Australian Government

Australian Radiation Protection and Nuclear Safety Agency

REGULATORY ASSESSMENT REPORT

Facility Licence Application A0266
from
Australian Nuclear Science and Technology Organisation
to
site and construct the SyMo Facility

R13/10192

REGULATORY SERVICES

May 2014

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Executive Summary

On 6 August 2012, the CEO of ARPANSA received an application (application number A0266) from the Chief Executive Officer (the CEO) of the Australian Nuclear Science and Technology Organisation (ANSTO) for authorisation to site and construct a controlled facility, namely the SyMo facility. Though the siting and construction are separate conducts the assessment of these conducts are consolidated for better interface in assessment.

The proposed facility will apply Synroc technology for immobilisation of intermediate level liquid waste (ILLW) from ANSTO's molybdenum-99 production processes. This includes current alkaline ILLW generated from fission molybdenum-99 production plant, future alkaline ILLW from 'ANSTO Nuclear Medicine Molybdenum-99 (ANM Mo99)' facility and the legacy acidic waste from the previous molybdenum-99 production process.

When considering the licence application and making a decision as to whether to issue a licence, the CEO of ARPANSA is required to take into consideration certain matters prescribed in the *Australian Radiation Protection and Nuclear Safety Act 1998*. The ARPANSA assessor prepared this Regulatory Assessment Report (RAR) for the CEO of ARPANSA to consider these matters.

This RAR is based on the assessment of the information described in licence application A0266, additional supporting material and discussions with facility representatives to clarify the application. The plans and arrangements for safety and other relevant information about the siting and construction of the facility have been reviewed against relevant guidelines and principles of the ARPANSA *Regulatory Guideline for Plans and Arrangements*, *Regulatory Design Criteria*, and ARPANSA *Regulatory Assessment Principles for Controlled Facilities*. These are based on national and international recommendations and guidelines for radiation protection and nuclear safety. The application describes the siting and construction of the SyMo facility, plans and arrangements for managing safety, technical specifications, safety analysis, and plans and schedules for construction of the facility.

The ARPANSA assessor identified some inadequacies in the HAZOP analysis and the risk assessment study for the SyMo facility and recommended that this matter should be resolved prior to operation of the facility being authorised. Therefore, ANSTO will be required to revise and resubmit the HAZOP analysis and risk assessment for the SyMo facility prior to, or with their application for an operating licence.

Construction of items of plant that will come into direct contact with the radioactive waste material during the Synroc process will require prior approval of the CEO of ARPANSA. ANSTO's submission must demonstrate that the design is informed by comprehensive risk identification and hazard assessment process and that construction will be undertaken in accordance with an appropriate quality management system.

The ARPANSA assessor finds that the application has satisfactorily addressed the matters to be taken into account by the CEO of ARPANSA in deciding whether to issue a facility licence. The ARPANSA assessor concludes that the application includes plans and arrangements to ensure that the facility may be sited and constructed without undue risk to the health and safety of the people and the environment subject to the implementation of the recommended licence conditions.

The ARPANSA assessor recommends that the CEO of ARPANSA issue a facility licence to ANSTO authorising siting and construction of the SyMo facility subject to the licence conditions set out in section 4.2 of this report.

ARPANSA will further assess the details of operation if and when ANSTO applies for a facility licence to operate the facility.

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1. Introduction

Commonwealth entities that undertake activities involving controlled facilities, controlled apparatus or controlled material must comply with the requirements of the *Australian Radiation Protection and Nuclear Safety Act (1998)* (the Act) [1] and the Australian Radiation Protection and Nuclear Safety Regulations 1999 (the Regulations) [2].

The object of the Act is to protect the health and safety of people and the environment from the harmful effects of radiation.

Under the Act, Commonwealth entities wishing to prepare a site for a facility, construct, possess and control, operate, or decommission, dispose of or abandon a facility must hold an appropriate licence.

A facility licence is a licence issued by the Chief Executive Officer (CEO) of the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA).

In the case of this application, the applicant, Dr Adrian Paterson (the CEO of ANSTO) seeks a facility licence under section 32(1) of the Act to site and construct a controlled facility known as the SyMo facility.

The Act defines a controlled facility as either a nuclear installation or a prescribed radiation facility. The SyMo facility is a prescribed radiation facility as defined in regulation 6.

1.1. RECEIPT OF APPLICATION

In accordance with the requirements of the Act, the CEO of ANSTO submitted an application for a facility licence on 6 August 2012. The application is in an acceptable form and was supported by the appropriate fee.

As required by the Regulations, the CEO published a notice in The Australian and in the Commonwealth of Australia Gazette (AG69104.1) on 10 October 2012, notifying of the receipt of a facility application from ANSTO and of his intention to make a decision on the application.

Additional information subsequently obtained from the applicant forms part of the application.

1.2. PURPOSE AND FORMAT

The objective of this report is to document the assessment of information contained in the ANSTO application against the criteria set out in the Act and Regulations. Consideration is given to the matters to be taken into account by the CEO under Section 32(3) of the Act, that is, international best practice in radiation protection and nuclear safety, and those matters set out in regulation 41 and information obtained under Part 1 of Schedule 3 to the Regulations.

Section 2 of this report details the review of information contained in the application. The conclusions of the ARPANSA assessor appear in Section 3 and inform the assessment of matters to be taken into account by the CEO in making a decision on the application. Section 4 sets out the assessor's recommendations to the CEO regarding the issue of a licence and any licence conditions.

The assessor has relied on the following documents and information in making recommendations to the CEO:

- The information contained in the initial application (Application No. A0266)
- Additional information obtained from the applicant following the receipt of the application
- Meetings and discussions with the applicant and/or their representatives
- Issues raised and questions asked during public consultation, including the community information session held at the Engadine Community Centre on 16 May 2013
- Other documents referred to in the body of this report

1.3. ASSESSMENT PROCESS

The following documents have been used in the assessment of this application:

- *Australian Radiation Protection and Nuclear Safety Act 1998*(the Act)[1]
- *Australian Radiation Protection and Nuclear Safety Regulations 1999* (the Regulations) [2]
- Australian Radiation Protection and Nuclear Safety Agency, *Regulatory Guide: Plans & Arrangements for Managing Safety* v4 (RG) (January 2013) [3]
- Australian Radiation Protection and Nuclear Safety Agency, *Regulatory Assessment Principles for Controlled Facilities* (RAPS) RB-STD-42-00, Revision 1, October 2001 [4]
- International Atomic Energy Agency, IAEA, *Site Evaluation for Nuclear Installations, Safety Requirements* (SR), NS-R-3, 2003 [5]
- Holistic Safety Guidelines V1, OS-LA-SUP-240U, November 2012 [6]
- Australian Radiation Protection and Nuclear Safety Agency, *Regulatory Assessment Criteria for Design of New Controlled Facilities and Modifications to Existing Facilities* (DC), RB-STD-43-00, Revision 1, October 2001 [7].

1.4. LEGISLATIVE FRAMEWORK

Under sub-section 30(1) of the Act, a controlled person must not prepare a site for a facility, construct, possess and control, operate, or decommission, dispose of or abandon a facility unless authorised to do so by a facility licence, or unless the controlled person is exempted in relation to the conduct concerned under the Regulations.

Sub-section 32(3) of the Act states:

> *In deciding whether to issue a licence under subsection (1), the CEO must take into account the matters (if any) specified in the regulations, and must also take into account international best practice in relation to radiation protection and nuclear safety.*

In addition to international best practice in radiation protection and nuclear safety, the CEO must also take into account the following matters from Regulation 41(3):

(a) whether the applicant includes the information asked for by the CEO; and

(b) whether the information establishes that the proposed conduct can be carried out without undue risk to the health and safety of people and to the environment; and

(c) whether the applicant has shown that there is a net benefit from carrying out the conduct relating to the controlled facility; and

(d) whether the applicant has shown that the magnitude of individual doses, the number of people exposed, and the likelihood that exposure will happen, are as low as reasonably achievable, having regard to economic and social factors; and

(e) whether the applicant has shown a capacity for complying with these regulations and the licence conditions that would be imposed under Section 35 of the Act; and

(f) whether the application has been signed by an office holder of the applicant, or a person authorised by an office holder of the applicant; and

(g) if the application is for a facility licence for a nuclear installation – the content of any submissions made by members of the public about the application.

Regulation 39(2) permits the CEO to request information from the applicant relating to the conduct for which the licence is sought. The following information (as listed in Part 1 of Schedule 3 to the Regulations) may be requested by the CEO in relation to an application for a licence to operate a controlled facility:

General Information

Item 1 The applicant's full name, position and business address

Item 2 A description of the purpose of the facility that is to be authorised by the facility licence

Item 3 A detailed description of the controlled facility and the site for that facility

Item 4 Plans and arrangements describing how the applicant proposes to manage the controlled facility to ensure the health and safety of people and the protection of the environment including the following information:

(a) the applicant's arrangements for maintaining effective control

(b) the safety management plan for the controlled facility

(c) the radiation protection plan for the controlled facility

(d) the radioactive waste management plan for the controlled facility

(e) the security plan for the controlled facility

(f) the emergency plan for the controlled facility

Authorisation for preparing a site for a controlled facility

Item 5 A detailed site evaluation establishing the suitability of the site

Item 6 The characteristics of site, including the extent to which the site may be affected by natural and man-made events

Item 7 Any environmental impact statement requested or required by a government agency, and the outcome of the environmental assessment

Authorisation to construct a controlled facility

Item 8 The design of the controlled facility, including ways in which the design deals with the physical and environmental characteristics of the site

Item 9 Any fundamental difficulties that will need to be resolved before any future authorisation is given

Item 10 The construction plan and schedule

Item 11 A Preliminary Safety Analysis Report that demonstrates the adequacy of the design of the facility and identifies structure, components and systems that are safety related items

Item 12 The arrangements for testing and commissioning safety-related items

2. Review Information

This section describes the review of information provided in the application and subsequently received from the applicant with respect to the matters to be taken into account by the CEO. It has been assessed having regard to:

(i) Letter from the CEO of ANSTO dated 26 August 2012
(ii) Facility Licence Application
(iii) Documents listed in Appendix 1

2.1. GENERAL INFORMATION

2.1.1. Applicant information [Item 1]

Item 1 of Part 1 of Schedule 3 of the Regulations requires the applicant to provide details of the Applicant.

The Application was made by the CEO of ANSTO, Dr Adrian Paterson, and signed on the 26 August 2012. The person nominated to be in effective control of the facility is Mr Sam Moricca, Director of Technology.

Conclusion

ARPANSA assessor considers that the Applicant information described in the Application is satisfactory.

2.1.2. Description of the purpose of the facility [Item 2]

Item 2 of Part 1 of Schedule 3 of the Regulations requires the applicant to provide a description of the purpose of the facility.

The Application states that the SyMo facility is a proposed purpose built facility at ANSTO to apply Synroc technology for immobilisation of waste from ANSTO's Mo-99 production processes.

The plant is designed to handle current alkaline Intermediate Level Liquid Waste (ILLW) from the Building 54 Mo-99 production plant, future alkaline ILLW from ANM Mo99 facility and acidic legacy waste stored in both the Building 57 ILLW tanks and as solid waste in TS1 containers from the previous Mo-99 production plant. The facility is proposed to be used to immobilise the ILLW generated from the fission Mo-99 production process in a stable form by reducing the volume.

Conclusion

The purpose of the facility described in the application is considered adequate by the ARPANSA assessor.

2.1.3. Detailed description of the facility and site [Item 3]

Item 3 of Part 1 of Schedule 3 of the Regulations require the applicant to provide a detailed description of the facility and site for the proposed facility.

2.1.3.1. Facility History

The proposed facility is a new facility. The process to be used in the facility has been developed over thirty (30) years of research and development as described in Section 2.4.1 of this report.

2.1.3.2. Location of Facility

The facility will be located at the Lucas Heights Science and Technology Centre (LHSTC) some 28 kilometres southwest of Sydney.

In relation to the siting of the SyMo Processing Plant, the proposed location is adjacent to Building 59 and Building 58. The proposed location is across the road from the OPAL reactor and the proposed ANM Mo99 facility. The proposed location suggests that it will provide advantage in transferring ILLW to be generated from the ANM Mo99 facility. The location of this facility has been considered in the assessment of consequences of events during routine operation and anticipated operational occurrences. The location is shown in Figure 1.1 of the SyMo preliminary safety analysis report (PSAR).

ANSTO operates a number of nuclear installations and radiation facilities at the site, for example the OPAL research reactor, radioisotope production facilities, waste operations facilities etc. ANSTO is utilising the following characteristics of the site:

- a 1.6 km buffer zone
- security perimeter fence and access controlled by the Australian Federal Police
- infrastructure including power, water supply, waste services, transport and communications
- support services including health physics, general safety and engineering
- emergency arrangements including a continuously manned alarm centre

The ARPANSA assessor notes that the location provides advantages in terms of infrastructure, proximity to the sources of ILLW and existing site arrangements for support services and emergency response. The ARPANSA assessor considers that the location of the facility is adequately addressed.

2.1.3.3. Description of the Facility

The facility will comprise the following:

- Underground transfer system of waste from the ANM Mo99 facility and/or transfer by flasks
- Storage tanks located in a bunker
- Hot cells for various processes (e.g. Evacuation bake-out Sealing Hot Cell EBSHC, Unloading Hot cell (UHC), Hot Isostatic Press Hot Cell (HHC) etc.
- Transfer Waste Room (TWR)
- Process System Room (PSR)
- Decontamination hot cell
- Active Containment Over Pack (ACOPs) and/or necessary tools are introduced into the cells.
- Hot Isostatic Press (HIP) equipment
- Full scale demonstration plant

The SyMo facility is a proposed purpose built facility at ANSTO to apply Synroc technology for immobilisation of waste from ANSTO's Mo-99 production processes. This plant will be built within a new building to be located near the proposed site for the planned ANSTO Nuclear Medicines (ANM) Facility. The ANM is subject to separate assessment.

The plant is designed to handle current alkaline Intermediate Level Liquid Waste (ILLW) from the Building 54 Mo-99 production plant, future alkaline ILLW from ANM and acidic legacy waste stored in both the Building 57 ILLW tanks and as solid waste in TS1 containers from the previous Mo-99 production plant.

Once waste is processed by the Synroc plant, using specialist equipment inside hot cells, the waste will be incorporated into a consolidated glass ceramic (alkaline waste) or ceramic (legacy waste) form inside a stainless steel container.

Completed Synroc cans will be moved as a batch inside shielded flasks from the new facility to existing ILSW storage pits in B27 for on-going management by ANSTO Waste Operations. The ILSW storage in B27 is operated under Facility Licence F0260.

Conclusion

The facility description includes the location of the facility, the main components comprising the facility and the operating envelope of the facility. The ARPANSA assessor notes that since detailed operating information is not yet available, this will be further assessed when reviewing the operating licence application for the facility. This includes comprehensive operational safety envelope based on detailed risk assessment and mitigation. The ARPANSA assessor considers that the description of the facility and its site as given in the application are acceptable for the proposed conduct.

2.2. PLANS AND ARRANGEMENTS FOR MANAGING SAFETY

Item 4 (Part 1 of Schedule 3 to the Regulations) of the general information that may be requested by the CEO refers to plans and arrangements for managing safety of the controlled facility to ensure the health and safety of people and protection of the environment. It is expected that there are plans and arrangements that describe how the applicant proposes to manage the controlled facility to ensure the health and safety of people, and the protection of the environment.

2.2.1. Arrangements for maintaining effective control [Item 4(a)]

In applying for a facility licence, the applicant may nominate a person or position that would control the conduct for which a licence is sought, and demonstrate how the nominee would maintain that control. The nominee must have appropriate responsibility, with adequate authority and control of material, human and financial resources to ensure safety of the conduct. Ultimate accountability remains with the applicant [3].

The arrangements for effective control have been assessed using the guidelines described in Section 2 of the RG [3] principles described in the relevant RAPS [4] as given below.

2.2.1.1. Accountability of applicant

The licence holder is responsible for maintaining control over all aspects of conducts and dealings and may authorise people to carry out certain actions but the licence holder remains ultimately accountable (RG 1.1-1.4) [3].

The CEO of ANSTO signed and submitted the application, and Mr Sam Moricca, Director of Technology, is the nominee for the facility. The CEO has the ultimate responsibility to maintain effective control and for ensuring compliance with the ARPANS legislation. The nominee is responsible for day to day work and for assisting the CEO in ensuring compliance with legislative requirements.

The ARPANSA assessor considers that the information submitted in relation to accountability of the applicant is acceptable.

2.2.1.2. Organisational arrangements

The licence holder must describe the organisational arrangements for managing the safety of the conduct and dealings to ensure the health and safety of people and the protection of the environment. This should include a description of responsibilities and lines of authority, and information on a quality system covering all activities that may impact on safety (RG1.5-1.20) [3].

Referring to AG2011 *ANSTO Organisation Chart,* the high level ANSTO organisational arrangements are shown in Figure 1 of the Effective Control Plan (SyMo-1310-2-B-AN-0002-B). Ultimate responsibility rests with the CEO who has delegated responsibilities to senior managers. The Director of Technology, ANSTO Synroc is both the delegated nominee for the SyMo facility and is responsible for this construction project. The Synroc division sits under the Business Development General Manager. Once the facility is constructed ANSTO Waste Operations will be in effective control of this facility.

Section 3 of the Effective Control Plan [SyMo-1310-2-B-AN-0002-B] states that ANSTO has a matrix staffing arrangement whereby ANSTO Synroc and other staff are seconded to project teams. In Engineering and Capital Programs (ECP), the Strategic Asset Programs Office (SAPO) sets the project standards for governance and is central to the system of monitoring projects during execution by senior management. Other groups in ECP are the Nuclear Mechanical Services Unit which provides specialist services to the project for licensed equipment, for example, Approval Officers for lifting equipment and pressure vessels. Systems Safety and Reliability section provides specialists' advice on detailed safety assessment.

In the original application it is stated that the Manager of Safety Environmental and Radiological Assurance (SERA) is responsible for safety standards and safety support, including radiation protection within the ANSTO site in general. The Regulatory Affairs Manager of SERA is responsible for liaising with ARPANSA in relation to all regulatory matters.

The Manager of SERA is also the Chair of the Safety Assurance Committee (SAC), and all the significant processes are subject to SAC approval. The SAC approval process provides an independent review of the project plans and submission.

However, following the submission of the application, ANSTO advised ARPANSA in a communication dated 11 February 2013 (D133292) that there were some organisational changes at ANSTO that included:

- A new group, namely, Nuclear Services had been formed
- Radiation Protection Services (RPS), health physics services, and environmental monitoring and instrument calibration will provide these services, which were provided formerly by SERA
- Former Manager of SERA is the Manager of the newly formed Nuclear Services
- Waste Operations of ANSTO Nuclear Operations will report through Nuclear Services.
- The Head, Nuclear Services is also the Chief Nuclear Officer (CNO) who is the Chair of the SAC. The CNO reports to the CEO in order to maintain independency between Waste Operations, Reactor Operations and Radiation Safety.
- WHS will report to the General Manager Human Resources now designated General Manager Human Resources and Work Health and Safety
- The Emergency Response staff will report to General Manager Security and Safeguards
- Regulatory and Safety Assurance will move into the Governance Risk and Compliance function in the CEO

The ARPANSA assessor notes that though there are some changes to the reporting line the functions remain unchanged.

ANSTO characterised this organisational change as a Regulation 52 change and ARPANSA accepted this change (R13/01787).

ANSTO states that organisational arrangements are reviewed periodically. The most recent changes important to all projects onsite at ANSTO including this project have been overhaul of the project governance processes. This resulted in the establishment in ECP division of the Strategic Asset Programs Office which provides project governance standards and project monitoring processes.

The SyMo project has been established within this framework using a matrix approach with staff drawn from ANSTO Synroc and other divisions into a collaborative project team. The organisational chart for SyMo project construction/commissioning is shown in Figure 4 of the Effective Control Plan [SyMo-1310-2-B-AN-0002-B].

