OPAL REACTOR

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## Introduction

This paper presents a general description of the ongoing safety review and update of the Safety Analysis Report (SAR) following the commissioning of the Australian Nuclear Science and Technology Organisation's (ANSTO) Open Pool Australian Light-water (OPAL) Reactor at their Lucas Heights site. It addresses the following aspects:

- A history of the existing safety case – includes a description how it is presented in the original SAR and the changes arising from the regulatory review process during the granting of the Operating Licence.
- Operating Licence Condition 1.2 – what it is and what it means to the safety review and SAR update project.
- The SAR Action List – what it is and the source of the actions, including those arising from the regulatory review process. A number of the more significant actions will be discussed in detail.
- Implementation of the SAR update – a description of the practical aspects of the implementation process, including configuration management, quality control, readability and consistency.
- Future safety review and SAR activities – compliance with Operating Licence Condition 1.4 and implementation of the OPAL change control process.

These aspects are all addressed from the point of view of the licensee and some lessons learnt that may be of benefit to other licensees are identified.

Note that this paper follows on from a presentation given at IGORR10.

## History and background

ANSTO's OPAL reactor is a 20 MW pool-type multi-purpose research reactor located at the Lucas Heights Science and Technology Centre, 35 kms south of the Sydney city centre. Its main purpose is to act as a neutron factory for neutron beam research and the irradiation of materials for the production of radiopharmaceuticals and industrial uses. It also forms the centrepiece of fulfilling ANSTO principle function of providing nuclear-based science expertise for Australia.

The current version of the SAR was prepared prior to commissioning the OPAL reactor as part of the application for a facility licence, operating authorisation submitted to the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA, the Australian nuclear regulator) in 2005. It was developed from the Preliminary Safety Analysis Report (PSAR) that was submitted to ARPANSA as part of the application for a facility licence, construction authorisation.

The content and format of the SAR follows the guidance contained in IAEA Safety Series No. 35-G1: *Safety Assessment of Research Reactors and Preparation of the Safety Analysis Report Safety Guide*

([http://www-pub.iaea.org/MTCD/publications/PDF/Pub960e\\_web.pdf](http://www-pub.iaea.org/MTCD/publications/PDF/Pub960e_web.pdf)) and consists of 20 chapters as follows:

- Chapter 1, Introduction and General Description of the Facility
- Chapter 2, Safety Objectives and Engineering Design Requirements
- Chapter 3, Site Characteristics
- Chapter 4, Buildings and Structures
- Chapter 5, Reactor
- Chapter 6, Reactor Cooling System and Connected Systems
- Chapter 7, Engineered Safety Features
- Chapter 8, Instrumentation and Control
- Chapter 9, Electric Power
- Chapter 10, Auxiliary Systems
- Chapter 11, Reactor Utilisation
- Chapter 12, Operational Radiological Safety
- Chapter 13, Conduct of Operations
- Chapter 14, Environmental Assessment
- Chapter 15, Commissioning
- Chapter 16, Safety Analysis
- Chapter 17, Operational Limits and Conditions
- Chapter 18, Quality Assurance
- Chapter 19, Decommissioning
- Chapter 20, Emergency Planning and Preparedness

The SAR was initially prepared by the reactor vendor, INVAP S.E. of Argentina, in accordance with the contract specification to reflect the “as-built” design of the OPAL reactor. It was subsequently revised to incorporate ANSTO comments prior to formal issue by INVAP. It was further revised and finalised by ANSTO in-house prior to submission to ARPANSA as part of the application for a facility licence, operating authorisation and was subsequently subject to a detailed review by ARPANSA. Operational aspects (particularly Chapter 13: Conduct of Operations and Chapter 17: Operational Limits and Conditions) were also subject to an international peer review by experts nominated by the IAEA.

The Australian regulatory regime (ARPANS Act, 1999) also requires applications for a facility licence for a nuclear installation be made available for public review and submissions, including detailed review by specific interested parties such as the local council and opposition groups. However, in the light of heightened security concerns (particularly in relation to terrorism) and the fact that the SAR contained proprietary information of a commercial sensitive nature, the public release of the complete SAR was not considered to be appropriate, even though the PSAR had been made available in its entirety on the ARPANSA web page and in hard copy to specific interested parties. As such, ANSTO also had to produce a public version of the SAR for general public release on the ARPANSA website ([http://www.arpansa.gov.au/Regulation/opal/op\\_applic.cfm](http://www.arpansa.gov.au/Regulation/opal/op_applic.cfm)).

