Nuclear Safety Committee

an advisory body to the CEO of ARPANSA, established under the ARPANS Act 1998
Secretariat: ARPANSA, Standards Development & Committee Support Section,
Tel: 03 9433 2211 Fax: 03 9433 2353 Email: arpansa.secretariat@health.gov.au
Lower Plenty Road, Yallambie, Victoria, 3085 Web: www.arpansa.gov.au

Minutes of the Reactor Pool Penetrations Briefing held on 14 July 2003 ARPANSA – Miranda

1. ATTENDANCE AND APOLOGIES

PRESENT

Members

Dr. Barbara Shields – Chair
Dr. John Loy
Professor Peter Johnston
Mr. Bob McAneny
Dr Neil McDonald
Professor Rob Melchers
Professor Ian Polmear
Dr. Alan Roberts
Dr. Garry Smith
Dr. Tamie Weaver

Observers

Ms. Rhonda Evans – ARPANSA Legal Advisor
Mr. Don Macnab – ARPANSA Regulatory Branch
Dr. Eng W (Voytek) Mazur – CSIRO Consultant
Mr. Vince Diamond – ARPANSA

Secretariat

Mr. Keith Dessent – Secretary

APOLOGIES

Professor Marcela Bilek
Dr. Rob Lee

2. OPENING OF MEETING

The Meeting commenced at 11:20 am. The Chair welcomed Members, ARPANSA observers and the CSIRO consultant, Dr Voytek Mazur. CSIRO had been engaged by ARPANSA to advise on the repair strategy.

Dr Shields summarised the purpose of the meeting as being to receive a briefing on:

- the reasons why penetrations in the reactor pool liner were made in the incorrect positions;
- what steps would be taken to rectify the fault consistent with the approval for construction of the liner; and
- what steps were in place to ensure that similar problems would not happen again both for this and other systems, structures and components.

Members would be given a chance to ask any questions that they considered necessary. These questions would assist Dr Loy in any decision in relation to an approval for the construction of the reactor to continue to the next stage. Members were encouraged to advise the CEO on:

- what ARPANSA needs to pay particular attention to in relation to the repairs, QA and management process for the project; and
- what problems need to be addressed.

Dr Loy advised that if Members wished to use any of the tabled documents marked 'commercial-in-confidence' for referencing, those Members should obtain approval from ARPANSA. All other tabled documents were public documents.

3. BRIEFING ON PROPOSED REPAIRS ON THE REPLACEMENT RESEARCH REACTOR POOL LINER

3.1 Briefing

Mr Macnab briefed the Committee on:

- the error that had occurred in locating the penetrations on the reactor pool liner;
- how the error had occurred; and
- the status of the repairs.

The reactor pool liner is approximately 15-metres high and 4-metres in diameter. It was constructed with 12-mm thick base plate upon which nine 6-mm thick rolled sections, or strakes, were welded. Each of the butt welds (longitudinal and circumferential) required 100% radiographic assessment, in addition to other testing and inspection. The welds at the joins of the base plate and the lowest strake could not effectively be radiographed.

The error that resulted in 22 penetrations in the rolled sections being misplaced arose from an incorrect reading of the technical drawings. Consequently, the plates making up the liner had been rolled inside out resulting in the penetrations being a mirror image of where they were supposed to be. Upon finding the error, the fabricator attempted a repair of 10 penetrations by filling them with plate and welding them. The repairs to these holes were not authorised by the design authority (INVAP) and lacked proper quality assurance documentation. The quality of the repairs had not been assessed, or approved, by ARPANSA to date.

The proposal from ANSTO/INVAP for repairs was as follows:

- the additional longitudinal seams in strakes 2 and 8 were acceptable – in view of their location and that all appropriate QA documentation was available.
- for the unrepaired holes:
  - all holes smaller than 100mm diameter would be enlarged to have a minimum diameter of 100 mm;
  - enlargement of holes would be made so as to not intersect with existing welds;
  - if enlarged holes ended up closer than 25 mm to each other, then a single enlarged hole would be made to prevent such occurrence;
  - the edge of any repair would be at least 25mm from any other penetration;
  - the repair edge would be at least 25 mm from any other weld or the repair edge would be extended to replace the other weld; and
  - welds would not be under a penetration reinforcement pad.
- for rectification of 7 repaired holes:
  - all holes which had been repaired would be re-repaired;

  - all criteria for rectification of unrepaired holes would be met; and
  - all heat affected zones (HAZ) of the original repairs would be removed.
- for rectification of repair near the base of the reactor pool:
  - the existing repair was to be removed and replaced; and
  - a full scale prototype of this repair would be manufactured and examined prior to undertaking it.