The Works Coordinator of the SyMo project is responsible for the onsite construction activities, working together with the main contractor's senior management to ensure that construction work is in compliance with ANSTO's WHS management system and ARPANSA requirements. The person in this role will report to the Project Director for construction activities planning and reporting, and for construction issues resolution. The Works Coordinator (being a SyMo project management representative) together with the overall Project Manager will be responsible for the day to day execution and control of the SyMo project, utilising the full SyMo project team resources and effective contractor management.

The Safety Management Plan is referred to for safety training. The roles of all staff are clearly defined and staff performance is assessed through the ANSTO Performance Appraisal process.

The organisational structure related to the SyMo facility and overall structure of ANSTO shows the line of communication and responsibilities, and is acceptable to the ARPANSA assessor for the proposed conduct. This aspect will further be considered when assessing the operating licence application.

2.2.1.3. Management system

The management system should be consistent with current AS/NZS ISO Standards and clearly documented policies and procedures are in place (RG 1.21-1.25) [3], (RAPS 13-14)[4].

Through the ANSTO Occupational Health, Safety and Environmental (OHSE) Policy, APOL 2.1, ANSTO gives commitments to occupational health, safety, the environment and sustainability. The application also refers to other policies, including those for security, quality, human resources and business, which provide a comprehensive framework. These policies are not reviewed in this assessment report.

There are several mechanisms in place to ensure these policies are available and understood. They include circulating through the intranet, discussion at regular staff forums held by the CEO and within the divisions, and through safety training programs.

The commitment to radiation safety objectives is given through ANSTO Radiation Safety Standard, AS 2310. The objectives include ALARA, setting dose constraints and meeting the statutory limits including RPS No.1.

ANSTO states that the documents supporting the policies are certified under the AS/NZS ISO 9001 quality management system and the AS/NZS ISO 14001 environmental management system. These systems ensure that there are procedures for document control and records management. The safety standards and requirements are contained in the Workplace Health and Safety (WHS) Management System which is within the SERA division's AS/NZS ISO 9001 system. The management systems are subject to

monitoring and audit (both internal and external) to determine the effectiveness as required by ISO certifications.

The ARPANSA assessor considers that the elements of the management system described in the application are acceptable. The ARPANSA assessor notes that previously ANSTO has successfully undertaken major projects.

2.2.1.4. Resources

The licence holder is responsible for ensuring that adequate and appropriate human, financial and material resources are available (RG 1.26-1.30) [3].

The application refers to organisation structure related to position descriptions for functions and responsibilities.

The application states that safety resource requirements are identified at several levels. For each potentially hazardous process or activity, a hazard identification and risk assessment following the ANSTO WHS Risk Management Standard (AS 2301) is performed which identifies the required equipment, including personal protective equipment (PPE). Referring to ANSTO Capital Process (ANSTO AR 2682) the Application states that the ANSTO project management and approval processes ensure there is sufficient funding available for the necessary equipment and people resources. The funding is approved in stages by the ANSTO Capital Investment Committee (CIC) comprising senior management and the projects are monitored throughout their lifecycle by the CIC. In addition, other services, training of staff members will be available. As a Commonwealth organisation ANSTO has been in operation for about sixty years with continuous Commonwealth support.

The ARPANSA assessor considers that ANSTO has adequate resources for the proposed conduct.

Conclusion

The application describes the line of responsibility and functions in maintaining control over all aspects of conducts and dealings for siting and construction. Arrangements to effectively control technical, administrative and human factors, ISO accredited management system and adequate human, financial and material resources are available for the proposed conduct. The arrangements for maintaining effective control for the proposed conduct are acceptable to the ARPANSA assessor.

2.2.2. Safety management plan [Item 4(b)]

The application should include a Safety Management Plan that demonstrates that safety management practices are in accordance with internationally accepted principles and practices and duty of care obligations [3].

The arrangements for managing safety in the facility have been assessed against the guidelines described in the RG [3] and the principles 1, 7-9 in the RAPs [4].

2.2.2.1 Safety Culture

The licence holder is responsible establishing safety as the organisation's highest priority consisting with international best practice and positive safety attitudes are encouraged by senior management (RG 2.1 2.19) [3], (RAPS 1, 3,6-9)[4]. A safe organisation will, at all levels, possess shared values and beliefs for safety that produce behaviour norms that provide appropriate and demonstrable attention to safety [5].

The safety culture during pre-operational phases is important to the ultimate safety of the operational facility because the initial design and any subsequent changes and compromises made during construction can impact on the safety of the operating plant. In addition, retrofit of some systems and components may significantly impact on some design safety features and may result in complexities arising from radioactive contamination.

Considering that the construction of the facility will involve high reliance on contractors and their sub-contractors it is important that ANSTO focus on a cross organisational safety culture during construction. It is expected that ANSTO will emphasise on safety in the placement of contracts, the careful selection of contractors, site induction and training courses, and on high quality supervision of works. For this facility the safety culture focus should cut across direct construction safety to quality management to ensure that the constructed facility can be operated safely by meeting high standards and specifications.

The application makes a number of references to documents to illustrate that safety is a recognised value at ANSTO but is less informative on how these values are conveyed to its contactors. For example the application states that the ANSTO strategic directions emphasise the goal of ensuring that ANSTO facilities and activities are safe (SyMo-1310-2-B-AN-0003-B).

ANSTO gives commitment to ensure safety of all staff and the public through its policy, APOL 2.1Occupational Health, Safety and Environment Policy. ANSTO also have explicit policies and procedures covering contractor safety and supervision. During the construction of the ANSTO SyMo Facility, ANSTO states that the Synroc division will formulate and execute the project activities incompliance with AG2389 Occupational Health and Environment Management Arrangements (hereafter called the "safety arrangements") which implement the safety requirements of the strategic plan and safety policy. The safety policy and safety arrangements are readily available to and accessed by staff on the ANSTO intranet. However, the application does not present information regarding the safety or specific quality requirements of contracts. It is acknowledged that ANSTO does have a track record of safely managing projects involving significant contractor activity. For example: Moata and National Medical Cyclotron decommissioning projects where ANSTO was effective in its promotion of safe behaviours in the contractor selection, training and supervision. The SyMo application also says little in regard to the link between safety culture and its impact on quality which as explained above may have an effect on the safety during operational life. The ARPANSA assessor notes that safety is a recognised value for ANSTO staff and there is a recent history of ANSTO promoting safety values to its contractors. It can be concluded that the application meets regulatory requirements for this stage of the project and these issues can be further explored during the regulatory assessment of applications to construct items important to safety.

In regard to leadership for safety many aspects are difficult to gauge from the application due to the characteristics of safety leadership rather than a weakness in the application itself, i.e. some leadership attributes are better observed than prescriptively written. ANSTO states that it encourages a questioning attitude and adopts a rigorous and prudent approach to work incorporating conservative decision making. ANSTO provides appropriate training and awareness instilled by safety briefings, toolbox talks, safety inspections and use of the STAR (Stop, Think, Act, Review) principle that help to engender such an approach to work. ANSTO also uses a well-developed event management system that provides an effective mechanism for workers to raise issues including safety and quality through to management. This system links into ANSTO organisational learning and change management systems and will be accessible to both ANSTO staff and contractors. ANSTO states that through the independent SAC approval process it ensures that implementation of safety requirements is not subject to inappropriate commercial pressures. The ARPANSA assessor notes that such practices (e.g. safety briefings, toolbox talks) are in place for other existing licensed facilities and provide generally acceptable

emphasis on safety by ANSTO leadership as well as a two way mechanism to pass feedback up to ANSTO's management.

ANSTO states that during the construction and commissioning, a daily start-up toolbox talk will be held with the workers to discuss safety and operational issues prior to commencing scheduled work. The ANSTO WHS Advisor will be available to provide advice on safety issues associated with the work, including Radiation Protection Services staff advising on any radiological risks using sealed sources during cold commissioning. ANSTO have not explicitly mentioned the use of these toolbox meetings to discuss quality control and the resolution of construction issues. In practice, it is obvious that these issues will be discussed but it goes to illustrate that ANSTO appears to have missed the connection between the quality of construction and the operating phase safety as being important to ARPANSA's licensing decision.

ANSTO states that at the organisational level, the CEO holds regular forums for all staff and promotes a safety theme. The Synroc division has a regular forum at which safety issues are discussed and workplace audits are scheduled and reviewed. This forum will include safety issues from project execution works, including this SyMo facility project.

The Synroc Quality Management System (QMS) will monitor the safety indicators for this project and implement measures that are required to improve operational and safety performance.

The application states that all safety related events/incidents will be reported and investigated in accordance with the ANSTO *OHSE Guide AG-2372, OHSE Management – Event Reporting, Event Response Process*. In practice ANSTO is in the process of introducing a new event reporting system which will be used during construction. Importantly this will encompass quality, environmental and relationship events along with safety events and provides an improved capacity to influence operational aspects which may have an impact during the operational phase of the facility as well as during the construction phase. This should provide a good basis for learning driven safety.

ANSTO states that safety issues and learning are communicated to staff in several ways. Toolbox talks are the main forum for the construction work itself. Feedback to Synroc management will occur through the Works Coordinator with input from the construction supervisor, using both routine verbal discussions and through formal project reports. This works coordinator will report to both the SyMo Project Manager and the nominee, who together will monitor issues relating to the facility licence.

At the organisation level, ANSTO conducts periodic surveys on safety culture. The most recent was in 2010 by external consultants engaged by the SERA division. ARPANSA assessor notes that survey on safety culture are also undertaken at other divisions of ANSTO.

The application describes relevant aspects of safety culture including commitment to the highest level of safety, consultation mechanisms, contractor supervision, communication of safety matter, which are acceptable.

The ARPANSA assessor has concluded that the application shows that there is a project framework and arrangements around which ANSTO can build an acceptable safety culture during the construction phase of the project. ARPANSA will undertake inspections and/or site visits during the construction phase which will aim to evaluate whether good safety practices are implemented in the workplace. Importantly, during the construction phase, these should concentrate on quality and compliance to specifications rather than conventional workplace safety.

2.2.2.2 Administrative Arrangements

The licence holder is responsible for ensuring that the organisation has recognised its responsibility for ensuring the health and safety of people and protection of the environment (RG 2.20-2.29) [3].

Section 3 of the Safety Management Plan (SyMo-1310-2-B-AN-0003-B) states that the construction oversight role will be managed by the ANSTO Synroc division following both their project management procedures documented in their QMS, project specific plans, and also applying ANSTO's WHS management system for oversight of the main contractors WHS related activities. For the hazardous activities, specific Safe Work Method Statements (SWMES) will be prepared which identify the hazards and necessary safety controls. The final version of these SWMES will involve the personnel actually performing the work. No detailed aspects of project management procedures have been assessed for this report.

ANSTO procedures will be in place to manage contractors. SWMES will be used to identify the hazards and their corresponding controls. The principal/main contractors' onsite works will be managed via the Works Coordinator working closely with the main contractors' construction manager. The main contractor will use its own safe work permitting system within the construction site which meets the requirements of the ANSTO safety systems, including permit process AG-2408 Safe Working Permit (SWP). ANSTO staff working on the construction site will need to obtain permits through the main contractor principally responsible for the construction site control.
Appropriate induction training and safety specific training including radiation safety training for radiation workers will be in place during cold commissioning. During this project the safety requirements will be reinforced by the works supervisors and in routine toolbox safety talks.

ANSTO Guide AG-2384 *Information for visitors* will be used to control visitors. In addition, ANSTO staff members will have control of the access by visitors as required.

The ARPANSA assessor considers that the administrative arrangements for lines of responsibility in ensuring health and safety of people and the environment are acceptable for the proposed conduct. This matter will be further considered when assessing the operating licence application for the facility.

2.2.2.3 Safe Premises, Building and Equipment

The licence holder is responsible for providing a safe working environment including considering appropriate standards and conservative proven design and engineering practice in design and construction (RG 2.30-2.37) [3], (RAPS 10-12) [4].

The Synroc process is an in-house technology developed by ANSTO over the past 30 years. ANSTO has adopted similar designs used in the USA and UK to immobilise high level waste. The design aspects are assessed under *Item 8* and *Item 11* of this report. ANSTO states that the design of the buildings will be in accordance with the Building Code of Australia (BCA).

Section 4 of the Safety Management Plan (SyMo-1310-2-B-AN-0003-B) states that the working areas of the SyMo facility will be classified according to ANSTO Guide, AG-2509 *Classification of Radiation and Contamination Areas*. For construction purposes, all areas will be classified as white. During non-radioactive testing as part of commissioning, some sealed radiation sources (e.g. gauges) may be used for inspection purposes, which may temporarily change area classifications. Section 4.11.5 of the SyMo PSAR provides designation of areas in terms of radiological significance. This will be controlled by the ANSTO Radiation Protection Advisor. Local notice boards and toolbox talks will be used to inform staff, contractors and visitors of hazards and controls in each area in accordance with AG-2414 *Safety Hazard Notice Board Process*.

ANSTO states that there will be start-up checklist and daily inspections of work areas by supervisory staff; a program of housekeeping inspections by management and inspections of the construction site by authorised site inducted ANSTO project staff will be scheduled.

Prior to undertake the onsite activity, SWMES will be prepared once the construction sequencing and specific methods are decided. Contractors will use their Work Health and Safety Management Plan to prepare detailed SWMES.

Where appropriate the main contractors Safe Work Permit system will be used to control specific tasks within the construction site such as hot works and electrical isolations. ANSTO Guide AG-2458 *Electrical Safety- Inspection and Testing* will be used to check and tag all electrical equipment.

ARPANSA assessment of hazards associated with this facility is assessed under *Item 11* in Section-2.4.4 of this report.

The ARPANSA assessor considers that the arrangements for safe premises, building and equipment area acceptable for the period of construction. This matter will be further considered when assessing the operating licence application for the facility

However, for construction of items of plant that will come into direct contact with the radioactive waste material during the Synroc process ANSTO will require prior approval of the CEO of ARPANSA. The ANSTO submission must demonstrate that the design is informed by a comprehensive risk identification and hazard assessment process and that construction will be undertaken in accordance with an appropriate quality management system.

2.2.2.4 Competency, Training and Supervision

The licence holder is responsible for ensuring the arrangements are in place for identifying and transferring knowledge and skills needed to ensure that all activities are undertaken by competent and authorised staff, appropriate supervision is in place (RG 2.38-2.55) [3].

Section 5 of the Safety Management Plan [SyMo-1310-2-B-AN-0003-B] states that potentially hazardous works are performed and supervised by properly authorised and qualified staff. Recruitment and selection of staff and long-term contractors is based on the technical and personal selection criteria for the role. These criteria include the qualifications, knowledge and experience appropriate for the work. Radiation protection personnel are extensively trained. The Radiation Protection Advisors (RPA) are recruited with the necessary knowledge, skills and experience or are trained and authorised within ANSTO. The Health Physics Surveyors (HPS) are given comprehensive theoretical and practical training and are authorised within ANSTO. The ARPANSA assessor notes that ANSTO provides radiation training to external clients and offers external radiation safety courses.

ANSTO states that contractors involved in the construction work will be subject to appropriate training including site specific inductions performed by the main contractor responsible for the construction site. Any necessary task-specific training will be identified in the job planning and SWMES processes. Visitors needing to enter the construction site area will be escorted by site inducted ANSTO staff who will explain the hazards and the controls in place.

ANSTO provides training to staff through appropriately qualified staff including task specific training prior to assigning the job. Training records are maintained in the ANSTO Pathlore training management system. A record of the construction site inductions will be maintained by the principal/main contractor.

The ARPANSA assessor considers that the arrangements for identifying skill and competency requirements, training, and supervision of staff, contractors and visitors are satisfactory.

2.2.2.5 Visitors, Contractors and Other Persons

The licence holder is responsible for ensuring safety of anyone entering a workplace including contractors, their employees and visitors (RG 2.55-2.62) [3].

Section 6 of the Safety Management Plan (SyMo-1310-2-B-AN-0003-B) states that all workers (including ANSTO direct staff, agency staff, and long-term contractors) are treated as ANSTO staff in terms of safety training and requirements and there are special arrangements for short-term contractors and visitors.

The new SyMo Facility building access will be controlled by the ANSTO security swipe card system (from cold commissioning onwards) and only inducted, approved staff and approved contractors will be given unaccompanied access. ANSTO staff will escort any visitors.

Short-term contractors undertake contractor induction training (general ANSTO site) and a short radiation safety course. ANSTO requires contractors to demonstrate their knowledge of the hazards and safety controls by their involvement in the preparation of the SWMES and their sign-off of these documents prior to doing their works. The main contractor ensures control of high risk works on the construction site by requiring sign-off of a safe work permit as relevant for the task before work commences.

The ARPANSA assessor considers that controls in place for visitors, contractors and other persons are acceptable to maintain a safe workplace.

2.2.2.6 Control of Hazards

*The licence holder or applicant is responsible for ensuring that all hazards associated with conducts and dealings are appropriately controlled (RG 2.63- 2.68) [*3].

Section 7 of the Safety Management Plan (SyMo-1310-2-B-AN-0003-B) states that for control of hazards ANSTO applies the SAC process which reviews the overall project safety approach, through to the SWMES process which identifies hazards and controls for individual tasks. The SWMES process ensures that workers identify hazards, evaluate risks and know of the controls implemented for the work task. The safe work permit (SWP) process ensures that contractors know of the hazards and accept the controls for the area. The SWP also provides approval control for the manager in charge of the area. ANSTO will reinforce this by the daily toolbox safety talks with the workgroups.

The application is supported by ANSTO SAC approval, 1931/12, for siting and construction of the SyMo facility taking into account the risk assessment and hazards analysis of the proposed conduct.

For the construction and cold commissioning activities, an overall plan for safe construction activity will come from the Contractors WHS Management Plan and then SWMES conducted for work tasks as construction proceeds. These SWMES will be developed with input from project personnel, Radiation Protection Services staff and the WHS Advisor.

The ARPANSA assessor considers that the arrangements for controlling hazards are acceptable for the proposed conduct. This matter will be further considered when assessing the operating licence application for the facility.

2.2.2.7 Deviations, Anomalies, Incidents and Accidents

The licence holder is responsible for ensuring that arrangements are in place and are implemented for dealing with deviations, anomalies, incidents and accidents arising from conducts and dealings, and these arrangements are regularly reviewed and updated in accordance with international best practice (RG 2.69-2.73)[3].

The application states that the ANSTO event reporting system, AG-2372 Event Response Process, will be used to capture hits, deviations, incidents and accidents. Incidents/events will be followed-up by an initial investigation by supervisory staff and a later review by the line manager or investigator with sign off by the division General Manager. All reports will be recorded in the ANSTO system which is managed by the HSS (Health and Safety Services) section in SERA, now renamed Nuclear Services Group. Outstanding event reports will be monitored by key performance indicators prepared by the HSS section and reviewed fortnightly in ANSTO Synroc management team meeting.

ANSTO states that the main contractor will take principal management and control for the construction site, and ANSTO will have an oversight role only to monitor their activities. For event reporting, any incidents on the construction site must be reported first through the main contractors system, and then also fed through the ANSTO reporting system (as per new WHS laws). Notwithstanding, any dangerous occurrences must be reported to COMCARE within 24 hours. Any ANSTO staff member involved in an incident on the construction site must also follow these arrangements.

The application refers to ANSTO Guide, AG-2376 *Reporting to ARPANSA*, for reporting requirements to ARPANSA.

The arrangements to deal with deviations, anomalies, incidents and accidents are acceptable to ARPANSA. This matter will be further considered when assessing the operating licence application for the facility.

2.2.2.8 Audits and Reviews

The licence holder is responsible for ensuring that arrangements are in place and are implemented for the assessment of all aspects of the safety management system through audits and reviews to ensure compliance with the ARPANS legislation and consistency with international best practice (RG 2.74-2.78) [3], *(RAP 41)* [4].