## Operating Licence Condition 1.2

The Facility Licence, Operating Authorisation for the OPAL reactor was issued in July 2006 ([http://www.arpansa.gov.au/pubs/regulatory/opal/op/op\\_lic.pdf](http://www.arpansa.gov.au/pubs/regulatory/opal/op/op_lic.pdf)). Schedule 2 of this licence contains a number of specific Licence Conditions, including Licence Condition 1 as follows:

- 1.1 *ANSTO must submit to the CEO of ARPANSA a periodic safety review that is 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 10 years.*
- 1.4 *ANSTO must arrange for the periodic safety reviews to be subject to international peer review.*

As can be seen, this Licence Condition requires ANSTO to perform a periodic safety review and update the SAR within two years of the completion of commissioning. In addition, the safety review and updated SAR is to be subject to an international peer review and the update must be to the satisfaction of the CEO of ARPANSA. However, other than the general requirement that the periodic safety review be 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, no specific guidance is provided as to what form this safety review should take.

To meet the safety review requirement, ANSTO has decided to effectively repeat the safety analysis from first principles. This is because the computation codes and models used in the original safety analysis have been revised and updated to reflect the results of hot commissioning the OPAL reactor and the experience gained during the initial operating period. This in turn means that virtually all the neutronic and thermal-hydraulic analyses will have to be repeated so it is a relatively small step to simply repeat the whole safety analysis. This decision also enables a different approach to be adopted for performing the safety assessment and presenting it in the SAR. In the case of the SAR for the OPAL reactor, it is proposed that a “fault schedule” approach be adopted similar to that used in the UK nuclear power industry (among others). This also has a benefit in that documented guidance is available regarding the review and assessment of safety analyses using fault schedules

At the time of writing, an ARPANSA hold point that constitutes the formal end of commissioning has not been signed off. As such, the clock on the first of these reviews has not started ticking. However, work has already started on the safety review and the update of the SAR.

### **The SAR Action List**

An SAR Action list has been drawn up that lists the changes and modification required to the SAR as identified to date and summarised below:

- During the course of the review of the application for a facility licence, operating authorisation, a large number of comments were raised by ARPANSA in relation to the SAR. ANSTO provided appropriate responses to each of these comments and many of these responses incorporated a commitment to revise the SAR to address

the comment. These commitments were subsequently identified separately in detailed addendum to each chapter of the SAR and have been identified in the SAR Action List.

- In addition to the above, some ARPANSA comments required a more detailed responses and justification to be provided. Again, the resultant changes to the SAR were identified in detailed addendum to the relevant chapter(s) of the SAR and have been identified in the SAR Action List.
- Following the formal issue of the SAR, a number of errata were identified. These were recorded in a separate Errata addendum and have been identified in the SAR Action List. Subsequently, numerous additional errata, many of an editorial or typographic nature, have been identified by users. These additional errata are also identified in the SAR Action List.
- Since the granting of the facility licence, operating authorisation for the OPAL reactor, a number of modifications (design changes, changes to operating practices, changes to the safety case etc) have been implemented. The Reactor Operations change control process incorporates measures by which changes to documentation are identified and recorded, including changes to the SAR. These changes have also been identified in the SAR Action List.
- As a result of experience gained during commissioning and the initial operation of the OPAL reactor, numerous proposals for suggested improvements to the SAR have been made by users. These generally relate to improvements or clarifications in the description of the design and/or operation of systems. These proposals have been identified in the SAR Action List.

At the time of writing, a total of 420 actions have been identified in the SAR Action List. These actions range from the very simple (e.g. correcting a simple editorial errata) to the very complex (e.g. ensure that consistent terminology is used throughout the SAR and incorporating the results of commissioning into Chapter 15). Furthermore, the SAR Action List is subject to regular review and revision so as to incorporate additional changes identified by users or generated through the Reactor Operations change control process. On some occasions, this review and revision process has resulted in the removal of a previously identified change that has since been superseded by events or otherwise made redundant.

### **Implementation of the SAR update**

A safety review and SAR update plan has been prepared outlining the processes by which the update to the SAR will actually be implemented. The principal input into this plan is the SAR Action List discussed above but it also includes organisational aspects, arrangements for reviews and the practical arrangements for the update.

The main differences between the preparation of the original SAR and the preparation of the update to the SAR are as follows:

- The preparation of the update of the SAR is to be done in-house within ANSTO rather than externally by the reactor supplier as was the case for the PSAR and the original SAR. It is anticipated that this will streamline the preparation, review and approval process as well as eliminate problems that were encountered with the reactor supplier writing the SAR in a language other than their native one.
- The Reactor Operations division within ANSTO incorporates a Configuration Management Group that is responsible for the development and maintenance of the

integrated Reactor Operations Business Management System (BMS) and employs specialist technical writers. During the preparation of both the PSAR and the SAR, such specialist technical writers were not available. As a result, the review and revision of the individual chapters of the SAR was delegated to individual “book bosses” who, whilst being the ANSTO expert in the area(s) covered by that chapter, were not necessarily skilled and experienced technical writers. The “book bosses” were also heavily committed to other activities associated with the construction of the OPAL reactor such that they were not always able to dedicate sufficient time to the review and revision of their chapters. It is anticipated that this approach will help ensure a more consistent “style” and use of terminology both within chapters and across the SAR as a whole. It will also remove a potentially heavy workload from the ANSTO experts who would previously have been tasked to be “book bosses”, responsible for the preparation of the revised SAR chapters.