The inspection and testing of the repairs would be, with the exception of the weld to the base:

- spot ferroxyl tests before and after welding;
- ultrasonic inspection for thickness measurement;
- 100% visual;
- 100% dye penetrant;
- 100% radiographic;
- 100% vacuum box;
- pickling and passivation of all welds in the repairs;
- weld polish inspection; and
- a leak test during hydrostatic test of the pool.

The weld to the base would be 100% visual and 100% dye penetrant tested.

The ANSTO submission also addressed metallurgical issues:

- sensitisation, which was argued not to be an issue with 304L stainless steel and appropriate welding technique;
- hot cracking, which was argued not to be an issue for 304L with appropriate filler metal (308L);
- embrittlement, which was argued not to be an issue with this thickness of plate; and
- the control of distortion would be addressed through welding procedures.

3.2 Discussion by Members

The following matters were raised by members in the course of the briefing:

- Members considered it important to ensure that the repairs had been effected with the same plate as the liner and not scrap.
- Professor Polmear and Dr McDonald indicated that they generally agreed with the assessments in the submission. Professor Polmear pointed out that there was some inaccuracy in the ANSTO evaluation of sensitisation. He would supply a brief written correction. This inaccuracy did not affect his conclusion. Professor Polmear subsequently supplied the following paragraph.

  > *"In welded components, it is possible for chromium carbides to form in heat affected zones of the parent metal that are parallel to either side of the weld, and which experience temperatures in the range 450-850^{o} C. These carbides precipitate preferentially at grain boundaries and their formation may cause localised depletion in chromium to levels below that needed for corrosion protection. These regions then provide paths along which localised intergranular attack can occur in the presence of a suitable corrodent".*

  Corrosion was considered unlikely in the de-mineralised water environment to which the liner would be subjected. However, it was important to ensure that the correct plate and weld filler material was used for the repairs.
- Members noted that the metallurgical issues were relevant to all the welding of the tank, not only the repairs. It was therefore important that ARPANSA be satisfied that the correct plate and filler materials had been used, together with qualified welding processes.

- Members noted that the welding of the tank walls to the base had not been radiographically tested. This arose from the design of the base, which meant that the joint was not suitable for radiography. Those welds would be visually inspected and subject to 100% dye penetrant inspection.

  Dr Smith noted that the report of Welding Technology Institute of Australia (WTIA) – employed by ANSTO as an independent adviser on the welding – seemed to assume 100% radiography of all welds. He asked:
  – whether they were aware of the circumstances affecting the base plate; and
  – that WTIA's awareness that 100% of welds were not to be radiographed be confirmed.

- Another issue that might affect the repair near the base was whether there had been a re-weld during the unauthorised repair. The international advice obtained relating to that issue was that two re-welds (that is, the initial weld plus two more) could be tolerated.

- Overall, Members agreed that ARPANSA needed to be assured of the QA process for the proposed repairs and that there was documentation of the construction of the tank.

- In relation to the structural analysis of the tank, Members were assured that, provided the repair welds had a welded joint efficiency of not less than unity, there would be no implications for the finite element analysis. This was because the joints and parent material would have the same mechanical properties respectively as the joints and plates in the rest of the unrepaired construction.

- The CSIRO consultant was to investigate issues including weld strength relative to the heat input to the repair.

- It was noted that for the unrepaired holes, the repairs were to be in accordance with the relevant Code requirements for design and construction of the tank. For the repaired holes, the re-repair procedures were to be in accordance with the relevant Code requirements for repair during construction. In both cases, this meant that the repair welds, if carried out correctly, would meet the same structural integrity and corrosion standards as for the original construction.

Members agreed that ARPANSA needed to satisfy itself that there were no other unauthorised repairs.

4. BRIEFING ON QUALITY CONTROL ISSUES ARISING FROM THE MISPLACED PENETRATIONS

4.1 Briefing

Mr Macnab briefed the Committee on:

- the chronology of events between the error being found and ARPANSA being advised;
- how the error had been found;
- what changes to the management structure of the fabricators had taken place to avoid future occurrences; and
- investigations into other processes and equipment to ensure that other errors had not occurred.