Section 9 of the Safety Management Plan (SyMo-1310-2-B-AN-0003-B) states that there are arrangements in place to audit and review both the main contractor's safety system and the implementation of the system for the construction site work areas. WHS Audits will take place at key milestones and set intervals according to AF 1502 *Construction Site WHS Audit* or equivalent. The SERA division maintains ISO9001:2008 certification of its procedures and conducts regular management reviews and audits of the WHS systems and procedures.

The ARPANSA assessor notes that ANSTO has systems for both internal and external audits for the existing facilities.

The ANSTO systems for audits and reviews are acceptable to the ARPANSA assessor.

2.2.2.9 Records and Reporting

The licence holder is responsible for maintaining and retaining records relevant to health and safety information associated with conducts and dealings (RG 2.79–2.84) [3].

ANSTO's quality management system is certified to the ISO 9001:2008 and environmental management system with ISO 14001:2004. The WHSMS is a component of these systems. Proper implementation of this system ensures appropriate reporting and retention of records.

The application refers to SERA document, QSERP S-QM Quality Manual, for requirements for safety records and reporting. Further, general requirements for safety records are given in QSERP S-P-003 Control of Records which details the storage locations, retention periods and responsibilities for maintaining the records. The specific requirements for radiation safety records are given in QSERP S-ROH-G-002 Radiation Protection Services Records Management. This includes the requirements for maintaining dosimetry records, including retention for the required periods and for health physics records, including survey results, log books and stack sampling results. For radiation workers dose records are available on termination of employment. The referred documents are not reviewed in this report as they have already been reviewed in relation to the existing facilities.

The training records are maintained in a database management system called Pathlore and the construction site specific induction training records will be maintained by the main contractor.

ANSTO event reports and records are maintained by the HSS section in SERA division. Medical records associated with any minor construction site injuries will be maintained confidentially by the main contractor's WHS supervisor. Medical records associated with more serious injuries are maintained confidentially by both the main contractor's WHS supervisor and the ANSTO Occupational Health Nurse and Workers Compensation Officer in ANSTO Medical Services.

The ARPANSA assessor considers that the arrangements for records and reporting are satisfactory.

Conclusion

The ARPANSA assessor considers that arrangements, procedures and polices described and/or referred to in the application for managing safety during the siting and construction phases of the facility are acceptable. This aspect will be further considered when assessing the licence application for operation of the facility.

However, for construction of items of plant that will come into direct contact with the radioactive waste material during the Synroc process ANSTO will require prior approval of the CEO of ARPANSA. ANSTO's submission must demonstrate that the design is informed by a comprehensive risk identification and hazard assessment process and that construction will be undertaken in accordance with an appropriate quality management system. Further details are presented in Section 2.4.2 of this report.

2.2.3. Radiation protection plan [Item 4(c)]

The applicant is responsible for ensuring that arrangements are in place for meeting their responsibilities towards radiation protection and nuclear safety [3].

The arrangements for radiation protection have been assessed against the guidelines described in section 3 of the RG [3] and the principles 57-62 of the RAPs [4].

2.2.3.1 Principles of Radiological Protection

The licence holder should ensure that conducts and dealings are justified, radiation protection system is optimised, dose limits remain within the statutory limits, there is net benefit from the conducts and dealings and doses are ALARA (RG 3.1-3.5) [3], (RAPs 57-62) [4].

Section 3 of the Radiation Protection Plan (SyMo-1310-2-B-AN-0004-B) describes the principles of radiation proetection including justification of the expected radiological exposure, optimisation of radiation protection and limiting the doses to operators and to members of the public.

It is expected that there will be very low or essentially no exposure during siting and construction of this facility.

As part of the optimisation process ANSTO has a dose constraint of 15 mSv/year or occupational workers and an annual ALARA objective of 2 mSv. In addition, currently ANSTO has an investigation level for effective dose of 1mSv per month. For members of the public the dose constraint is 300 µSv/year, and the annual ALARA objective for members of the public is 20 µSv.

ANSTO has given commitment to comply with statutory dose limits in the Regulations, and also to the recommendations of international organisations such as the IAEA and ICRP. The SyMo Facility is committed to ensure that, for all activities at the facility, effective radiation doses (including committed effective radiation doses) to occupationally exposed persons and members of the public do not exceed any dose constraints for the facility.

The ARPANSA assessor considers that proposed principles of radiation protection described in the application are acceptable.

2.2.3.2 Radiation Safety Officer

The licence holder is responsible to appoint a suitably qualified RSO as appropriate to undertake specific duties (RG 3.6-3.8) [3].

The SERA division, now renamed as Nuclear Services Group, will provide radiation protection services staff to the proposed facility. This includes a Radiation Protection Advisor (RPA), Health Physics Surveyor (HPS) and related services during the siting and construction of the facility.

The RPA is an experienced professional trained in radiation protection who advises the Works Coordinator, employees, visitors and contractors during the construction of the SyMo Facility on radiation protection issues, safe working practices, relevant standards and the optimisation of operational radiation protection measures. The RPA assists staff with improvements in radiation safety at a practical operational level through the review of working practices and input into working procedures.

The RPA will advise on the commissioning, development, application and modification of facility procedures, instructions and written work systems for all activities where radiological safety assessment is required.

The provision of a RSO or its equivalent and his/her roles and responsibilities, knowledge and skills described in the application is acceptable to the ARPANSA assessor.

2.2.3.3 Radiation Safety Committee

The licence holder is responsible to appoint a suitably qualified RSC as appropriate to undertake specific duties (RG 3.6-3.8) [3]

Radiation protection services will be provided by the SERA, now renamed as Nuclear Services Group, during the siting and construction of the facility. The RPA will advise on the monitoring programs and their implementation, and their review as required. The HPS will perform radiation monitoring surveys of areas identified by the RPA.

The services to be provided by SERA are equivalent to that provided by a RSC. This matter will be further considered when assessing the operating licence application for the facility.

2.2.3.4 Planning and Design of the Workplace

The planning and design of the workplace should ensure that planning and design take into account relevant codes and standards and international best practice to minimise the exposure to radiation. It is expected that appropriate engineering controls are in place to minimise the reliance on administrative controls (RG 3.21-3.22) [3].

Section 4 of the Radiation Protection Plan (SyMo-1310-2-B-AN-0004-B) describes the radiological hazards, their levels and the corresponding controls considered in the design to minimise the exposure. The design features include:

- Shielding of various process equipment
- Hot cells
- Interlocks
- Area monitors
- Audio-visual alarms
- Active ventilation system
- Scrubber tank
- Portable monitoring instrument
- Stack monitoring
- Airtight doors and penetrations

The ARPANSA assessor considers that the design features in terms of engineering controls to minimise the exposure to radiation as described in the application are acceptable. This matter will be further considered when assessing the operating licence application for the facility. Further details of assessment of design are presented in Section 2.4.1 of this report.

2.2.3.5 Classification of Work Areas

It is expected that areas are classified in accordance with the levels of exposure involved, and there is appropriate delineation of areas by appropriate means. Accesses to the areas are controlled by local rules and procedures, use of personal protective equipment and appropriate warning signs are in place (RG3.24-3.36) [3].

Section 5 of the Radiation Protection Plan (SyMo-1310-2-B-AN-0004-B) states that ANSTO WHS Radiation Safety Standard AS2310 will be followed for radiological classification of areas to control, prevent, limit and review occupational exposure (actual or potential) to ionising radiation. This system of radiological classification ensures that occupational dose limits and dose constraints are not exceeded, and is part of the process of ensuring that doses to individuals are kept ALARA.

ANSTO states that the area classification for the construction site for the SyMo Facility is White Radiation and White Contamination. The initial area classification for the operation of the facility will be determined by the Radiation Protection Advisor in consultation with the appointed Facility Manager and the Area Supervisors. Section 4.11.5 of the SyMo PSAR provides designation of the areas in terms of radiological significance.

Details of access and exit controls and local procedures are not available. This information will be considered when assessing the operating licence application for the facility.

The ARPANSA assessor considers the information provided in relation to classification of work areas are acceptable.

2.2.3.6 Local Rules and Procedures

The licence holder is responsible for ensuring that local rules and procedures are in place and are implemented to provide an adequate level of protection, safety and supervision for controlled persons and visitors (RG 3.37-3.47) [3].

No local rules related to radiation protection such as entry and exit procedures, rules and responsibilities, monitoring of work place are available. These arrangements are related to operation of the facility and will be considered when assessing the operating licence application for the facility.

2.2.3.7 Personal Protective Equipment

The licence holder is responsible for ensuring that there is provision of adequate and appropriate personal protective equipment (RG 3.48- 3.52) [3].

Section 6.1 of the Radiation Protection Plan (SyMo-1310-2-B-AN-0004-B) states that during the construction phase of the SyMo Facility, there will be no requirement to protect against radiological hazards as the construction site area classification is White Radiation and White Contamination.

The application refers to the following ANSTO guidelines for PPE (Personal Protective Equipment):

- AG 2511 *Clothing to be worn in Classified Radiation Areas*
- AG 2512 *Clothing Change Procedures When Entering or Leaving Classified Areas*

The PPE shall be determined against the nature of the hazard and the work that is being undertaken however the minimum requirement for work in the classified areas will be:

- Laboratory Coat
- Enclosed shoes with Overshoes
- Gloves
- Safety eyewear (as appropriate)

The information provided for PPE is acceptable for the proposed conduct. This matter will be further considered when undertaking assessment for ANSTO's application for operating the facility.

2.2.3.8 Monitoring of Workplace

The licence holder should have a documented workplace monitoring program supported by procedures and rules (RG 3.53-3.60) [3].

The application states that (Section 7 of the Radiation Protection Plan) radiation monitoring programs will be in place to confirm adequate protection and optimisation of radiation protection measures.

The application states that routine area monitoring will be performed, to an audit programme, by HPS staff for the purposes of:

- Confirmation that dose rates and contamination levels within and around the controlled areas of the SyMo Facility are within agreed parameters
- Confirmation of the area classifications within the SyMo Facility

ANSTO states that during the construction phase of the SyMo Facility, there will be no requirement for routine audit based monitoring.

Task based radiological monitoring will also be performed within the SyMo Facility; this monitoring will principally be performed by trained staff from the SyMo Facility following agreed procedures and with clear 'pass/fail' criteria (as defined by the RPA). The application states that during the construction phase of the SyMo Facility, task based monitoring may be required during non-radioactive testing activities if sealed radioactive sources are used.

The application foreshadowed the type of radiation monitoring instrumentation including area monitors, in-cell monitors, portable contamination monitoring, ventilation and liquid effluent monitoring etc. The ARPANSA assessor notes that ANSTO has a program for annual calibration of monitoring equipment.

The ARPANSA assessor considers that principles and practices to be followed for workplace monitoring are acceptable. This matter will be further considered when assessing the operating licence application for the facility.

2.2.3.9 Monitoring of individuals

The licence holder should have arrangements to monitor individuals including visitors and contractors and record the results of monitoring and report abnormal dose results if there is any (RG 3.61-3.71) [3].

Section 7.2 of the Radiation Protection Plan states that occupationally exposed persons will be monitored as part of routine dosimetry program. ANSTO OHSE Guide AG 2521, *Radiation Safety-Exposure Monitoring & Health Surveillance*, describes the monitoring of individuals and surveillance including investigation level.

Considering that the activities involved in siting and construction would be primarily civil, mechanical and electrical works it is expected that the amount of exposure involved will be very low. The current ANSTO arrangements described in the application are adequate for the proposed conduct.

The ANSTO personal dosimetry program requires the TLD issue/assessment period for routinely exposed staff is monthly and for occasional visitors or students quarterly. Staff entering the radiological controlled areas will be required to wear electronic personal dosimeter (EPD). Staff exiting the controlled areas will require self-monitoring for contamination.

ANSTO states that when the SyMo Facility is operational whole body monitoring will comprise part of individual monitoring program, and this matter will be further considered when assessing the operating licence application for the facility.

2.2.3.10 Monitoring the Environment

The licence holder is responsible for ensuring appropriate arrangements for monitoring the environment (RG 3.72-3.77) [3].

Considering the nature of the conduct (siting and construction) there is no potential for release of radioactivity to the environment and there are no radioactive gaseous discharges to the environment from the facility at this stage. Therefore, environmental monitoring is not applicable to this facility. However, the design of the facility has taken into account the controls to be in place during operation of the facility. This includes gaseous discharge monitoring system and the active ventilation system.

The ARPANSA assessor will consider this matter when assessing the operating licence application for the facility.

2.2.3.11 Transport

The licence holder is responsible for ensuring appropriate arrangements for on-site and off-site transport of radioactive material in accordance to legislative requirements (RG3.37-3.50) [3].

Section 9 of the Radiation Protection Plan gives commitment to comply with the ARPANSA Code of Practice for Safe Transport of Radioactive Material for off-site transport of radioactive material. Items and waste products leaving the facility or moving between contamination controlled areas require health physics monitoring and clearance.

The ANSTO OHSE Guide-Radiation Safety- Movement and Transport, AG 2515 provides step by step guidance on responsibilities and requirements to be followed for safe transport of radioactive material. This includes controls in movement, packaging, labelling, contamination levels, reporting of incidents/accidents, non-conformance control. The design of the facility has incorporated the provision of loading the vitrified waste on a dedicated vehicle for transporting the waste to B27 for storage.

It is expected that the siting and construction conduct will not involve notable amount of on-site transport of radioactive material. This matter will be considered when assessing the operating licence application for the facility.

Conclusion

It is expected that siting of the facility may involve very low level exposure to radiation. Though the application describes relevant arrangements for radiation protection including principles of radiation protection, expected design controls, radiation monitoring programs, the ARPANSA assessor notes that more information will be provided for planning and design of the workplace and local rules and procedures for radiation protection in the application for operating licence for the facility. Further details of radiation protection plan will be considered when assessing the operating licence application for the facility.

The ARPANSA assessors consider that the arrangements for radiation protection plan for the siting and construction of the SyMo facility are acceptable.

2.2.4. Radioactive waste management plan [Item 4(d)]

The arrangements for managing radioactive waste have been assessed against the guidelines of section 4 of the RG [3] and the principles 68, 69, 73-76 of the RAPs [4].

2.2.4.1 Management of Radioactive Waste

The applicant must provide arrangements to protect the health and safety of people and to protect the environment from hazards arising from the handling, treatment, storage, discharge and disposal of any radioactive waste expected to arise from any conduct. The arrangements should address appropriate codes and standards; the physical, chemical and radiological characteristics of the waste; methods of

minimising the volumes and activities of radioactive wastes generated; the treatment, storage, disposal and discharges of radioactive wastes; and the control, monitoring, recording and reporting of wastes (RG 4.1-4.18) [3], (RAPS 68, 69, 73-76) [4].
Section 2 of the Radioactive Waste Management Plan [SyMo-1310-2-B-AN-0005-B] states that the construction and cold commissioning process is not expected to generate any significant radioactive waste. It also states that all wastes are handled by ANSTO Waste Operations under a separate licence using existing procedures.

Section 5.1 of the Radioactive Waste Management Plan [SyMo-1310-2-B-AN-0005-B] describes various types of solid wastes expected to be generated during operation of the SyMo facility including intermediate level solid waste (ILSW) and low level solid waste (LLSW). ILSW comprise HIPed cans and general cell waste, and LLSW comprise cell decontamination waste, spent resin columns from off-gas system and active ventilation filter media.

Low level liquid waste (LLLW) and intermediate level liquid waste (ILLW) will also be generated during operation of the facility. LLLW includes condensed water vapour from the dryer and calciner, discharged waste water from off-gas scrubber and demineralised water used for the decontamination of selected hot cells. ILLW includes any liquid wastes above the limits of LLLW.

The ARPANSA assessor notes that the proposed conduct will not generate any notable radioactive waste and expects that details of the procedures for managing these wastes will be described in the application for an operating licence for the facility. Further details of risk identification and hazard analysis are presented in Section 2.2.2 of this report.

The ARPANSA assessor considers that relevant procedures applicable to this facility should be developed during the construction stage, and details of the procedures to be used in this facility need to be provided in the application for an operating licence.

2.2.4.2 Limiting Exposure to Radioactive Waste

The licence holder is responsible for limiting the exposure to operators and to the members of the public during handling, treatment, transport, storage and transfer of radioactive waste (RG 4.9-4.41) [3].

No information is available related to limiting exposure to radioactive waste. ARPANSA assessor notes that no significant amount of radioactive waste will be generated during siting and construction phases.

The ARPANSA assessor notes that Section 4 of the SyMo PSAR describes the systems and their safety features to be in place to limit the exposure from the radioactive waste including hot cells complex, transfer system, shielded rooms, active ventilation systems and interlocks.

The ARPANSA assessor will assess details of arrangements when assessing the operating licence application for the facility.

2.2.4.3 Packaging and Containment of Radioactive Waste

The licence holder is responsible for ensuring that radioactive waste are packaged and contained appropriately to minimise dispersion and to limit external exposure (RG 4.32-4.38) [3].

Though the proposed conduct will not involve any packaging and containment of radioactive waste, Section 5.1 of the Radioactive Waste Management Plan states that ILSW, to be generated during operation, will be properly packaged inside a retrievable bin and transported to B27 for long-term storage [Note: This facility is licensed to store intermediate level solid waste]. LLSW will be packaged and

stored according to the existing procedures of ANSTO Wastes Operation. However, details of such procedures should be explicitly referred to in the application for an operating licence for the facility.

The ARPANSA assessor considers that details of procedures for packaging and segregation need to be provided in the application for an operating licence for the facility.

2.2.4.4 Interim Storage of Radioactive waste

The licence holder is responsible for ensuring the radioactive waste in an appropriate interim store, which ensures safe and secure operation (RG 4.39-4.46) [3].

It is expected that the proposed conduct will not involve any interim storage of radioactive waste. The ARPANSA assessor notes that the final containment of the waste canister has not been finalised, and this aspect will be considered when assessing the operating licence application for the facility.

This aspect will be considered in future assessment of an application to move to the operating stage.

2.2.4.5 Documentation of Radioactive Waste

The licence holder is responsible for ensuring details of radioactive waste including nature, location, safety and security procedures are appropriately documented (RG 4.47-4.51) [3].

It is expected that essentially no radioactive waste will be generated during the proposed conduct. The Radioactive Waste Management Plan (SyMo-1310-2-B-AN-0005-B) does not provide clear information about documentation of radioactive waste. However, Section 10 of the Effective Control Plan describes the records and reporting and ISO Certification of Quality System. The ARPANSA assessor notes that the ANSTO Waste Operations Quality System is certified under ISO 9001 and the facilities of Waste Operations have a good documentation system for radioactive waste.

When the facility is approved for operation it will be under the effective control of ANSTO Waste Operations and its documentation of radioactive waste has already been assessed for Facility Licence F0260.

2.2.4.6 Routine Discharge of Radioactive Waste to the Sewer

The licence holder is responsible for ensuring radioactive wastes which is to be discharged to the sewer is disposed of safely (RG 4.52-4.59) [3].

Section 3 of the Radioactive Waste Management Plan (SyMo-1310-2-B-AN-0005-B) states that during the construction and cold commissioning phases there will be no radioactive liquid waste generated and hence no radiological discharges to the sewer or environment. The ARPANSA assessor notes that any discharge from the site is subject to the licence conditions of existing ANSTO Waste Operations (F0260).

2.2.4.7 Routine Discharge of Radioactive Waste to the Atmosphere

The proposed conduct will not involve any routine discharge of radioactive waste to the atmosphere. However, during operation of the facility there will be negligible amount of radioactive particulate discharges and details of which will be confirmed during the Off Gas System Prototype test. The ARPANSA assessor notes that any airborne discharges will be subject to compliance with the existing ANSTO Waste Operations Licence (F0260).

2.2.4.8 Routine Discharge of Solid Radioactive Waste to Municipal Tip

ANSTO does not discharge solid radioactive waste to the municipal tip.