- The format of the SAR will be revised from the standard adopted under the contract and used by INVAP for the original SAR to the Reactor Operations BMS standard used for all manuals (i.e. design operation, maintenance and user manuals). It is intended that this will result in a SAR that looks and feels the same as any other BMS document and thus aid user familiarity. This will also enable modifications and updates to be implemented within the SAR using the same document change process as used for other Reactor Operations BMS documents.
- Configuration management of the updated SAR will be done in the same way as for any other Reactor Operations BMS manual. Control of the electronic master document will be maintained within the Configuration Management Group with all changes implemented by the technical writers in response to comments and other input from the relevant experts within Reactor Operations and other parts of ANSTO as appropriate. It is anticipated that this will also streamline the preparation, review and approval process as well as provide documented evidence of this process to satisfy the requirements of ARPANSA.
- No public version of the SAR is required, thus eliminating the need for the SAR to be written with a view to public release. This will enable a certain level of technical knowledge and understanding to be assumed in readers and users and should reduce verbosity in the text. However, in the longer term, consideration is being given to the preparation and public release of a summary version of the SAR.

These differences in approach result from the experience gained during the preparation of both the PSAR and the SAR. In particular, significant difficulties were encountered in the configuration management of the individual chapters of the SAR as they went through the preparation and review process, particularly where high level management reviews overlapped with the revision of chapters to address previous comments. This resulted in significant effort being required to reconcile the finalised versions of each chapter to verify that they had been adequately covered by the review process and that all internal comments had been adequately addressed

The updated SAR, including the revised safety analysis, will be subject to a number of formal reviews as follows:

- a) Internal reviews by relevant experts within Reactor Operations and other parts of ANSTO. This will include operations staff, utilisation staff and engineering & maintenance staff with respect to technical accuracy and particularly in relation to their own experience with operating and maintaining the plant.

- b) Independent internal reviews by the Reactor Assessment Committee (RAC) and ANSTO Safety Assessment Committee (SAC) in accordance with the ANSTO Safety Management System. Note that it is our intention that modifications to the OPAL reactor (both plant and operational) incorporated into the update of the SAR will have already been subject to review and approval under the ANSTO Safety Management System. As such, the RAC and SAC reviews need only address the actual changes to the SAR and the safety case contained therein and not such modifications.
- c) External review by INVAP as the Design Authority to verify the technical accuracy of the plant description and design intent.
- d) An internal high level management review (commonly referred to as a “red team” review) for general fitness for purpose.
- e) International peer review, anticipated to be similar in nature to that performed previous for the PSAR and SAR.

Due to the size and complexity of the SAR, it is anticipated that reviews a), b) and c) will generally be performed on a chapter-by-chapter basis whilst reviews d) and e) will be performed on the SAR as a whole. It is also anticipated that there may be some repetition of reviews where a chapter or section is subject to significant revision.

It is only after the SAR has completed the final review and been revised as appropriate in response to comments will it be formally issued to ARPANSA.

#### **Future safety review and SAR activities**

Reactor Operations BMS documentation is currently available to all Reactor Operations staff via an intranet webpage whilst plant documentation (such as drawings, system descriptions etc) is available via a read-only MS Access database, also accessible via the intranet webpage. The SAR is available on the intranet webpage as part of the reference library supporting the Reactor Operations BMS documentation since it falls between the definition of BMS documentation and plant documentation. However, this system of controlling BMS and plant documents through the Reactor Operations intranet webpage is cumbersome and awkward to use. ANSTO is currently in the process of introducing a web-based Electronic Document and Records Management System (EDRMS) that will enable all Reactor Operations documentation, including the SAR, to be maintained and controlled under the same interface.

As stated previously, the use of a standard Reactor Operations BMS template for the SAR enables modifications and updates to be implemented within the SAR using the same document change process as used for other Reactor Operations BMS documents. Specifically, configuration control of the SAR will be done in the same manner as for any other Reactor Operations BMS manual through the Configuration Management Group while all changes will be implemented by the technical writers as appropriate. It is anticipated that this will streamline the preparation, review and approval process for future modifications, including those arising as a result of compliance with Licence Condition 1.3.