The plate for the pool liner was delivered to the fabricator in late 2002 with the penetrations already 'stitch cut'. The plate was inspected, then cut to size and rolled in mid-December 2002. A subsequent inspection of the rolled plate did not reveal the error. The error arose from being rolled in the wrong direction.

Longitudinal welding of the rolled plates commenced on 30 December 2002 however, it was not until mid-February 2003 that the misaligned penetrations were noticed by the fabricators. It is unclear how and why the defects were discovered at that stage and not earlier in the process.

An internal decision by the fabricators resulted in the commencement of welded repairs. Repairs on ten of the penetrations were completed by mid-March 2003 but the engineering contractors, JHEDI, were not advised until mid April 2003.

JHEDI did not advise INVAP of the defect until 6 May 2003. ANSTO and ARPANSA were notified immediately following the advice to INVAP.

The following corrective and preventative actions have been proposed for the fabricator by JHEDI:

- design changes proposed by the fabricator shall be raised in Change Advice Note (CAN);
- no changes to be made unless approved by INVAP (design authority);
- any 'deviations' to be reported immediately in Non-Conformance Report (NCR);
- audit of Specific Inspection and Test Plans (SITPs) – jointly by ANSTO, INVAP, JHEDI; and
- SITP Surveillance Points (SPs) to be Hold Points (HPs).

JHEDI would supply a welding inspector and a QA documentation reviewer to oversee the work of the fabricator. In addition, a design person, manufacturing person and QA person would be inserted into the management line of the fabricator. ARPANSA required information on the qualifications, experience, responsibilities and authority of inserted personnel. The final proposals for these arrangements (Attachment 22 of the ANSTO submission) have not yet been received.

The ARPANSA review of rectification of the errors to date included:

- a review of documentation;
- discussions with ANSTO, INVAP, JHEDI;
- ANSTO answers to ARPANSA questions;
- the retaining of a CSIRO material science and welding specialist and other consultancy services (Toshiba (Japan)) to advise on the welding and repair strategy respectively;
- a visit to the fabricator's works to view
  - the reactor pool liner; and
  - other vessels, pipes, skirts etc

Future ARPANSA review of the rectification of the errors would include:

- a CEO visit to fabricator's works;
- CEO discussions with JHEDI quality management;
- a report from CSIRO; and
- draft recommendations to CEO.

To ensure that the systemic mistakes in the interpretation of the engineering drawings would not be repeated by the fabricator and other sub-contractors, INVAP had taken the following actions:

- the frequency of visits to all workshops associated with the RRR project was increased;
- a program for visits would be developed;
- during each visit, INVAP personnel would:
  - speak to the person responsible for the manufacturing engineering in the workshop;
  - assess the quality and pertinence of the shop drawings being prepared; and

– report, in writing, any source of potential difficulties in engineering or manufacturing detected,

- stress with all sub-contractors the projection in the detail engineering drawings carried out by INVAP was different from the usual in Australia.

4.2 Discussion by Members

Members raised the following matters during the discussion:

- the simple statement that other errors had not arisen from the same root cause error was not sufficient. It should be demonstrated that each item manufactured by the fabricator had been checked.
- ARPANSA needed to be assured that the injection of JHEDI and INVAP personnel into the fabricator's management stream did not remove proper responsibility from the fabricator, nor that it overwhelm the management of the fabricator. This is particularly important as the fabricator is a small company. Each person in the line would have their own responsibility and would need to discharge it accordingly.
- The authority of INVAP and JHEDI vis a vis the fabricator in regard to quality issues at the shopfloor level would need to be established.
- It is clear that the control of this particular sub-contractor is being addressed, but ARPANSA needs to be satisfied that there is a proper quality control system in place and operating for all the contractors and sub-contractors. While the role of ANSTO as the licence-holder is fundamental, ARPANSA needs to be active through audits and checks of the system in order to provide public confidence.

Meeting Closure

Dr Loy thanked the Committee for their input and comments during this meeting. Members were asked to forward any further queries or comment to Dr Loy following the meeting.

Members approved the tabling of the draft minutes of this meeting at the Radiation Health Committee the following week (23-24 July 2003). The meeting closed at 3:10 pm.

The further consultant reports would be available for NSC members when completed.