2.2.4.9 Routine Discharge of Radioactive Waste by Incineration

This does not apply to this facility.

Conclusion

The ARPANSA assessors consider that the information related to the waste management is acceptable for the purpose of preparing a site for the facility and to construct the facility. However, this matter will be further considered when assessing the operating licence application for the facility.

2.2.5. Security plan [Item 4(e)]

The arrangements for security have been assessed against relevant guidelines of section 6 of the RG [3] and the provisions of the *Code of Practice for Security of Sealed Sources (2007)* (RPS 11).

2.2.5.1 Security Procedures

The licence holder is responsible for *arrangements for security of controlled material or apparatus that includes arrangements to prevent sabotage, theft or unauthorised use (RG 6.1-6.9) [3].*

The arrangements for security have been assessed against relevant guidelines of section 6 of the *Regulatory Guide*: *Plans & Arrangements for Managing Safety v4* (January 2013) [3] and the provisions of the *Code of Practice for the Security of Radioactive Sources* (2007) (RPS 11) and ASNO's (Australian Safeguards and Non-Proliferation Office) National Design Basis Threat (NDBT), issued in 2012.

The SyMo Facility Security Plan (SYMo-1310-2-B-AN-0006) details the security risks associated with the conduct of the construction phase, and also details the security risks associated with the proposed operation of the facility. These risks have been mitigated by a number of protective security measures outlined in the SyMo Facility Construction Security Plan and its supporting documentation. A number of minor recommendations on the risk assessment framework developed by ANSTO were provided by ARPANSA. ARPANSA has been provided with sufficient evidence that the recommendations were adopted in full, which complies with the expectations of ARPANSA and ASNO against the National Design Basis Threat, RPS 11 and the national requirements covered under the Attorney-General's Department Protective Security Policy Framework.

ARPANSA conducted a siting security inspection for the proposed facility which satisfied ARPANSA's expectations.

The application states that during construction only sealed sources will be used under arrangements agreed with the ANSTO Radiation Protection Advisor. While the facility becomes operational the immobilised solid waste will come under category 2 in accordance with RPS 11. This matter will be further considered in the assessment of the licence application for operation of the SyMo facility.

Section 8 of the SyMo Facility Construction Security Plan states that the implementation of the SyMo site specific security provisions during construction will be the responsibility of the construction contractor, with the SyMo project team having overall responsibility for accepting and delivering provisions within the plan. The security arrangements are integrated with the emergency arrangements, and Australian Federal Police (AFP) Officers will respond to security alarms. ANSTO Lucas Heights Site Control centre

(SCC), which is continuously staffed by the AFP 24 hours a day, seven days a week (24/7) coordinates the response and is the focal point for communication in an emergency situation. Any security incident will be recorded using ANSTO notification form AF 1922 and will be escalated and investigated as required. ANSTO states that during the construction phase there will be on-going communication between the construction contractor, SyMo project staff, ANSTO security personnel and the AFP following the standard communication procedures for ANSTO projects.

Conclusion

The ARPANSA Assessor notes that ANSTO has satisfied all ARPANSA and ASNO requirements regarding proposed and existing security measures to be implemented in order to reduce risks to an acceptable level for the construction phase. Nevertheless, ARPANSA will observe and verify that these measures are implemented throughout construction. During the preparation of the site, ANSTO's current site-wide security plan is acceptable, providing that the interim security measures described within the plan are in place to preserve the integrity of the protective security system at the boundary and the integrity of existing buildings at ANSTO during this phase.

An additional review will be conducted by ARPANSA on the specific security design features to be incorporated prior to construction when available.

2.2.6. Emergency plan [Item 4(f)]

The applicant must have emergency plans and procedures that address all foreseeable emergencies to ensure the protection of personnel, the public and the environment. Adequate facilities and equipment must be available and an appropriate state of preparedness maintained [3].

The emergency plans related to the conducts and dealings of the facility have been assessed against the guidelines of the RG [3] and principle 54(d) of the RAPs [4].

2.2.6.1 Emergency plan

The licence holder is responsible for providing detailed emergency plans based on the assessment of consequences of reasonably foreseeable accidents aiming to minimise the consequences and ensuring the protection of on-site personnel, the public and the environment (RG 7.1-7.21) [3].

Section 1 of the Emergency Plan (SyMo-1310-2-B-AN-0007-B) states that the ANSTO SyMo facility is being constructed in a new building and as such, there are no radiological hazards during the construction phase. Therefore, the application describes the arrangements for non-radiological emergency and ANSTO framework for managing emergencies.

ANSTO states that during construction and cold commissioning the responsible contractors will prepare SWMES to identify risks and controls for works arising from such activities prior to commencing the activity. The SWMES will also discuss the controls to be put in place for control of test sources which will be used during cold commissioning.

ANSTO states that the Works Coordinator in conjunction with the SyMo Project Manager is responsible for ensuring the emergency arrangements are in place and all those involved are trained in their roles during the construction period.
During construction phase the main contractor will be responsible for emergency arrangements and ANSTO Synroc Works Coordinator will have oversight of these arrangements. In the event of a site safety incident the main contractor is required to provide first aid response facilities in accordance with WHS laws. The main contractor is required to maintain a site WHS plan including an evacuation plan. In the

event of a major incident which needs more than minor first aid, then the ANSTO site control centre (SCC) is contacted for further support. During evacuations of the construction site, the main contractor will provide a site supervisor to take on the role of accounting for all personnel onsite and managing the muster point checks. The muster point for the construction site will be determined in conjunction with the Works Coordinator.

ANSTO states that from cold commissioning onwards the Security Officer will be the Building Warden who is responsible for marshalling evacuees and securing the building. There will be a trained deputy for this role. The Health Physics Surveyor and Radiation Protection Advisor have roles in radiation incidents as part of the ANSTO general emergency response arrangements.

The ARPANSA assessor considers that the elements of emergency plan described in the application are acceptable for the proposed conduct. The matter will be further considered when assessing the operating licence application for the facility. As part of the design verification during the construction of the facility ARPANSA will consider emergency arrangements including evacuation, isolation and monitoring.

2.2.6.2 Emergency procedures

The licence holder is responsible for ensuring that comprehensive procedures are prepared according to emergency plan (RG 7.22-7.35) [3]

The application describes the following procedural aspects related to emergency:

The Contractors WHS management Plan and the controls identified in the task specific SWMES will be in place to deal with routine emergency and Works Coordinator will have oversight of contractors' emergency arrangements.

If an incident or accident occurs on the defined construction site which requires a greater response, the main contractor will be responsible for alerting all workers onsite of the emergency per the contractors WHS plan. Additionally, the ANSTO emergency response arrangements will be invoked noting that the ANSTO Site Control Centre (SCC) is manned 24/7 and is the focal point for communications in an emergency. Once the facility is cold commissioned all facility safety alarms will be monitored and all calls to the ANSTO emergency number are directed to this centre. Initial emergency response is provided by the Site Operations Shift Supervisors (SOSS) available 24/7, with additional support from the Health and Safety Services team and the ANSTO Health Centre during business hours.

Referring to the arrangements of ANSTO SOP 05 *Duty Safety Co-ordinator (DSC) – Role in Emergencies* ANSTO states that the next level of emergency response is managed by an on-call role known as the Duty Safety Coordinator. This role is staffed 24/7 by a senior ANSTO safety officer who is contactable by phone or pager. This officer is experienced in the emergency arrangements and has the necessary authority to take control of the emergency and command further ANSTO resources if required. The DSC will ensure that the local response is satisfactory and, where necessary, that the external emergency response services are contacted. The response to an incident may be escalated to the DSC in two ways. The officers in the Site Control Centre have defined responses for each facility alarm (from cold commissioning onwards) and for some alarm situations, the automatic response is to inform the DSC. The DSC will also be contacted by the Site Control Centre when there is a call to the centre requesting further emergency assistance.

The application states that ANSTO Radiation Protection Services section maintains 24/7 health physics support for radiation incidents. It is unlikely to be necessary during the construction and cold commissioning because there are no radioactive materials in the facility during the construction and cold commissioning phases, except sources used for shielding short path testing.

ANSTO states that the procedure for the initial response to an incident will be practised in the emergency drills before commencing construction works. The higher-level response arrangements involving the DSC are exercised regularly and some of these exercises involve the external emergency services. There is ongoing review of the emergency arrangements, including updating of the contact lists and safety alarm responses. Adequate resources for emergency response are available as required.

The ARPANSA assessor considers that the procedural aspect for emergency is acceptable noting that this matter will be further considered when assessing the operating licence application for the facility.

2.2.6.3 Emergency preparedness

The licence holder is responsible for ensuring that all relevant agencies are prepared for such emergencies and adequate facilities and equipment are available and maintained (RG 7.36-7.42) [3], (RAPS 16, 54(d), 123)[4]

Section 4 of the Emergency Plan [SyMo-1310-2-B-AN-0007-B] states that the ANSTO SCC, which is the emergency communications point, is monitored 24/7 by the AFP. The DSC roles are rostered 24/7. If for any reason, the DSC is unavailable, the SCC has standing orders to notify the next rostered DSC.

ANSTO states that emergency personnel are trained and there are exercises of the emergency arrangements. There will be emergency exercise drills when the work teams are in place during construction and commissioning. The higher-level response arrangements involving all aspects of ANSTOs emergency management and response are exercised regularly and many of these exercises involve the external emergency services. The ARAPNSA assessor notes that ARPANSA also oversights some all-agency emergency exercises. The emergency arrangements are continually updated, including updating of the contact lists and safety alarm responses.

The ARPANSA assessor considers that the arrangements for emergency preparedness are acceptable noting that this matter will be further assessed when assessing the operating licence application for the facility.

Conclusion

It is expected that no radiological emergency can occur during siting and construction of the proposed facility. The ARPANSA assessor considers that the plans and procedures described in the application for emergency management taking into account the scenarios identified in the PSAR are acceptable. The ARPANSA assessor is of the view that proper implementation of such plans and procedures will ensure protection of people and the environment in the event of an emergency.

As part of the design verification during the construction of the facility ARPANSA will consider emergency arrangements including evacuation, isolation and monitoring.

2.3. AUTHORISATION FOR PREPARING A SITE

2.3.1. Detailed site evaluation [Item 5]

Item 5 of part 1 of Schedule 3 of the Regulation requires the applicant to provide a detailed site evaluation for the proposed controlled facility.

The purpose of the site evaluation for a nuclear installation [Note: SyMo facility is a prescribed radiation facility] is to assess whether the site characteristics are such that adequate protection of the public and the environment from the radiological consequences of radioactive releases during accidents and normal operation can be maintained [5]. The site evaluation needs to consider:

(a) the effects of external events occurring in the region of the particular site
(b) the characteristics of the site and its environment that could influence the transfer to persons and the environment of radioactive material that has been released
(c) the population density and population distribution and other characteristics of the external zone in so far as they may affect the possibility of implementing emergency measures and the need to evaluate the risks to individuals and the population.

Assessment

Section 4 of the SyMo Facility Siting Assessment [SYMo-1310-2-B-AN-0010] states that the ANSTO LHSTC is located in bushland approximately 28 kilometres southwest of Sydney. The LHSTC site has been investigated extensively in the past, during the preparation of the safety assessments and ARPANSA licence applications for the OPAL research reactor and other facilities.

The ARPANSA assessor notes that the LHSTC has been found to be a suitable location for ANSTO activities, including operation of the OPAL reactor, manufacture of radiopharmaceuticals, interim storage of radioactive waste and research and development facilities including the operation of accelerators.

The application has addressed the site characteristics for the proposed facility and the assessment of site characteristics including the external events considered in the siting is presented in the following section.

The application is supported by a Preliminary Risk Assessment for the SyMo facility, ANSTO/T/TN/2012-02, that analysed relevant accident scenarios that may have radiological consequences to the population and to the environment. Considering the design of the facility and the intended operations and relevant controls to be in place no credible scenario has been identified with significant consequences outside the facility. The ARPANSA assessor considers that the accident analysis is acceptable noting that this matter will be further considered when assessing the licence application for operation of the facility. Details of site characteristics and preliminary safety analysis are presented in Sections 2.3.2 and 2.4.4 of this report.

Conclusion

The preliminary risk assessment showed that there are no credible scenarios with the potential to cause a significant dose offsite, or onsite beyond the SyMo facility. The ARPANSA assessor considers that the elements considered in the site evaluation are adequate.

2.3.2. Site Characteristics [Item 6]

Item 6 of part 1 of Schedule 3 of the Regulation requires the applicant to provide the site characteristics for the proposed controlled facility.

Assessment of the site characteristics is to describe those characteristics that would influence the facility's safety and potential impacts of normal operation and accidents on people and the environment, and to identify the design bases that would take account of these characteristics (RAP 54) [4], (SR 2.2) [5].

2.3.2.1 Radiological baseline

Before any work may be commenced on the proposed ANM Mo99 Facility, it is important that the radiological baseline of the site is established. This information would be used during the construction, operation and decommissioning of the facility to assess the impacts of these activities on the environment and ultimately, the effectiveness of decommissioning activities (SR 4.15) [5].

In order to establish the radiological baseline ANSTO undertook a radiological survey of the proposed site and the results of such survey were provided to ARPANSA. The results show that the radiation level is at the background level. This radiation level will be used in future assessment as the baseline to assess the impact of the future activities to be undertaken at this facility.

The ARPANSA assessor notes that ANSTO has an ongoing routine environmental monitoring program for the entire site, and the results of such monitoring are subject to regulatory oversight.

The ARPANSA assessor considers that the information provided on radiological baseline monitoring is acceptable.

2.3.2.2 Geography

Geographical information including creeks, rivers, lakes, mountains, valleys, and any topography and details of present and projected land and water usage and ecology should be provided(SR 4.4-4.9, 4.14) [6].

Section 2.4 of the Preliminary Safety Analysis Report (SyMo-1310-2-B-AN-0001-B) (SyMo PSAR) describes the land use and water use of the site. According to Sutherland Shire Local Environmental Plan (SSLEP), land within the ANSTO for the 70 ha fenced area is zoned 12- Special Uses (research and Technology) and 12 –Special Uses (Military) for that buffer zone outside the fenced area. There are small areas on the western perimeter of the buffer zone that are zoned 13-Public open space.

ANSTO states that the public occupancies within the buffer zone closest to the ANSTO fenced area are the ANSTO canteen which is open during the day and the Stevens Hall motel which has 24 hours occupancy.

Surface water

The application (Section 2.2.3.1, SyMo PSAR) states that there are no known private dams which could be fed by runoff from the area surrounding the LHSTC, and none of the groundwater bores identified in the past is within a groundwater catchment that could be directly influenced by runoff from LHSTC. The application refers to the nearest dam (Woronora Dam), principal surface stream Woronora River and the flow profiles of this river.

The ARPANSA assessor notes that any discharge from the LHSTC site is subject to the licence conditions of the ANSTO Waste Operations licence (F0260).

The ARPANSA assessor considers that the provided information on surface hydrology is adequate.

Groundwater hydrology

Section 2.2.3 of the SyMo PSAR states that close to the Woronora River, the ground water level will fluctuate sympathetically with the level of water in the river. Further away from the river, the ground water level should only show a small response to the effects of rainfall.

Referring to the measurements for the OPAL siting ANSTO states the result show that the deeper groundwater is assessed to flow in a north-westerly direction and eventually to the Georges River. The mean horizontal flow velocity ranges from 0.05 $m.d^{-1}$ in the shallow aquifer, and from $1.2x10^{-3}$m.d-1 to 0.012 $m.d^{-1}$ in the deeper aquifer. Noting that the ILW will be housed in a tank, which will be housed in concrete bunker, the ARPANSA assessor considers that even in most unlikely scenario of leakage of liquid waste in the event of earthquake ANSTO will have enough time to take corrective measures.

The ARPANSA assessor considers that the submitted information on the ground hydrology is adequate for the proposed conduct.

Land and water use

Section 2.4 of the PSAR for SyMo facility (SyMo-1310-2-B-AN-0001-C) describes the land and water use. It states that the ANSTO Lucas Heights site is surrounded by a 1.6 km radius buffer zone which is owned by the Commonwealth or its Agencies except for a small section on the eastern side of the Woronora River which is Crown land. Land within the ANSTO for the 70 ha fenced area is zoned 12 – Special Uses (Research and Technology) and 12 – Special Uses (Military) for that buffer zone outside the fenced area. There are small areas on the western perimeter of the buffer zone that are zoned 13 – Public Open Space. Part of the buffer zone is leased to Waste Service NSW which operates the Lucas Heights Waste Management Centre. Other areas are leased to public entities in an area called the Business and Technology Park. The buffer zone is used for recreational purposes including bushwalking and bike riding. The proposed facility will not affect these on-going land uses.

ANSTO states that the public occupancies within the buffer zone closest to the ANSTO fenced area are the ANSTO canteen which is open during the day and the Stevens Hall motel which has 24 hour occupancy. The application states that there is no farming in the buffer zone and very little mixed farming within 5 km of the site.

The ARPANSA assessor notes that ANSTO preliminary risk assessment shows that no credible scenario has been identified with significant consequences outside the facility suggesting that during routine operational conditions and anticipated occurrences the foodstuffs will remain unaffected.

ANSTO states that the rainwater collected on-site is used for ground watering, and the storm-water runoff to the surrounding watercourse does not contribute to any water catchments for public water supply. The storm-waters leaving the ANSTO Lucas Heights site and the Woronora River water are routinely tested as part of the environmental monitoring program.

The ARPANSA assessor considers that the submitted information on land and water use is adequate.

2.3.2.3 Radiological assessment

For the proposed site the potential radiological impacts in operational states and in accident conditions on people and to the environment need to be evaluated (SR 2.12) [5].

The application is supported by Preliminary Risk Assessment for the SyMo Facility [ANSTO/T/TN/2012-02 rev1]. ANSTO risk assessment considered various scenarios expected to during routine operations and anticipated operational occurrences. ANSTO assessment shows that no scenarios would have a risk of high or very high.
One scenario was assessed to have a medium risk, being potential oxygen depletion in the HIP equipment room. ANSTO assessed three scenarios were assessed as having a major or severe consequence, but low risk. These scenarios were:

- Transport of waste from B54/B57
- Leak of ILLW into ground water (seismic)
- Equipment failure – lifting device

ANSTO considered the bounding case accident for off-site dose to be a severe earthquake causing damage to both the feed tank and bunker as it is the most conservative scenario. This scenario is recommended to be the reference accident for this facility.

ANSTO's analysis shows that there is no scenario with significant consequences outside the facility and therefore, suggests that the facility comes under hazard category F1. The ARPANSA assessor notes that the ARPANSA RAPs recommends a Reference Accident for a facility with F2 or F3 category.

The ARPANSA assessor considers that ANSTO has adequately considered relevant aspects of operation and design in accident analysis to determine the radiological consequence to the environment and to the people from this facility if it is approved for operation.

2.3.2.4 Design basis external events

The characteristics of the proposed site that would influence the design of the facility or the radiological impact of operations or accidents needs to be taken into account. These include seismology, meteorological events, flooding, geotechnical hazards and external human induced events. While the design base will be considered in detail as part of the design stage of the project, it is important that any design-basis external events that may result in design problems for a proposed facility be identified early in the project, at the siting stage (SR 3.1-3.50) [5].

Seismology

Section 2.2.1 of the SyMo PSAR states that LHSTC is located on a sandstone plateau in the Sydney Basin and the region is intra-plate and generally exhibits low seismic hazard. While there are a number of geological features in the Sydney Basin indicative of past earthquake activity, no seismically active geological structures have been identified, and there are no major capable faults within 35 km of LHSTC. The application refers to OPAL siting study during which seismic investigations were extensively carried out by an expert panel. Referring to the OPAL siting study a summary of seismic hazards in terms of horizontal ground accelerations at four different return periods and at different spectra periods are presented in Table 2.1 of the SyMo PSAR.

Based on the available information and operation of the existing facilities at the site the ARPANSA assessor considers that relevant seismic aspects have been considered in the proposed design of the facility.

Meteorology

Section 2.2.2 describes the meteorology of the LHSTC. It also includes the winds, rainfall and evaporation. Section 9.8.3 of the PSAR states that the facility is designed according to the requirements of the BCA.

The application refers to OPAL SAR for the turbulence climatology. The ARPANSA assessor notes that ARPANSA was satisfied with the information on turbulence climatology considered in the OPAL licence application.

ANSTO assessed the likelihood of bushfire as low taking into account the site maintenance and the fire loading to be present in the facility. It states that in the unlikely event that an external fire does spread to the facility, internal fire-fighting systems are in place to deal with such situation (Section 9.8.7 of the PSAR).

The ARPANSA assessor considers that the submitted information on the meteorology for the proposed conduct is adequate.

Geotechnical hazards

The application refers to the recent geotechnical study undertaken for the ANM Mo99 facility, and the geotechnical study for the OPAL reactor. This has been assessed separately in the RAR for the ANM MO99 facility (R13/08434).

The ANM Mo99 RAR considers that the geotechnical data considered in the siting of the facility is adequate.

Human induced events

The application has considered the following human induced events:

- Aircraft crash
- Transport accidents
- Industrial activities
- Military activities

Considering the site locations, policy and procedures and restrictions in place, the risk of any of the above resulting in significant radiological consequences is low. The ARPANSA assessor considers that the human induced events considered in the proposed conduct are adequate.

2.3.2.5 Operational radiation doses

The assessment of the site for a controlled facility should consider the implications of the site characteristics for the radiological impact of the controlled facility on the surrounding population and the environment during normal operation, and anticipated operational occurrences. (SR 2.22-2.24) [5].

The application is supported by the Radiation Protection Plan that describes the arrangements and controls will be in place when the facility becomes operational. The Radiation Protection Plan is assessed separately in this report (Section 2.2.3). The design of the facility incorporates various active and passive engineering controls to reduce the radiological risk including area monitors, interlock systems, alarms. Process monitoring system, gaseous monitoring system, radiation monitoring instrumentation, shielding etc. Administrative controls including radiation monitoring program, local rules and procedures will also be in place to reduce the radiological risk to the operators, the public and the environment.

ANSTO undertook a preliminary risk assessment for the SyMo facility [ANSTO/T/TN/2012-02] and considered various scenarios during routine operations and anticipated operational occurrences. ANSTO used the computer code PC-Cosyma to determine the radiological consequences. The results did not identify any scenario that would have significant consequence outside the facility.

The ARPANSA assessor considers that analysis undertaken by ANSTO in terms of normal operation and anticipated operational occurrences to determine the radiological consequences is acceptable for the proposed conduct. This matter will be further considered when assessing the operating licence application for the facility for which a Final Safety Analysis will be required.

2.3.2.6 Suitability of the site

Acknowledging that siting considerations and engineering are coupled any unreasonable introduction of special design requirements to compensate for a poor site should be discouraged (DC 18-19) [7].

The bounding accident for this facility is considered to be severe earthquake causing damage to the feed tank and bunker. ANSTO used PC-Cosyma to analyse the consequences and their analysis shows that this accident does not have consequences at 1000 m and at 1500 m (the edge of the site exclusion zone).

The site operates a number of nuclear installations including a 20 MW research reactor, radioisotope production facilities and waste operations facilities. Based on the submitted information and analysis by the applicant the ARPANSA assessor did not identify any unreasonable introduction of special design requirements to compensate for a poor site. Further details of design will be considered in the assessment of operation of this facility.

ANSTO is utilising the following existing advantages for the site:

- a 1.6km buffer zone
- security perimeter fence and access controlled by the Australian Federal Police
- infrastructure including power, water supply, waste services, transport and communications
- support services including health physics, general safety and engineering
- emergency arrangements including a continuously manned alarm centre

The ARPANSA assessor notes that the proposed facility will be located adjacent to the proposed ANM Mo99 facility. Waste from the proposed ANM Mo99 plant will be transferred to the SyMo Facility by a transfer-line, located in an underground shielded trench. ANSTO states that existing wastes will also be transferred to the SyMo Facility using a flask transfer system from Building 54 and Building 57.

The overall assessment of the site characteristics did not identify any poor aspect of the site for which any special design requirements were proposed. The design features and their corresponding engineering controls are assessed in Section 2.4.1 of this report and found acceptable.

The ARPANSA assessor considers that the information and analysis of the suitability of the site suggests that the proposed site is suitable for the proposed conduct.

2.3.2.7 Decommissioning

The impact of a site on the decommissioning of a controlled facility requires detailed design information not available at the siting stage. However for a complete description of the site assessment process consideration should be given to all direct and indirect exposure pathways, for all anticipated activities during decommissioning, including the handling, interim storage, transportation and disposal of radioactive waste The design addresses the features of minimising the exposure during decommissioning (DC 137-138) [7].

ANSTO states that the facility is likely to be well maintained and cared for over its lifetime. Thus it is likely that decontamination of dismantled equipment will be possible and that the building could be demolished or refurbished as required. ANSTO further states that a decommissioning Safety Assessment Report indicating waste to be removed will be prepared as part of the decommissioning licence application. The ARPANSA assessor notes that for other nuclear installations operating at the Lucas Heights site, ANSTO adopts an approach to minimise exposure and waste generation by selecting suitable construction materials and also uses a facility layout that is suitable for decommissioning.

ANSTO has considered the following design objectives to facilitate decommissioning:

- ensuring public, staff and facility safety and of environment protection through all decommissioning stages
- removal and/or immobilisation of mobile radioactivity within the facility as soon as practicable after the facility is shut down
- facilitating early removal of potentially hazardous materials in the facility
- implementation of the ALARA principle
- minimisation of production of radioactive waste, including both primary and secondary wastes

In order to facilitate decommissioning ANSTO has considered following key aspects in the design of the facility:

- space and accessories for installation of removable biological shield for working in high radiation areas
- provisions for remote decontamination of systems and components
- selection of components and structures for easy decontamination and dismantling
- selection of surface finishes for easy decontamination
- provisions for adequate lifting and transport devices to facilitate the removal of decommissioned material including radioactive waste
- the exit route for removing decommissioned material including radioactive waste

The ARPANSA assessor considers that the features taken into account in the design for minimising exposure during decommissioning are acceptable. This matter will be further considered when assessing the licence application for decommissioning.

2.3.3. Environmental impact statement [Item 7]

Item 7 of part 1 of Schedule 3 of the Regulation requires the applicant to provide any environmental impact statement requested or required by a government agency, and the outcome of the environmental assessment.

ANSTO referred the proposal to site and construct the SyMo facility to the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) for a determination on whether an Environmental Impact Statement (EIS) is required. ARPANSA provided its observations in terms of the processing the intermediate level liquid waste generating from the proposed ANM Mo99 facility. DSEWPaC decided that the proposed siting and construction of the SyMo facility is not a controlled action under the EPBC Act. Copies of ARPANSA advice to DSEWPaC and DSEWPaC decision are presented in Appendices 2 and 3.

Conclusion

The ARPANSA assessor notes that no EIS was required for the proposed conduct.

2.4. AUTHORISATION TO CONSTRUCT

2.4.1. Design of the facility [Item 8]

Item 8 of Part 1 of Schedule 3 of the Regulations requires the Applicant to provide the design of the controlled facility, including ways in which the design deals with the physical and environmental characteristics of the site.

The design of the facility has been assessed against the ARPANSA regulatory assessment criteria for design of controlled facilities which requires to implement principles of defence in depth, use of physical barriers, independency and diversity between levels of defence in depth and greatest emphasis on the first level of defence [DC 1-4].

2.4.1.1 Design features

Section 3 of the SyMo PSAR describes the safety principles followed in the design of the facility. The fundamental safety objective for the SyMo Facility is stated to protect individuals, the general public, and the environment from exposure to radiation resulting from the operation of the facility. ANSTO states that this objective is achieved by establishing and keeping efficient defences at the facility against radiological risks.

ANSTO described each level of defence in depth principle and stated that the defence-in-depth approach was adopted to ensure that the design and operation of the facility incorporates multiple and diverse levels of protection against the emissions of radioactive materials.

The key systems involves in the SyMo process include:

- transfer of wastes from the ANM Mo99 facility
- storage tank
- transfer waste room (TWR)
- process system room (PSR)
- filling hot cells (FHC)
- evacuation bake-out and sealing hot cells (EBSHC)
- unloading hot cell (UHC)
- HIP hot cell (HHC)
- auxiliary system (off-gas/active ventilation/instrumentation)

The process description is detailed in ANSTO document, namely, Process Description for the Mo-99 ILLW and ILW Waste Treatment Process, SyMo-067-2-B-AN-0018, and the construction and operating principles of the systems and the expected operational issues and their resolution are presented in Sections 4.2-4.7 of the SyMo PSAR.

The ARPANSA assessor notes that depending on the nature of the process involved each system has a number of barriers. Each barrier is designed in accordance with the relevant standard and code. The submitted information suggests that the independency between level of defence and diversity are incorporated into the design. In addition, greatest emphasis has been placed on the first level of defence depending on the system.

The ARPANSA assessor considers that the design has incorporated relevant aspects of defence in depth principles. This matter will be further considered when assessing the licence application to operate the facility.

2.4.1.2 Conservative Proven Design and Engineering Practice

It is expected that the design of the facility is based on technologies and engineering practice that are proven by testing and experience, and that items important to safety are designed in a manner that is commensurate with the safety analysis (DC 33-36) [7].

Background and evolution of Synroc technology

The application is supported by a document, namely, Background Experience and Maturity of Synroc Science and Technology [SyMo-0000-2-B-AN-0004], describing the basis of the technology and its development. The application states that ANSTO has over 30 years' continuous experience in waste form and technology development. The technology has been developed through various phases of research and development programs from pure science to the near full-scale Synroc development. The Synroc project resulted in a significant body of knowledge on waste form design, crystal chemistry, physical properties, waste form durability, etc. plus process technology and design.

ANSTO started the development in the 1980s in a research-scale hot-cell facility to manufacture samples doped with radioactive Cs-137 and Sr-90 isotopes to prove that the leaching of active isotopes was the same as those of the inactive isotopes. Irradiated samples were also tested, including samples irradiated by neutron in the HIFAR reactor beam line at Lucas Heights and many ion beam irradiation samples. In addition, internal self-irradiation damage was investigated with Pu-238 and Cm-244 samples made in collaborative programs with US, UK and Japanese national laboratories. The results have shown that Synroc retains its integrity and durability even when damaged to a metamict state.

ANSTO's preliminary process design contains a number of elements that have been demonstrated at full scale with actual wastes (e.g. Idaho HLW calcine) and consequently have a very high maturity level. These include pneumatic/vacuum conveyance of dried/calcined powders, discharge into and release from hoppers, powder blending and powder handling valves, additionally related aspects of the front-end powder handling, including can filling and sealing, which are being widely employed at other nuclear facilities with a wide range of materials.

The submitted information suggests that the development of Synroc technology is based on established scientific and engineering principles and the practical application of this technology has been adequately demonstrated.

HIP Technology

Hot Isostatic Press (HIP) is a commercial process utilised in production environments for processing tons of material ranging from metal castings to encapsulated metal and ceramic powders (Section 5, Background Experience and Maturity of Synroc Science and Technology, SyMo-0000-2-B-AN-0004). ANSTO has adopted the Hot Isostatic Press (HIP) technology commercially available and have been operating in the USA for about 30 years. The application refers to the use of HIP technology in nuclear industry including in the US Navy for use in diffusion bonding of nuclear fuels. ANSTO jointly worked with Argonne National Laboratories-West (ANL-W) in Idaho in the development and demonstration of hot-cell HIP facility. The application states that ANSTO has HIPed a 450g can containing 50g of plutonium as part of the US DOE Plutonium Immobilisation Project.

The application states that ANSTO has performed extensive testing of HIPed ceramic, glass and glass-ceramic waste forms with simulated wastes. In addition, pilot-scale HIP testing has been demonstrated of glass-ceramic containing waste forms at a 30-200 kg scale. These tests validated the 100 times scalability of the process, and confirmed the 35-60% volume reduction for this waste after HIP treatment. ANSTO has also subjected to HIP a 100 kg scale package containing a zeolite-glass type waste

form, plus 10-20 kg scale cans of various waste forms including an at-scale test using non-radioactive simulants for a plutonium waste stream.

The application also refers to the HIP technology used in UK to process containing alpha emitters including actinide residues.

Based on the submitted information the ARPANSA assessor considers that the HIP technology used in the prototype project is internationally accepted, and seems suitable for the proposed conduct.

Calciner technology

Section 6 of the background Experience and Maturity of Synroc Technology (SyMo-0000-2-B-AN-0004) ANSTO has extensive experience with thermal treatment options for processing slurries and powders with and without reactive precursor additions, under reducing, neutral or oxidising conditions. Between 1990-1997 ANSTO operated two rotary calciners, at an engineering scale, in the SDP processing several tons of nitric acid waste simulant and powder. This plant operated at 10-20kg/hr and with an off-gas emission control system.

The application refers to extensive use of calciner systems in nuclear applications, including the treatment of HLW in the UK. ANTO states that it has operated several other types of calciners and more recently a small scale demonstration on uranium bearing nitric acid waste. ANSTO has also designed, built and operated a thermal treatment system to successfully stabilise 2.5 tons of uranium and thorium metal swarf and pieces contaminated with oil, cutting fluid and kerosene. ANSTO has tested several models of vibratory heat treatment-calciners. Currently ANSTO has an operational pilot system set up to process powders at approximately 60 kg/hr throughput, which was sighted during a site visit. The available information suggests the technology is commonly used in other countries.

Can design

Section 7 of the Background Experience and Maturity of Synroc Science and Technology [SyMo-0000-2-B-AN-0004] ANSTO has extensive experience designing cans in a partnership with Axial Dynamics, the Manufacturer of the HIP can. ARPANSA assessors sighted the HIP can during site visit that have been used at ANSTO in the prototype process.

The ARPANSA assessor considers that the design and technology incorporated in the Synroc process have been used in other countries such as USA and UK for radioactive waste management. In addition, the development of this technology is supported by a large number of literature reports including international journals. The ARPANSA assessor considers that the design has taken into account proven experience and technology. This matter will be further considered. The ARPANSA assessor notes that no EIS was required for the proposed conduct.

2.4.1.3 Codes and standards

It is important that appropriate national and international standards are used in the design of the facility. The information has been assessed against relevant design criteria (DC 37 – 39, 41)[7].

Section 3.3 of the PSAR states that ANSTO has considered IAEA Safety Guides in the design, and appropriate international standards have been used where local standards are not available. A comprehensive list of all relevant standards is supplied in a supporting document to the application, namely, Project Standards and Guidelines list, (SyMo-0000-E-B-AN-0002, Revision: A, 13th February 2012).

ANSTO states that in the absence of relevant code(s) ANSTO used the results of experience; tests, analysis or a combination thereof was applied and justified. This matter is further considered in conservative proven design and engineering practice above.

The ARPANSA assessor considers that relevant standards have been considered in the design and proper implementation of referred standard will ensure modern design standards.

2.4.1.4 New technologies

It is important to consider thorough prototype testing and validation while new technologies are incorporated in the design (DC 50) [7].

ANSTO has developed the technology through extensive research and development as stated in the application. ANSTO has used this technology in prototype facility and the ARPANSA assessor visited the facility and sited the prototype conditioned waste. Similar technology is in use in USA and in UK.

The ARPANSA assessor considers that the aspects of incorporation of new technology have been adequately addressed.

Conclusion

The application refers to the defence-in-depth principles in accordance with ARPANSA's safety principles in the design of the plant and equipment and the facility. This includes use of multiple barriers, monitoring and alarm systems to control abnormal operation and detection of failures, and provisions of control of design basis accidents. The application refers to various types of safety systems and their classifications. Details are presented in Section 2.4.4 of this report.

The ARPANSA assessor considers that the application has adequately addressed the safety design principles, use of proven design and engineering practice and application of relevant standards and codes in the plant, equipment and in the design of the facility. This aspect will be further considered when assessing the licence application for operation.

2.4.2. Fundamental difficulties needing resolution [Item 9]

Item 9 of Part 1 of Schedule 3 of the Regulation requires that the applicant provides information on any fundamental difficulties that needs to be resolved before any future authorisation is given.

Hazard and Operability Study (HAZOP) provides a systematic and detailed examination of the design and/or operation of a facility, and it focuses on exploring the consequences of deviations from the usual operating conditions. The results of a HAZOP study are used in risk assessment of the incidents related to a facility.

ANSTO conducted a HAZOP and risk assessment for the proposed SyMo facility. A detailed assessment of the HAZOP study is presented in Appendix-4. The ARPANSA assessor considers that the submitted HAZOP study needs more detailed analysis as the selection of guidewords and elements are not considered to provide a suitable level of examination of the SyMo process. Further, an examination of identified deviations suggests that there are significant gaps in the reported findings.

ANSTO preliminary Risk Assessment for the SyMo facility [ANSTO/T/TN/2012-02 rev1] describes the preliminary safety assessment based on the finalised preliminary engineering design of the facility. ANSTO analysis relied on currently known information and expected information during detailed design. Considering the expected operational activities thirty one (31) accidents due to process failures were

postulated. Three (3) scenarios have been assessed as having a major or severe consequence, but low risks. Further relevant details are presented in section 2.4.4 below.

The ARPANSA assessor notes that it is not clear from the HAZOP documents whether the HAZOP team included members with operational experience. ANSTO should consider this in the revised HAZOP analysis for the next stage of submission for an operating licence.

The ARPANSA assessor considers that the inadequacy of the HAZOP analysis and risk assessment study for the SyMo facility needs to be resolved prior to authorisation for operation of the facility. Therefore, the HAZOP analysis and risk assessment for the SyMo facility needs to be revised and submitted to ARPANSA with the application to operate the facility. The HAZOP analysis is acceptable to the ARPANSA assessor for the proposed conduct subject to the following recommended licence condition:

> *The licence holder must seek prior approval of the CEO of ARPANSA for construction of items of plant that will come into direct contact with the radioactive waste during the Synroc process. The submission must demonstrate that the design is informed by comprehensive risk identification and hazard assessment process and that construction will be undertaken in accordance with an appropriate quality management system.*

2.4.3. Construction plan and schedule [Item 10]

Item 10 of Part 1 of Schedule 3 of the Regulation requires the Applicant to provide the construction plan and schedule of the proposed facility.

ANSTO provided the following documents related to construction plan and schedule.

- Construction Plan of the SyMo Facility, SyMo-1310-2-B-AN-0008, Revision: B, 27th July 2012
- Overall Project Milestones, SyMo-1910-E-D-AN-0003-L (Gantt Chart)

Section 2.3 of the construction plan [SyMo-1310-2-B-AN-0008] describes the project schedule. The summary of the program and key milestones are presented in Overall Project Milestone [SyMo-1910-E-D-AN-0003-L].

The ARPANSA assessor considers that the provided information related to construction plan and schedule is adequate.

2.4.4. Preliminary safety analysis report [Item 11]

Item 11 of Part 1 of Schedule 3 of the Regulation requires the Applicant to provide a Preliminary safety Analysis Report for the proposed facility.

It is important that the preliminary safety analysis report (PSAR) is submitted for a licence to construct the facility. The safety analysis report needs to address the hazard categorisation of the facility taking into account the categorisation of the safety significance of systems, structures and components (RAPS 45, 66, 90) [4], (DC 15-20) [7].

Hazard categorisation of systems, structures and components

Section 4.11.6 of the SyMo PSAR describes the categorisation of systems, structures and components referring to ANSTO Guide (Guidance on Safety Categorisation of Structures, Systems and Components), WHS AG2494.

ANSTO states that items with safety category 1 or 2[1] are important to radiological safety and are subject to separate regulatory approval for construction under Regulation 54. ANSTO did not identify any item as safety category 1. The following items have been classified as safety category 2:

- Posting Port Access interlocks
- Posting Port Access Seals
- Transfer Flask Interlock Door interlocks
- Transfer Flask Interlock Door Seals
- PSR Access Door interlocks
- PSR Access Door Seals
- Dry Additives System Interlock
- Liquid Additive System Interlock
- Cell Penetrations – Confinement barrier
- Cell Penetrations – Seals
- Hot Cell Access Doors Seals
- Hot Cell Roof Doors Seals
- Radiological Protection Instrumentation – In cell
- Radiological Protection Instrumentation – Out cell
- Cells Master Slave Manipulator (MSM) Penetrations
- Cells Shielding Windows

The ARPANSA assessor considers that the approach used for hazard categorisation of systems, components and structures is acceptable for the proposed conduct.

Operating limits and conditions

Section 5.5 describes the preliminary operating limits and conditions (OLCs) for the SyMo facility. The following preliminary OLCs have been proposed:

- Airborne discharge emission, in accordance with statutory limits, which will be set during detailed design stage
- Confinement Air Pressure Differentials limits to be set during detailed design stage
- Leak tightness of confinement barrier
- Confinement interlocks shall be operational all times
- Maintaining sub-criticality (based on criticality certificate)
- Functionality of Radiological Protection Instrumentation
- Minimum staffing level

The ARPANSA assessor considers that ANSTO have taken a proactive approach by foreshadowing the OLCs in the PSAR.

Noting that OLCs are parts of operation of the facility ARPANSA will assess the OLCs taking into account the detailed design and operational limits and conditions to be derived from the Final Safety Analysis when assessing the application for an operating licence.

[1] Safety category 1: Items whose failure could lead to a radiological exposure exceeding 100 mSv (5 mSv for a member of the public), taking into account other protective measures, with some degradation.
Safety category 2: Items whose failure could lead to a radiological exposure exceeding 20 mSv (1mSv for a member of the public), but not exceed 100 mSv (5 mSv for member of the public), taking into account other protective measures, with some degradation.

Safety Analysis

The safety analysis has considered the routine operational conditions and potential accident scenarios. The safety analysis is based on preliminary hazard identification and risk assessment studies.

An ARPANSA assessor has identified deficiencies in preliminary hazard analysis and details are presented in Section 2.4.2 above.

In the preliminary risk assessment ANSTO has postulated the following 31 accident scenarios during normal operation. The risks associated with these scenarios have been assessed using ANSTO Internal Guidance, *Perera, J. 2005. Guidance on the Conduct of a Risk Study, S/TN/2005-24 rev 2*.

(1) Transport of waste fromB54/B57
(2) Transfer of Waste from ANM
(3) Leak from Feed Tank into Bunker
(4) Leak of Intermediate Level Liquid Waste into Ground Water(Seismic)
(5) Leak of Intermediate Level Liquid Waste into the Transfer Waste Room (TWR)
(6) Leak of Intermediate Level Liquid Waste into the Process Safety Room (PSR)
(7) Spill of Powder into the PSR
(8) Interlock Failure – Can Filling
(9) Can toppling
(10) Failure of Can during HIP Process
(11) Interlock Failure – Liquid Additives
(12) Interlock Failure – Dry Additives
(13) Interlock Failure – Posting Port
(14) Interlock Failure – Transfer Flask Port Door
(15) Interlock Failure – Flask Door
(16) Cell Access with High Activity In-Cell
(17) Equipment Failure – Lifting Device
(18) Equipment Failure – Conveyor and transfer carrier
(19) Equipment Failure – Other (PSR & TWR)
(20) Equipment Failure – Other (Hot Cells)
(21) Equipment Failure – Building Crane
(22) High pressure in HIP
(23) High temperature in HIP
(24) Filter Fire
(25) Fire in the rear-of-cell area
(26) Fire in the cell face area
(27) Fire in the Instrumentation Room
(28) Loss of ventilation
(29) Loss of electrical supplies
(30) Criticality
(31) Oxygen depletion

Out of 31 scenarios the following three scenarios have been identified by ANSTO as having a major or severe consequence, but low risk:

- Transport of waste from B54/B57
- Leak of ILLW into ground water (seismic)
- Equipment failure-lifting device

ANSTO considered the bounding case accident for off-site dose is severe earthquake causing damage to the feed tank and bunker. ANSTO recommended this accident as the reference accident.

ANSTO's risk assessment did not identify any scenario with significant radiological consequence outside the facility and therefore, ANSTO classified the proposed facility as hazard category F1[2] in accordance with ARPANSA Regulatory Assessment Principles. ARPANSA performed an independent accident analysis for the SyMo facility, which also shows that the facility comes under hazard category F1.

The ARPANSA assessor considers that the PSAR has addressed hazard categorisation of the facility taking into account the categorisation of the safety significance of systems, structures and components. The ARPANSA assessor will further consider the safety analysis, which will be submitted in the form of Final Safety Analysis Report for the licence application for operation of the facility.

2.4.5. Testing and commissioning [Item 12]

Item 12 of Part 1 of Schedule 3 of the Regulations requires the Applicant to provide the arrangements for testing and commissioning of the proposed facility.

Design of the safety systems needs to ensure that they can be tested, inspected and maintained before operation and throughout the operational lifetime of the facility to assure acceptability for service. Testing of safety systems determines or verifies the capability of such systems to meet specified requirements by subjecting the systems to a set of physical, chemical, environmental or operational conditions. The criteria for provisions for testing and commissioning in the design are given in (DC 235, 237-242) [7].

The application is supported by the Plan for Testing and Commissioning [SyMo-1310-2-B-AN-0009] that describes the arrangements for testing and commissioning of the radiological safety related items during construction and cold commissioning phases of the SyMo facility. Section 3 of the Testing and Commissioning Plan describes the safety systems such as interlocks, hot cell roof doors, intercell doors etc. Thirteen systems are described and all are of safety category 2 (SC2).

Section 4.1.1 of the Testing and Commissioning Plan [SyMo-1310-2-B-AN-0009] states that the project will undertake pre-commissioning activities to verify the operability and performance of each individual plant items and/or each separate plant system. Approved Specific Inspection and Testing Plans (SITPs) and issuance of system level release certificate will be used at the end of construction of that system as prerequisites to commence pre-commissioning activities.

ANSTO states that for the SC2 systems, the following pre-commissioning processes, methods and controls are proposed to be applied:

- Pre-commissioning SITPs (inspection and test plans) forms provided by suppliers/contractors responsible for the item, then reviewed, verified and approved by the ANSTO Synroc project team prior to implementation

- Pre-commissioning test procedures with acceptance criteria provided by suppliers/contractors responsible for the item, then reviewed, verified and approved by the ANSTO Synroc project team prior to implementation

- Carry out onsite testing of the relevant equipment item/system per the above approved pre-commissioning SITP and test procedures, with ANSTO Synroc project team representatives present as nominated on the SITP/procedure control points. Closure tracking of deviations listed on NCRs.

[2] Hazard category F1: where there is no potential for significant consequences outside the facility

- Complete pre-commissioning release certificates for each plant item / system once all testing results meet acceptance criteria, approved by ANSTO Synroc

The ARPANSA assessor notes that the SITPs and test procedures including acceptance criteria will not be developed until the detailed engineering design phase of the project, and detailed safety assessments of safety functions for each SC2 system will be documented in the relevant Regulation 54 RFA submissions to ARPANSA.

ANSTO states that the pre-commissioning of specialist equipment such as radiation monitors, overhead cranes, active ventilation system, and pressure equipment, will be undertaken by the main nuclear contractor using expertise from both the ANSTO Synroc project team and ANSTO approval officers. These services will be provided by suitable qualified practitioners who are either ANSTO staff or reputable contractors. The advice provided by radiation protection advisors from SERA, now renamed Nuclear Services Group, will be an integral part of any commissioning process requiring the use of radiation sources.

According to the arrangements a test release certificate will be issued after completion of the pre-commissioning that verifies that the system‘s operation is acceptable as a standalone system.

After the pre-commissioning activities non-radioactive testing activities will be undertaken to test and demonstrate that the individual plant systems work as an integrated facility and meet acceptance criteria. This integrated approach affects all connected plant systems of various categories (e.g. SC2, SC3).

Section 4.1.2 of the Testing and Commissioning Plan [SyMo-1310-2-B-AN-0009] presents the following processes, methods and controls to be in place for non-radioactive testing of SC2 systems:

- If requested, provide ARPANSA with a copy of the overall project commissioning plan (detailed), as relevant to items important to safety (SC2 systems)

- Non-radioactive test procedures developed and verified in accordance with the overall project commissioning plan, and with acceptance criteria determined and applied by the ANSTO Synroc project team in conjunction with key contractors

- Carry out onsite testing of the relevant equipment items/systems per the above approved test procedures by the ANSTO Synroc project team, with representatives present from key suppliers and contractors as support

- Test results approval by ANSTO Synroc, and closure tracking of commissioning deviations listed on non-conformance reports (NCR’s)

The application states that these control methods and processes will be determined and described in detail in an overall project commissioning plan (CP), which will be developed during the detailed engineering design phase by ANSTO Synroc with key contractors, and approved by ANSTO Synroc.

The following SC2 systems will comprise cold commissioning and the application describes how and what components will be tested during cold commissioning:

- Hot cells doors, posting port, shielding windows, radiological protection instrumentation
- Additives systems interlocks – Dry and Wet
- Cells penetrations confinement barrier and seals, MSM wall sleeve

The application states that the following cold commissioning activities and safety-related items of safety category 3 (SC3) will be part of non-radioactive testing and the procedures for cold commissioning of these items are describes in Section 4.2.2 of the application.

- Simulant Alkaline ILLW
- Simulant Legacy ILLW
- Shielding, Hot CAN's storage
- Waste storage tanks (Alkaline, Legacy) and piping transfer systems
- Off gas system – condenser/scrubber and instrumentation
- Building crane
- Active ventilation system – Primary cell filters and housings

After the cold commissioning a report will be prepared that will form part of the next stage submission and will be used for training of personnel and as precursor of hot commissioning.

The ARPANSA assessor notes that details of the commissioning procedures are not available and expected to be developed based on the subsystem acceptance testing and the results of the full-scale trial (section 2.6) using non-radiological material. The ARPANSA assessor also notes that ANSTO undertook to perform a separate full-scale trial using non-radioactive material that will support testing and commissioning of the plant and equipment of the facility. Considering that the facility is the first of its kind for routine operation the results of the full scale trial will provide better understanding of the operation of the facility and will be important to develop procedures for operation and also for providing training to operators. Therefore, the commissioning of the facility using non-radiological material will form part of the application for full operation of the facility.

Conclusion

The ARPANSA assessor considers that the results of full-scale trial will be essential for commissioning of the safety items, and the arrangement for testing and commissioning are acceptable subject to the following licence condition.

> *The licence holder must not undertake any testing using radioactive material or full plant testing of the facility using non-radioactive material as part of the construction.*

2.5. OTHER MATTERS FOR CONSIDERATION

2.5.1. Whether the information establishes that the proposed conduct can be carried out without undue risk to the health and safety of people, and to the environment [Regulation 41(3)(b)]

The application (application number A0266) to site and to construct the SyMo facility has included information that establishes acceptable controls for siting and construction activities; by identifying the hazards and assessing the safety and risks of proposed activities. The ARPANSA assessor has assessed the application against relevant matters to be taken into account by the CEO, as described in sections 2.1 to 2.4 of this report. Based on this assessment, the ARPANSA assessor is of the view that the information contained within the application can establish that the proposed conduct of siting and construction of the SyMo facility can be carried out without undue risk to the health and safety of people, and to the environment and therefore satisfy the requirement of Regulation 41(3)(b).

2.5.2. Whether there is a net benefit from the conduct [Regulation 41(3)(c)]

The proposed facility will apply Synroc technology to process the current alkaline ILLW from fission Mo-99 production plant, future alkaline ILLW from ANM Mo99 facility and legacy acidic ILLW into a stable immobilise ceramic and glass form. The proposed process will reduce the volume of the waste and facilitate safe disposal of radioactive waste and will lower the environmental risk. The technology to be used is an innovative approach developed by ANSTO based on the research of a number of years. Therefore, this facility makes significant contributions to the national innovation and research program and supports a broad range of research that are of benefit to the general public and scientific community. Once the facility is approved for operation it will involve occupational exposure to ionising radiation that has harmful effects. Considering the engineering and administrative controls to be in place the risk to such harmful effect of radiation is low. The benefits of the facility outweigh the low risks involved in operation of the facility.

The ARPANSA assessor considers that there is net benefit from the proposed conduct in the area of radioactive waste management and reduction of environmental risk.

2.5.3. Whether the doses are as low as reasonably achievable, having regard to economic and social factors [Regulation 41(3)(d)]

The dose constraint for ANSTO facilities is 15 mSv/year. In order to further optimise the radiation protection ANSTO uses an annual ALARA objective of 2 mSv. Considering the nature of the conduct the effective dose from the siting and construction of the SyMo facility is expected to be very low and well below the ANSTO annual ALARA objective of 2 mSv. Further details are presented in section 2.2.3 of this report. In future assessment when details of engineering and operational are available the ALARA aspect will be further considered when assessing the application for an operating licence for the facility.

2.5.4. Whether the Applicant can comply with the regulations and the licence conditions [Regulation 41(3)(e)]

The applicant is the CEO of ANSTO. ANSTO is licensed by ARPANSA to operate various nuclear installations and prescribed radiation facilities and has proven that they are capable of complying with the ARPANS Act and Regulations and licence conditions.

2.5.5. Whether the Application has been signed by an authorised person [Regulation 41(3)(f)]

The application was signed by Dr Adrian Paterson, the CEO of ANSTO.

2.5.6. If the Application is for a facility licence for a nuclear installation - the content of any public submissions [Regulation 41(3)(g)]

Regulation 40 requires the CEO of ARPANSA to advertise receipt of a facility licence application and invite public submission if the facility is a nuclear installation.

The application is not for a nuclear installation. The application is for a prescribed radiation facility. Considering the interface with the ANM Mo99 facility the CEO of ARPANSA invited public submissions on this facility.

The public was advised of the application and submissions were invited in the following ways in conjunction with the ANM Mo99 facility:

- a notice was published in the Commonwealth Gazette on 12 October 2012
- on the ARPANSA Website from 8 May 2013
- an advertisement in The Australian on 10 October 2012
- an advertisement in the St George and Sutherland Shire Leader on 7, 9, 14, 16 May 2013
- an advertisement in The Australian and Liverpool Leader on 8 May 2013
- public forum on 16 May 2013

Copies of the siting licence application submitted by ANSTO were made available to the public, along with the advice as to how and when submissions could be made. Information was made available through the ARPANSA website.

In making a decision on the licence application, Regulation 41(g) requires the CEO of ARPANSA to take into account any submissions received from the public about the application.

ARPANSA received three (3) submission related to this facility. The submissions were related to the following:

1) Legal challenge in moving radioactive waste
2) Use of Synroc technology in other countries
3) Cost benefit analysis

The comments and their resolutions are presented below:

Question/comment	ANSTO Response	ARPANSA Comment
1. If the Synroc system is so safe then why have there been so many successful legal challenges to moving the waste from Lucas Heights to a permanent repository?	There have been no successful legal challenges to moving the waste from Lucas Heights to a permanent repository. There is currently an unresolved court case (in which ANSTO is not involved) regarding the nomination of Muckaty Station in the Northern Territory as a possible site for a National Radioactive Waste Management Facility (NRWMF), but that case is based around provisions of the Land Rights Act, not any hazard which might be posed by radioactive waste.	ARPANSA is not aware of any legal challenge in transferring waste from Lucas Heights.
2. Is Synroc being used anywhere else in the world? If it is successful in dealing with nuclear waste why did we need to transport our waste overseas if we had this technology at the time?	Synroc is being investigated by many governments around the world and it has been shown to be cost effective for certain wastes. The Synroc HIP technology has been chosen by the UK for Pu-wastes and in the USA for calcined waste in Idaho. The *Environment Protection and Biodiversity Conservation Act 1999* and the *Australian Radiation Protection and Nuclear Safety Act 1998*prohibit the development of reprocessing facilities in Australia. It is therefore not possible to use Synroc in such a process.	There are literature reports on the use of similar form for managing HLW in other countries. Australian spent nuclear fuel was transported overseas for reprocessing. As part of contractual obligation Australia will accept the returned waste arising from reprocessing of Australian spent nuclear fuel. Transformation of liquid waste into highly stable immobilised glass ceramic and/or ceramic form is a technique and that has been around for some time.

3. A cost/benefit appraisal of Synroc and its reliability are missing from the public information.	A cost / benefit appraisal was developed in preparing the business case for the ANM projects. This has been subject to detailed scrutiny through the Cabinet process and the subsequent application to the Public Works Committee (PWC).	The issue is commercial in nature and not related to regulatory assessment.

ARPANSA has considered the public submissions addressing ANSTO's application to prepare a site for the ANM Mo99 Facility. The comments made in public submission are resolved on the basis of ANSTO's and ARPANSA's assessment as presented above.

2.5.7. International Best Practice

Section 32(3) of the Act requires the CEO, in making a decision on a facility licence, to take into account international best practice in relation to radiation protection and nuclear safety.

To ensure that this is the case, ARPANSA has developed a set of Guidelines [3] and Principles [4] which are based on international standards and recommendations, particularly those of the International Atomic Energy Agency (IAEA), and the contemporary practices in the radiation and nuclear safety industries of developed countries. The IAEA standards and recommendations have been developed by consensus of member countries and represent the distillation of best practice of their cumulative radiation and nuclear safety experience.

To address Section 32(3) of the Act, this document took into account assessments of the application against the RG [3], RAPS [4], SR [5] and DC [7].

Assessments against the RG [3] and RAPs [4] were used to determine the adequacy of the plans and arrangements to operate the controlled facility safely. The assessment also considered whether the provisions for implementation of plans and arrangements are adequate.

The ARPANSA assessor notes that this facility is the first of its kind to process intermediate level liquid waste. However, the plant, equipment and technology to be used in the facility are proven and used in other countries (e.g. UK, USA) for immobilisation of radioactive waste. The proposed technology is based on established scientific and engineering principles. Relevant results to prove the suitability of the form for immobilisation of waste have been published in international journals[3].

The dose limits considered in the siting of the facility are in accordance with the RPS 1, which are based on the ICRP Recommendations 60 superseded by ICRP 103.

Conclusion

The facility has incorporated internationally well tested principles in the siting and construction of the facility. The ARPANSA assessor considers that the adoption of international best practice in radiation protection is acceptable.

[3] M. L. Carter et al.(2009), Titanate ceramics for immobilisation of uranium-rich radioactive wastes arising from ^{99}Mo production, *J Nuclear Materials*, **384**, 322-326

2.6. ADDITIONAL MATTERS

Considering that the proposed facility will be the first of its kind for routine conditioning of intermediate level liquid waste applying Synroc technology it is important that safety aspects of routine operation are clearly understood. In order to address this matter ANSTO undertook to perform a full scale trial using non-radioactive material as part of testing and commissioning of the plant and equipment of the facility. ARPANSA will conduct inspection of testing and commissioning and will consider the results of this trial closely prior to issuing a full operating licence for the facility. The ARPANSA assessor considers that a full scale trial of plant and equipment will facilitate confirmation of the design objectives and routine operational aspects of the facility, and results of such full scale trial with non-radioactive material will be important in assessing the licence application to operate the facility. The ARPANSA assessor considers that this matter should be communicated to ANSTO.

3. Conclusions

The matters set out in Regulation 41(3) that the CEO is required to take into account in making a licensing decision, have been described in this report in section 2.5 'Other Matters for Consideration'. The application and information provided in support of the application provide evidence that:

- The application was in a form approved by the CEO under Regulation 39(1), including payment of the relevant application fee (section 1.1)
- The applicant included all of the information required by the CEO under s34 of the Act (sections 2.1 to 2.4)
- The information establishes that siting and construction of the SyMo facility poses no undue risk to the health and safety of people or to the environment. This has been considered for anticipated normal operation and potential accident scenarios (section 2.4.4)
- The applicant has shown a net benefit from siting and construction of the SyMo facility (section 2.5.2)
- The magnitude of individual doses, the number of people exposed and the likelihood that exposure will happen have been shown to be as low as reasonably achievable (section2.5.3)
- The applicant has shown a capacity for complying with the regulations and licence conditions (section 2.5.4)
- The application was signed by the requisite office holder (section 2.5.5)

In relation to international best practice, it should be noted that the regulatory review documents relied on in the licence assessment and preparation of this report (section 1.3) reflect current international best practice in relation to radiation protection and nuclear safety, and in the use of technology incorporated in the design of the facility. Further, the standards and practices considered in the design of the facility have also been considered as part of the international best practice.

4. Recommendations

4.1. ISSUE OF LICENCE

It is recommended that Facility Licence F0266 be issued to the Australian Nuclear Science and Technology Organisation in respect of licence application A0266 authorising the siting and construction of a controlled facility, namely the SyMo, subject to the licence conditions listed below.

4.2. LICENCE CONDITIONS

The ARPANSA assessor recommends that the following licence conditions be included in the facility licence issued to the CEO of ANSTO for the conduct described on the application:

1) The licence holder must seek prior approval of the CEO of ARPANSA for construction of items of plant that will come into direct contact with the radioactive waste during the Synroc process. The submission must demonstrate that the design is informed by comprehensive risk identification and hazard assessment process and that construction will be undertaken in accordance with an appropriate quality management system.

2) The licence holder must not undertake any testing using radioactive material or full plant testing of the facility using non-radioactive material as part of the construction.

LEAD ASSESSOR			
NAME: Samir Sarkar	SIGNATURE:	ORIGINAL SIGNED	DATE: 13/5/ 2014
BRANCH HEAD			
NAME: Martin Dwyer	SIGNATURE:	ORIGINAL SIGNED	DATE: 13 /5/2014

Contributors:

- John Baldas
- John Ward

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[1] *Australian Radiation Protection and Nuclear Safety Act 1998*

[2] *Australian Radiation Protection and Nuclear Safety Regulations 1999*

[3] Australian Radiation Protection and Nuclear Safety Agency, *Regulatory Guide*: *Plans & Arrangements for Managing Safety v3* (October 2011)

[4] Australian Radiation Protection and Nuclear Safety Agency, *Regulatory Assessment Principles for Controlled Facilities*, RB-STD-42-00, Revision 1, October 2001

[5] International Atomic Energy Agency, IAEA, Site Evaluation for Nuclear Installations, safety requirements, NS-R-3, 2003

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[7] Australian Radiation Protection and Nuclear Safety Agency, *Regulatory Assessment Criteria for Design of New Controlled Facilities and Modifications to Existing Facilities*, RB-STD-43-00, Revision 1, October 2001.

Appendix 1

1. Preliminary safety Analysis Report of the SyMo Facility, SyMo-1310-2-B-AN-0001, Revision C, 3 July 2013
2. Preliminary safety Analysis Report of the SyMo Facility, SyMo-1310-2-B-AN-0001, Revision B, 27 July 2012
3. Preliminary HAZOP of the SyMo Off-Gas System for the Dryer, ANSTO/T/TN/2011-24 rev0,December 2011
4. Preliminary Hazard Identification Study of the SyMo HIP Process, ANSTO/T/TN/2012-05 rev 0, March 2012
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7. Basis of Design for Waste Form Used for SyMo Project-Alkaline Intermediate Liquid Level Waste, SyMo-0700-2-B-AN-0009, Rev A, 27 February 2012
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13. ANSTO Responses to ARPANSA Questions March 2013
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18. Process Description for the Mo-99 ILLW and ILW Treatment Process, SYMO-0697-2-B-AN-0018, Revision C, 20 July 2013
19. Front End operating and Control Philosophy, SYMo-0697-2-B-AN-0019, Revision C, 20 July 2012
20. SyMo Facility Construction Effective control Plan, SyMo-1310-2-B-AN-0002, revision B, 20 July 2012
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23. SyMo Facility Construction Radioactive waste Management Plan, SyMo-1310-2-B-AN-0005, revision B, 4 June 2012
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41. Process System Room, Active Solid Waste Calcining Operations, SyMo-0697-2-A-AN-0024-C -P&ID
42. Process System Room - Active Solid Waste Transfer and Filing Station, SyMo-0697-2-A-AN-0025-C - P&ID

Appendix 2

Australian Government
Australian Radiation Protection and Nuclear Safety Agency

D12016473

7 November 2012

Ms Mahani Taylor
Director
New South Wales Section
South-Eastern Australia Assessment Branch
Department of Sustainability, Environment, Water, Population and Communities
GPO Box 787
CANBERRA ACT 2601

Dear Ms Taylor

Thank you for your letter of 26 October 2012 to the Parliamentary Secretary for Health and Ageing, The Hon Catherine King MP, inviting comment on referral EPBC 2012/6598 ANSTO Nuclear Medicine Mo-99 Facility, Lucas Heights, NSW. The Parliamentary Secretary has asked me to respond on her behalf.

The Australian Radiation Protection And Nuclear Safety Agency (ARPANSA) is the licensing authority for radiation production facilities proposed to be established by a Commonwealth entity or contractor under the *Australian Radiation Protection and Nuclear Safety Act 1998 (ARPANS Act).*

On 26 October 2012, ARPANSA received a siting licence application from the Australian Nuclear Science and Technology Organisation (ANSTO) for a facility to produce molybdenum-99 (Mo-99). The proposed action by ANSTO represents a major expansion of ANSTO's Mo-99 production capacity with a planned increase of three to four times the capacity of the existing Mo-99 production facility in the ANSTO campus at Lucas Heights. It will be a new facility requiring a separate siting licence The activity level of the material to be manufactured causes the facility to be classified as a nuclear action under the *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act). Provided I grant ANSTO a siting licence, the project will still require licences from ARPANSA for the construction and operation of the facility.

I note that in 2003 the Parliamentary Secretary for Health and Ageing commented on a referral (EPBC 2003/1114) under the EPBC Act for an extension of the existing Mo-99 production facility. At that time, our advice to the Parliamentary Secretary was that the extension was a nuclear action under the EPBC Act as it significantly modified a nuclear installation. In that instance, ANSTO applied to the CEO of ARPANSA for approval under Regulation 51 of the *Australian Radiation Protection and Nuclear Safety Regulations 1999* to make a change with significant implications for safety.

In relation to the potential for off-site release and radiological consequence, the currently available equipment and technology, if employed and operated correctly, could enable the proposed facility to operate within the existing environmental discharge limits set for the

E-mail: info@arpansa.gov.au
Web: www.arpansa.gov.au
Freecall: 1800 022 333 (a free call from fixed phones in Australia)

PO Box 655, MIRANDA NSW 1490
Phone: +61 2 9541 8333, Fax: +61 2 9541 8314
619 Lower Plenty Road, YALLAMBIE VIC 3085
Phone: +61 3 9433 2211, Fax: +61 3 9432 1835
3-5 National Circuit, BARTON ACT 2600
Phone: +61 2 6141 4891

existing smaller Mo-99 plant. ANSTO's present application is only for the siting of the proposed facility and this licence is not required to include sufficient information about whether the current environmental discharge limits are likely to be compliant when the proposed Mo-99 production facility is in operation. We will receive more comprehensive information in this respect when ANSTO applies for its construction and operation licences at a later stage of this process.

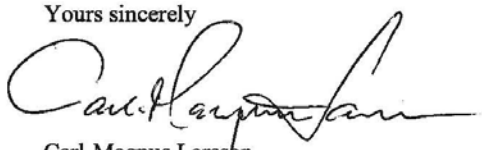
You will also note from page 4 of ANSTO's referral ('001 Referral of proposed action v Nov 10') that the disposal pathway for intermediate level liquid radioactive wastes in the proposed Mo-99 production facility will involve the use of a proposed radioactive waste treatment facility (SyMo) using ANSTO's Synroc technology. We have received a separate licence application from ANSTO for the siting and construction of SyMo. The proposed SyMo facility does not require consideration under the EPBC Act as a nuclear action as it is a 'prescribed radiation facility' and not a 'nuclear installation' under the ARPANS Act. However, in view of the connection between Mo-99 production and the proposed waste facility, and considering the SyMo facility will involve high temperatures and pressures, we have requested ANSTO seek your view on whether SyMo might also justify scrutiny under the EPBC Act. Nevertheless, we note SyMo's potential to greatly reduce the volume of physical waste generated by the proposed Mo-99 production facility.

The new Mo-99 facility will render the existing Mo-99 facility redundant and we would expect to receive advice from ANSTO in the near future about its plans to decommission, remove or re-use this facility. We have not currently received advice from ANSTO on the redundant Mo-99 facility.

ARPANSA's assessment of ANSTO's application for a siting licence for the proposed Mo-99 production facility under the ARPANS Act will include technical assessments of the safety of the proposed facility. Guidance to applicants is given in documents available on our website at http://www.arpansa.gov.au/pubs/regulatory/guides/OS-LA-SUP-240G.pdf. These documents detail the issues for consideration when making the licensing decision for this type of facility. Also, as part of our assessment, there will be public consultation, opportunity for public submissions and comments and public forum discussion. Comments received during public consultation will be considered by ARPANSA in its assessment of the licence application.

I hope this information is helpful to your Department as you consider ANSTO's application under the EPBC Act.

Yours sincerely



Carl-Magnus Larsson
CEO of ARPANSA

Appendix 3

NOTIFICATION OF
REFERRAL DECISION – NOT CONTROLLED ACTION

SYNROC Waste Treatment Facility, Lucas Heights, NSW (EPBC 2012/6697)

This decision is made under section 75 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Proposed action

person named in the referral	Australian Nuclear Science and Technology Organisation ABN: 47956969590
proposed action	The construction, commissioning and operation of a facility to process (using SYNROC technology) intermediate level liquid waste, arising from the production of the medical radioisotope molybdenum-99, into a durable solid waste, at Lucas Heights Science and Technology Centre on Einstein Avenue, Lucas Heights, NSW (See EPBC Act referral 2012/6697).

Referral decision: Not a controlled action

status of proposed action	The proposed action is not a controlled action.

Person authorised to make decision

Name and position	James Tregurtha Assistant Secretary South-Eastern Australia Environment Assessments
signature	
date of decision	19/2/13

APPENDIX 4

Australian Government

Australian Radiation Protection and Nuclear Safety Agency

FILE NOTE

File Number	S2013/00643 (TRIM Record R13/04487)
Author	John Ward
Date	28 April 2013
Subject:	Assessment of ANSTO Hazard Assessment of the SyMo Facility Application

1. BACKGROUND AND INTRODUCTION

In August 2012, ANSTO submitted a application to site and construct a new facility at the Lucas Heights Science and Technology Centre (LHSTC). The facility is known as SyMo and will process intermediate level liquid waste (ILLW) produced during the extracting Mo-99 from irradiated uranium target plates. Initially plant will process waste generated from building 54 and then, from the new ANSTO Nuclear Medicine (ANM) facility which will ultimately replace building 54. Waste will be transferred from building 54 in a flask by truck and from the ANM facility by underground pipe. The ANM facility will have increased Mo-99 production capacity and ANSTO's intention increase production of Mo-99 for the national and overseas markets. The SyMo process is necessary to manage the increased quantities of waste produced at the ANM plant and is therefore an important element to ANSTO's overall long term strategic investment.

2. PURPOSE AND SCOPE OF THIS REVIEW

This file note does not constitute a comprehensive review of the ANSTO application to site and construct a prescribed radiation facility; the SyMo facility. I was requested to review the HAZOP studies provided with the application. HAZOP is a technique commonly used in the process industries to identify both process safety hazards and potential operability problems. Operability problems can themselves result in radiation protection issues for workers involved in process recovery work and therefore are important to the ALARA principle. HAZOP is not a process of risk assessment and does not set out to solve any issues that may be identified. The original scope of this review has crept to encompass a more general assessment of the risk identification process.

This review provides advice to Dr Samir Sarkar who is the lead regulatory reviewer of the entire application. Analysis of the any chemical process hazards, radioisotope inventory and shielding is outside the scope of this review and needs to be considered by other reviewers.

In undertaking the review I have been mindful of the regulatory guidance available to ANSTO via the ARPANSA website at the time of the application [i]. This guidance includes important principles including:

- *"plans and arrangements should be a comprehensive programme of policies and procedures that demonstrate how radiation safety will be assured"*. See [$i_{Section\ E}$]
- *"the applicant should provide information that shows there will be no undue risk to the health and safety of people and the environment from the harmful effects of radiation arising from the proposed conduct"*. [$i_{Section\ H(2)}$]
- "*the applicant should provide information to show that the magnitude of individual doses, the number of people exposed, and the likelihood that exposure will happen, are as low as reasonably achievable, having regard to economic and social factors"*. [$i_{Section\ H(4)}$]

3. DOCUMENTS SUPPORTING THE APPLICATION

The following documents from the application were identified as having importance to the hazard identification and risk assessment. The application now comprises of documentation provided with the original application and supplementary documents that have been requested during the regulatory review.

Documents provided with the original application that relate to Hazard Assessment

- Licence Application [ii], [iii]
- ANSTO Internal Safety Review documents [iv], [v], [vi]
- Preliminary Safety Analysis Report [vii]
- Preliminary Risk Assessment [viii]

Documents provided on additional request that relate to Hazard Assessment

- Preliminary hazard identification study of the SyMo HIP process [ix] – Provided 13.09.12
- Preliminary overview HAZOP of the Front-End Process [x] – Provided 13.09.12
- Preliminary HAZOP of the off-gas system [xi] – Provided 13.09.12
- Process Description [xii]
- Front End Operating Philosophy [xiii]
- Product Quality Control Description [xiv]
- Front End Maintenance and Shielding Description [xv]
- Letter answering ARPANSA Questions – Provided 20.03.13 [xvi]

4. OVERVIEW OF SYMO

I do not intend to provide a detailed overview of the SyMo process of plant; this is described in various documents provided with the submission including [vii], [xii], [xiii], [xiv] and [xv]. An understanding of the complexity of this system is necessary in order to appreciate the depth of hazard assessment needed to ensure that the plant design, operation and maintenance are undertaken without undue risk to the health and safety of people and the protection of the environment.

The SyMo process is designed to immobilise alkaline or acidic intermediate liquid waste by conversion to a synthetic rock material. The PSAR [vii Table 4.1] associates a 523-843mSv.h-1 dose from a volume of 0.05ml of this liquid and a dose of 1.9 Sv.h-1 at a distance of 1m from a full storage feed tank which is used to temporarily store liquid waste prior to processing. Without precautions this liquid presents a significant hazard to people and the environment. The planned life of this plant is also 30 years and hence its reliability and maintainability are also important factors, especially for the safety of workers.

The overall SyMo process is split into two major parts. These are known as the 'front end process and the hot iso-static pressing (HIP) process.

The 'front end' process is multi-stage and requires the sequential mixing with liquid, then solid additives to form slurry that is then dried to a granular form. The granules are next transferred to a calcinator to drive off any residual volatile chemicals. The spherical grains from this process are loaded into a stainless steel can which is evacuated and sealed to complete the front end process. Throughout the front end process there is a sweep gas and off gas system used to carry away and treat gasses which are emitted in the process.

The sealed can is subject to hot iso-static pressing to convert the material into the final product.

The liquid waste material is progressively processed to its final solid form by equipment located in a series of hot cells. The hot cells provide a reducing environment, radiological containment and shielding to workers. The requirement to access the hot cells, if necessary, can result workers being exposed to dose rates that ANSTO estimate [viii] to be up to 300mSv.h-1 at the cell door.

From a process perspective there are a lot of inputs in the form of additives, sweep gasses, temperature, and pressures. The process descriptions make apparent the requirement to maintain a dry reducing atmosphere to ensure that the final product is dry and free of volatiles. The control of the chemistry is important in this regard. Gasses used in the process include nitrogen, argon and hydrogen. The mixing of additives is also important to both to the final product and in ensuring that any waste material does not prematurely begin to amalgamate at the wrong time. At this time the extent of human control over process variables is not well defined and its impact on the Hazard identification process has not been assessed.

There are a number of contingency arrangements if the process suffers a breakdown. During the front end process these contingencies generally involve the washing down the liquid or slurry into a shielded dump tank from where agitation is maintained and it can be recycled at a later time. In the later stages such as calcination or can loading the granules can be transferred by gravity flow into a storage hopper. The ability to remove the material from the main line is important to overcome the risk of conglomeration during process failure and also to reduce the dose rate from equipment that may require maintenance or repair.

5. GUIDANCE IN HAZARD IDENTIFICATION AND RISK ASSESSMENT

Hazard identification is an initial stage of risk assessments and is necessary to support safety case development. Hazard identification should identify any aspects associated with the process and equipment that need to be managed and assessed in the safety case. A variety of methods are commonly used in major hazard facilities including HAZOP, FMEA, and Fault Tree Analysis. Each of these provides a systematic and staged approach to the process which reduces the likelihood that hazards will be missed or underplayed through the application of lateral thinking and the avoidance of presumption.

Although ARPANSA does not have explicit guidance on risk assessment, the requirement is implicit in the guidance discussed in Section 2 of this document. Guidance on hazard identification is commonly available from industry and larger regulatory organisations. Examples are provided in the boxes below from the IAEA General Safety Requirements [xvii] and Safe Work Australia [xviii]:

IAEA GSR Part 4 Requirement 6: Assessment of the possible radiation risks

The possible radiation risks associated with the facility or activity shall be identified and assessed.

The possible radiation risks associated with the facility or activity include the level and likelihood of radiation exposure of workers and the public, and of the possible release of radioactive material to the environment, that are associated with anticipated operational occurrences or with accidents that lead to a loss of control over a nuclear reactor core, nuclear chain reaction, radioactive source or any other source of radiation.

The term 'possible radiation risks' relates to the maximum possible radiological consequences that could occur when radioactive material is released from the facility or in the activity, with no credit being taken for the safety systems or protective measures in place to prevent this.

Safe Work Australia – Guide for Major Hazard Facilities: Preparation of a Safety Case

6.1 Hazard and Major Incident Identification

The safety case must include a summary of the identification of major incidents and major incident hazards conducted under regulation 554. It should also include a justification of the approach taken and methods used in conducting the major incident and major incident hazard identification process. The operator should be able to demonstrate that:

- *appropriate steps have been taken to comprehensively identify all potential major incidents, for the complete range of expected and unexpected operating modes i.e. start-up, shutdown, commissioning, differing capacities, seasons and other expected variations*
- *they have had regard to any advice and recommendations given by any relevant authority*

- *worker participation has been appropriate and documented.*

Each major incident that may potentially occur in the course of operation of the facility should be described in sufficient detail to assure the regulator that the operator understands:

- *the nature of each major incident and major incident hazard*
- *the likelihood of each major incident hazard causing a major incident*
- *in the event of a major incident occurring, its potential magnitude and the severity of its potential health and safety consequences.*

Representative major incidents may be presented if the operator can provide on request that all major incidents and major incident hazards have been identified.

6. NORMAL CONVENTION OF HAZOP STUDIES

HAZOP studies are a powerful method of identifying hazards as they force a knowledgeable team of people to think systematically about any hazards that may exist in a process. It is a process which can identify hazards which can lead to both major plant accidents and also lesser deviations and operability problems. The study uses a set of guidewords and parameters to explore a process for hazards. Examples of guidewords are: none; more of; less than; other than. Examples of parameters are: flow; pressure; temperature. The HAZOP leader applies each guideword to each parameter in turn and asks the team how such a deviation can occur during the process. The process being examined is split into elements or nodes. These are manageable sections of a process and will usually be from the input of one stage to the output of the same stage. In the case of SyMo an example may be the waste input to the rotational dryer to the output from that dryer or perhaps the point at which waste material enters one particular hot cell to the point that it exits the same hot cell. Therefore the ultimate number of process deviations considered is obtained by multiplying the number of guidewords and parameters and elements. For the combination of guidewords and parameters just mentioned there would be nominally a total of twelve types of deviations for each element/node. In some cases a deviation will not be applicable for a particular element and in others there may be more than one occurrence of the same deviation in the element. HAZOP is therefore a resource intensive process which needs to be seen as an investment by the organisation that conducts it.

It is an important principle that all credible deviations should be explored regardless of the perceived likelihood of the deviation occurring. The HAZOP process does not set out to quantify the risk of a hazard occurring or to solve specific problems and it is important not to do this as doing so may ruin the team dynamics. It is the HAZOP leader's responsibility to ensure that this does not occur and to prevent the HAZOP from becoming bogged down or for debates/arguments to occur. Thorough planning of the HAZOP is essential to its ultimate success especially in regard to the selection of guidewords and parameters and the selection of the HAZOP team.

There are many standards available which describe the HAZOP process and which are consistent with the description above. The Australian Standard is AS IEC 61882-2003 [xix]. ANSTO have also quoted a NSW Government guideline [xx] in response to ARPANSA questions.

7. THE ANSTO HAZARD IDENTIFICATION PROCESS FOR SYMO

The SyMo process i.e. the conversion of a liquid waste to a synthetic rock, is undertaken through a number of stages requiring the control of additives and mixtures, temperatures, pressures, and a reducing atmosphere comprising of hydrogen in nitrogen. The SyMo facility also involved an up-scaling of the process compared to anything that ANSTO has undertaken before, plus this is believed to be the first integration of technologies into a single production plant worldwide. Whilst there is some automation in the process it is also heavily reliant on manual control especially in the transfer between stages, albeit the no operating instructions are currently available. This type of process lends itself well to the use of a comprehensive HAZOP study.

ANSTO have provided two HAZOP documents one HAZID[4] document along with an explanation of its process for risk assessment. Other than the HAZOP documents there is no other systematic hazard identification documents provided in the submission, i.e. there is no FMEA, Fault Tree Analysis, etc. ANSTO has advised [xvi] that the HAZOP reports are finalised and that there is no intention to undertake further HAZOP unless there is a significant deviation from the preliminary design.

ANSTO's HAZOP documents [ix], [X], [xi] have been reviewed and there are a number of observations in regard to the information provided by ANSTO.

How comprehensive are the HAZOP studies?

An initial observation is that, given the complexity of the SyMo process the resulting HAZOP study reports are not very large.

In a response [xvi] to questions from ARPANSA [XXi], ANSTO advised that the reports have applied a process of 'reporting by exception'. ANSTO quotes the following underlined extract from the NSW government HAZOP Guide [xx]. The whole paragraph is included here for context:

"There are two possible approaches to record keeping. One is to record only key findings ('reporting by exception'). The other is to record all issues. Experience has shown that reporting by exception can be adopted in most cases since it minimises the secretarial load and focuses on the issues that need attention. It is important, however, that the recording of safeguards is retained, even when no further action is required. This record helps ensure that safeguards are not removed through ignorance, subsequent to the HAZOP".

There are a total of 96 deviations listed in the three reports provided to ARPANSA of which 70 deviations have recommendations for design considerations attached; the remaining deviations have existing safeguards listed. In anything other than a basic design concept the ratio of 96/70 would not be expected as the process designers would already have taken account of obvious safeguards and noting these safeguards would be sufficient. It would be reasonable to expect the ratio to be reversed with many more existing safeguards listed and far fewer recommendations. This suggests that either; the design remained conceptual at the time of the HAZOP or; safeguards where not consistently recorded, or some other flaw in the conduct of the HAZOP such as insufficient time spent on it or a presumption of the team to concentrate on known vulnerabilities.

ANSTO were asked to provide the duration of the HAZOP meeting for SyMo. In reply [xvi] ANSTO advises on the 'typical structure of the design review process' ANSTO states that the whole process takes five days of which the third day is the HAZOP and may run into the fourth day. Whilst ANSTO has not answered the specific question asked, its answer does illustrate that the time invested in HAZOP is very short and, in the experience of the regulatory reviewer, far less than that needed to indicate a robust HAZOP process.

Use of Guidewords

The choice of guidewords used in a HAZOP is important to the identification of hazards. Only one of the SyMo HAZOPs uses fluid guidewords, examples of which are high, low, zero, reverse. This is the HAZOP for the off-gas system [X]. In this case the guidewords are combined with flow and pressure parameters. All other guidewords

[4] In this document the HAZOPs and HAZID will be known collectively as HAZOPS.

are checklist guidewords, examples include; impurities, change in composition, change in concentration, reactions, electrical, instruments. In the case of the other two HAZOPs [ix], [xi] all guidewords are the checklist type examples being; toxicity, services required, construction materials, commissioning, start-up, shut down. The reviewer considers that checklist guidewords are less effective than the common flow guidewords which are the founding type of guideword for HAZOPs. The benefit of the common flow guidewords is in their ability to challenge any pre-conceptions amongst the HAZOP team and to get that team, who are largely made up of project staff, to think in a different way to that of the other design review stages. Although the results are very thorough, the disadvantage of common flow guidewords is that it tends to take longer to perform the HAZOP. The reviewer also notes that there are a number of typical checklist guidewords which are absent from the ANSTO HAZOPs which seem to be relevant to this process. Examples include level, pH, speed, time, mixing. ANSTO was asked to provide the rationale for the selection of guidewords but the response [xvi] provided very little explanation or demonstration of thoughtfulness in their guideword selection.

Selection of Process Elements

Another important aspect of the HAZOP study is the selection of process elements (also known as nodes). It is usual for the study to be broken down into logical stages each of which is subject to the same set of guidewords. This has the advantage of ensuring that the guidewords are suitably applied to all aspects of the process in a focused manner. The size and number of the element must be carefully considered to make it manageable and effective without making the process unnecessarily long. The SyMo process would lend itself well to this separation as the waste is processed through a variety of equipment, each stage of which performs a different task. The waste is also transferred through a variety of hot cells which would provide an alternative way in which to break up the overall HAZOP into manageable elements. ANSTO's HAZOP for the process front end has not been separated into elements and is listed as a process overview. The logic behind this is not apparent to the reviewer. The HAZID for the HIP is separated into elements. It is noted that the HIP HAZID meeting included a number of contractors from the supplier of the HIP machine and it is possible that ANSTO's lesser knowledge of the HIP process lead to greater scrutiny of this stage of the process. The HAZOP for the off gas system is split into two elements plus an overview. ANSTOs logic for the way it has split the HAZOP studies is not apparent. The reviewer considers that this has weakened the effectiveness of the study. This is especially the case for the Front End HAZOP which has not been split into elements.

Examination of Deviations

The content of the HAZOP report tables has also been reviewed and provides little information on specific deviations. It is questionable if the information included is of very much guidance to the designers. The following are examples from the Front End HAZOP [xi].

Line 17 considers the checklist guideword 'Commissioning' and a cause of 'Maintenance Planning'. Possible consequences are high doses during recovery and the safeguard is that all maintenance tasks are to be trialled during cold commissioning. This is very general and of little use to a designer as by the time cold commissioning is undertaken the design is complete and difficult to be changed. The time to influence the maintainability is during the design phase not afterwards. Further, there is no detail on any particular part of the facility where attention needs to be given.

Line 22 considers the checklist guideword 'Breakdown'. The only possible cause that is listed is the loss of the control system. This is in a system that extensively utilises mechanical and electrical equipment including motors, pumps, valves, instrumentation, conveyor systems, etc. The material being processes is either acidic or alkaline and later gradually and dusty. This type of environment is one that would normally be expected to encounter reliability problems. This shows an inadequacy to the HAZOP process.

General Conclusion on the SyMo HAZOP Process

The reviewer has considered the scope, depth and methodology of HAZOPs that support the application and considers that ANSTO's application does not show that an adequate HAZOP process has currently been performed on this application. The selection of guidewords and elements are not considered to provide a suitable level of examination to the SyMo process. Further, an examination of identified deviations suggests that there are

significant gaps in the reported findings. The ultimate conclusion is that the HAZOPs contained in the application do not provide support for the application.

Other Hazard Identification Processes

Whilst ANSTO has failed to demonstrate a thorough HAZOP process in its application, it is recognised that a good deal of thought to potential hazards and operability problems is apparent elsewhere in documents that have been provided a during the regulatory review process. My review has not undertaken a thorough assessment of these documents but I have endeavoured to ascertain whether or not a general hazard identification process has taken place that is not apparent from the HAZOP reports.

The PSAR [vii] itself appears to cover the usual subjects for a safety analysis. There is high level consideration of potential deviations that are focussed on major plant failure but have relevance to lesser incidents and operational events. The ability to transfer the waste inventory to a wash down tank in the event of a process interruption is discussed. There is also an overview of certain anticipated maintenance tasks such as replacement of the vibrator motors on the calciner.

The Preliminary Risk Assessment [viii] provides a list of failures during normal process operations and a table of hazard scenarios. As normal for a risk assessment, it is largely about evaluating a list of risks based on the potential consequence and likelihood of occurrence[5]. It is not clear from where these lists are derived but it is noted that many of the failures and hazards are not identified in the HAZOP reports. This document also lists the safety categorisation of various structures systems and components. There are no safety category 1 items in SyMo (i.e. with potential to cause doses to personnel above 100mSv). ANSTO have stated that the risk assessment is conservative and that the categorisation of items may be lowered.

Other documents which show ANSTOs consideration of hazards include a report on the operating and control philosophy [xiii], a maintenance and shielding description [xv]. Each of these documents identifies many of the safeguards which could have been shown in the HAZOPs. The Operating philosophy has a section dealing with abnormal operations which describes the processes during various process interruptions. The maintenance description provides an overview of maintenance activities including the removal and replacement of some items from the hot cells. This overview includes stepped pictures from a computer solid model and shows a level of detail planning that is not apparent elsewhere in the application. This includes the removal it items of equipment such as the rotary dryer.

8. CONCLUSION AND RECOMMENDATION REGARDING HAZARD IDENTIFICATION

ANSTO has not demonstrated a thorough systematic hazard identification process in this application. ANSTO has also stated that there is no intention to review the current HAZOP studies unless there is a significant change to the process in the detail design phase. This is despite calling the HAZOP preliminary reviews and despite little information on the actual operating procedures being available at this time.

In an engineering sense, the hazard identification in some supporting documents is more mature than the HAZOP reports. HAZOP process should commence before detail design so that the findings can be used to inform the design. This is not apparent in the application as the link between the hazards listed in the HAZOPs is at best tenuous with those of other supporting documents. It is assumed that the hazards discussed in the supporting documents have been identified in other design review processes. Whilst useful, design review processes have failed to identify causes of accidents which have occurred elsewhere; this is one driver for HAZOPs becoming so common in process industries where HAZOPs are seen as an effective way to identify hazards and operability issues that may be missed in other design processes. HAZOPs are not foolproof but they offer improved scrutiny.

Assuming that the regulatory review of the facility containment, ventilation and shielding systems is found to be acceptable, the direct risk to people and the environment of a process failure is acceptable on the basis that the facility will remain safe in an interim period between a failure and recovery actions. However, recovery processes have implications to worker dose, especially if access to hot cells is necessary and wash down and cleaning of the equipment is not effective. The HAZOPs do not demonstrate that a thorough consideration has been given to

[5] The assessment of cconsequence and likelihood values has not been reviewed here.

process breakdown and recovery and whilst other supporting documents go further, the maintenance is described on the basis that the equipment is cleaned beforehand.

The review considers that ANSTO should look again at its HAZOP processes for SyMo and undertaken further assessment. In regard to how ARPANSA may apply regulatory management of this issue there are three options which are apparent to the reviewer:

● Option 1: Require ANSTO to repeat HAZOP processes before granting a licence to site and construct the SyMo facility

This option, at first glance is attractive. However a problem with this option in that ANSTOs safety department who undertake the HAZOP processes have given no indication to ARPANSA that they are not fully satisfied with their process or the outcome. Discussions between ANSTO and ARPANSA have highlighted regulatory concerns but it is not apparent that these voiced concerns have had any effect. ANSTO in answer to questions have pointed out that it has many years of experience in conducting HAZOP, that the staff and leaders in this case had training and extensive experience of HAZOP and that ANSTO has undertaken commercial HAZOP work. In practice, this approach on its own is unlikely to change the thoroughness of a HAZOP study unless ANSTO acknowledge and agree with ARPANSA's concern. This may be the case even if ARPANSA is prescriptive in specifying the type of guidewords and elements or a level of reporting above that currently considered by ANSTO to be reporting by exception. ANSTO simply and misguidedly believes its HAZOP processes are good and are not listening to ARPANSAs concerns and therefore have no incentive make anything more than cosmetic improvements.

● Option 2: Require ANSTO, through a licence condition, to conduct further HAZOP on the SyMo facility before a licence to Operate will be granted.

This has many of the drawbacks of Option 1. However it does give ANSTO more time to undertake the task without the same impact on the SyMo project plan and ANSTO's knowledge of the final design and operation is improved from when the original studies took place. It provides ANSTO an opportunity to plan the HAZOP so that priorities are given to long lead items. It does have a further drawback in that if any new hazards are identified it may require re-engineering and retrofitting of safeguards and could lead to compromises being made. Ultimately, ARPANSA will have a final say with the decision on whether or not to grant an operating licence. There have been precedents for this type of intervention; during the construction of OPAL for example the inspection process for the secondary cooling circuit where ARPANSA required ANSTO to excavate buried cooling pipes and conduct further inspection of pipe welds.

● Option 3: Require ANSTO, through a licence condition to have the HAZOP processes for SyMo independently reviewed. This review should be complete before ANSTO apply for an operating licence.

The reviewers expectation of this option would be that ANSTO will need to conduct further HAZOP studies of SyMo. This option has an advantage of obtaining a second, expert opinion on ANSTO's HAZOP processes which will provide additional weight to concerns already expressed by ARPANSA. If this option is selected it is recommended that ARPANSA select the expert rather than leaving the choice to ANSTO. This option has the advantage that it will maintain regulatory independence by avoiding the need for ARPANSA to be more prescriptive.

Recommendation: The reviewer recommends that Option 3 is selected to

Recommendation: The review also recommends that regulatory advice on risk identification and assessment is developed by ARPANSA. ARPANSA notes that Safe Work Australia has a range of guidance available for Major Hazard Facilities. Consideration could be given to referencing this advice within a skeletal ARPANSA guideline.

9. OTHER ISSUES ENCOUNTERED DURING REVIEW OF RISK ASSESSMENT

In the process of identifying information relating to hazard and risk assessment the following items were identified which may need to be considered in the overall application:

The SyMo Emergency Plan [xxii] deals with arrangements during construction rather than during the subsequent operation. There is no radiological hazard during construction other than the use of calibration sources which are

already under licensed control. The only concern we have may regard an emergency originating in a different facility which would also be covered under another, existing licence. Therefore ANSTO have provided a plan to support its application which only deals with hazards that are outside of ARPANSA's jurisdiction, which are irrelevant to the application and which may render the application incomplete. Normal practice (demonstrated in the OPAL application, is to outline the emergency arrangements needed for the operating phase. This may be important as those arrangements may have implications on the detailed design on the facility.

The radiation protection plan [xxiii] has a similar issue. Whilst the plan discusses the range of doses that are expected during operation it defers area categorisation and other decisions until hot commissioning. There is also the following statement in the scope of this plan: "This plan does not describe the radiological arrangements for the subsequent operation of the facility (including hot commissioning)". It is possible that conservative consideration will not be given to the design of the facility unless there are bounding estimates for the radiological hazards before the detail design stage to that any radiation protection systems required are properly installed in the facility and not retro-fitted afterwards. This may lead to unnecessary comprises following the completion of construction.

Recommendation: It is recommended that the scope of each plan provided with the licence application is assessed to ensure that the principles above are taken into account.

Recommendation: It is recommended that regulatory guidance on the content to plans and arrangements required for licence applications is clarified to ensure that those plans include arrangements for operation even when the application is seeking permission to site or construct a facility.

Signed	
	John Ward

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[ii] Letter – Dr A Paterson (ANSTO) to Dr Larsson (ARPANSA) – Application for a Licence to Site and Construct a Controlled Facility – SyMo Facility ARPANSA TRIM Record R12/07951

[iii] Facility Licence Application – Prescribed Radiation Facility, ARPANSA TRIM Record A0266

[iv] Safety Assurance Committee Approval 1931/12, ARPANSA TRIM Record R12/07953

[v] Results of SAC Assessment form ARPANSA TRIM Record R12/07954

[vi] SAC Application Form 1931/12, ARPANSA TRIM Record R12/07952

[vii] Preliminary Safety Analysis Report for the SyMo Facility, ANSTO Document Reference SyMo-1310-2-B-AN-001, ARPANSA TRIM Record R12/07958

[viii] Preliminary Risk Assessment for the SyMo Facility, ANSTO Document Reference: ANSTO/T/TN/2012-02 rev 1 – July 2012, ARPANSA TRIM Record R12/07955

[ix] Preliminary Hazard Identification Study of the SyMo HIP Process, ANSTO Document Reference: ANSTO/T/TN/2012-05 rev 0, ARPANSA TRIM Record R12/11455

[x] Preliminary HAZOP of the SyMo Off-Gas System for the Dryer, ANSTO Document Reference: ANSTO/T/TN/2011-24 Rev 0, ARPANSA TRIM Record: R12/11457

[xi] Preliminary Overview HAZOP of the SyMo Front-End Process, ANSTO Document Reference: ANSTO/T/TN/2011-22 rev 0, ARPANSA TRIM Record R12/11456

[xii] Process Description for the Mo-99 ILLW and ILW Waste Treatment Process, ANSTO Document Reference: SyMo-0697-2-B-AN-0018 Rev C – 20 July 2012, ARPANSA TRIM Record R13/03679

[xiii] Front End Operating and Control Philosophy, ANSTO Document Reference: SyMo-0697-2-B-AN-0019 Rev C – 20 July 2012, ARPANSA TRIM Record R13/03688

[xiv] SyMo Plant Product Quality Control Description, ANSTO Reference: SyMo-0600-2-B-AN-003 Rev A – 17 February 2012, ARPANSA TRIM Record T13/03699

[xv] SyMo – PSR-TWR Maintenance and Shielding Description, ANSTO Reference: SyMo-0670-2-B-AN-0010-A Rev A – January 2012, ARPANSA TRIM Record R13/02926

[xvi] Letter – F Wigney (ANSTO to M Dwyer (ARPANSA) – 15.03.2013 – Response to ARPANSA Queries R13/01865 on Synroc Facility Application, ARPANSA TRIM Record R13/02607

[xvii] IAEA Safety Standards: Safety Assessment for Facilities and Activities, IAEA General Safety Requirements Part 4: GSR Part 4

[xviii] Safe Work Australia – Guide for major Hazard Facilities: Preparation of a Safety Case – March 2012

[xix] Australian Standard – Hazard and Operability Studies (HAZOP Studies) – Application Guide AS IEC 61882 – 2003

[xx] NSW Government Planning and Infrastructure – Hazardous Industry Planning Advisory Paper No.8 – HAZOP Guidelines - January 2011

[xxi] Letter - M Dwyer (ARPANSA) to F Wigney (ANSTO) – 28 February 2013 – ANSTO Application for a Licence to Site and Construct a Controlled Facility – SyMo Facility, ARPANSA TRIM Records R13/01865

[xxii] SyMo Facility Construction Emergency Management Plan, ANSTO Document Reference: SyMo-1310-2-B-AN-0007, ARPANSA TRIM Record R12/07964

[xxiii] SyMo Facility Construction Radiation Protection Plan, ANSTO Document Reference: SyMo-1310-2-B-AN-0004, ARPANSA TRIM Record R12/07961