Australian Government
Nuclear Safety Committee

Minutes of the briefing held on 25 January 2008
ARPANSA – Miranda Campus

ATTENDANCE AND APOLOGIES

PRESENT

Members

Dr. Barbara Shields – Chair
Professor Marcela Bilek – by teleconference
Mr. Jim Hondros – by teleconference
Professor Peter Johnston
Dr. John Loy
Mr. Don Macnab – by teleconference
Professor Ian Polmear

Secretariat
Mr. Keith Dessent – Secretary

APOLOGIES

Mr. Ian Drinnan
Dr. Rob Lee
Dr. Neil McDonald
Professor Rob Melchers
Dr. Tamie Weaver

OTHER ATTENDEES

Mr. Peter Burns – ARPANSA
Mr. Vince Diamond – ARPANSA
Mr. Ian Graham – ARPANSA
Dr. Gerhard Horoschun – ADFA
Mr. Guenael Le Cann – ARPANSA
Ms. Olga Liavas – ARPANSA
Mr. Vaz Mottl – ARPANSA
Mr. John Ward – ARPANSA

OPENING OF MEETING

The meeting commenced at 10:00 am. The purpose of the meeting was to brief Members on the ANSTO submission for rectifying the fuel plate event. Comments from Neil McDonald and Marcela Bilek were tabled.

Dr Loy asked members to consider three aspects of the process, in particular: the root cause analysis; the modified design; and the need to consider any changes to existing operational licence conditions.

Members were provided with background information as required during the meeting.

The ANSTO submission had been received at 5 pm on 21 December 2007. This caused some logistical issues relating to the holiday season. ANSTO had originally forecast a decision on the submission from ARPANSA by the end of January 2008 but this had been based on an expected earlier timing of the submission.

ARPANSA had commissioned the services of consultants, Dr Gerhard Horoschun from Australian Defence Force Academy and Mr Jim Snelgrove from the United States to assist in assessing particular parts of the submission.

It had been clarified with ANSTO that the submission related to modification of CERCA fuel only. Any proposal to use CNEA fuel would require a separate application.

In the early designs stage of the fuel assemblies, the orientation of the side plates had been inverted, with the slots for the fuel plates extending to the bottom and finishing below the top of the side plate. The side plates had effectively been turned upside down in later design to facilitate construction at the bottom of the assembly. It appeared that neither INVAP nor ANSTO were conscious of this change having implications for safety in that there was now no effective stopper to prevent upwards movement of the fuel plates in the coolant flow, other than the swaging of the fuel plates to the side plates. In its submission for approval of the final design of the fuel assemblies, ANSTO stated that there were no changes that had a significant implication for safety.

Three types of fuel assemblies were used, each having a different quantity of fissionable uranium, but only the 'standard' type had exhibited the problem of fuel plates being displaced. All the affected plates were located in the periphery of the core grid.

Several issues relating to the fuel plate event were considered and discussed.

1) There was no stopper in place to prevent movement of the fuel plates in the fuel assemblies. The grooves in the fuel assemblies were swaged to prevent fuel plate movement. The proposal was that two stopper plates be added to each fuel assembly and these would each be held in place by two screws.

   Stoppers had been used in fuel assemblies in other reactors in the past. The design of the stoppers needed close review and vibration effects might need to be considered. For example, the stress on the screws might be higher than estimated. A third screw in each stopper plate could solve that problem.

   Members raised the issue of peening of the screws and considered that tack welding might have been a better solution. In extreme cases, peening could actually result in the loosening of a screw. Peening was acceptable in the airline industry, however, and had been used in other reactors around the world.

2) Was the production of the fuel assemblies performed adequately? The CERCA process for roll swaging was more consistent and reliable than in the original assemblies and a change of fuel could alleviate that problem.

   The quality of the swaging could affect the fuel plates. It was noted that the clamping of the fuel plates within the CNEA fuel assemblies could be asymmetric because of the technique used, which could cause a microscopic ratchet action. Over time, that ratchet action could create a means for slippage and that could be an issue for investigation. Transverse slipping of the fuel plates was part of the design consideration however, flexing could occur at the critical coolant flow velocity with a frequency range of between 15-70 Hz. Further, there was no uniformity of the positioning of the

plates in the fuel assembly. Swaging by itself was not capable of preventing longitudinal movement and the fuel assembly grooves should be stopped or swaged well past the fuel plates.

3) Was normal operation of the reactor sufficient to cause the displacement or did something abnormal happen to cause the event? No abnormalities had been observed during the operation of OPAL leading up to the event. Videos of the core during operation had been examined and theses videos had been supplied to ARPANSA.

Some operating aspects would also require investigation. For example, the secondary cooling system had an effect on the primary cooling system. This problem manifested itself during commissioning resulting in several reactor trips. Also of possible interest was low frequency, low amplitude vibrations.

Although similar fuel assemblies had been use elsewhere in the world, there had been no analysis of the operating conditions compared with OPAL. The Egyptian reactor was using Russian fuel and was not operating on a continuos basis, nor was it intended to be.

The coolant flow velocities in many other reactors were, however, noted to be lower than the coolant flow in OPAL, meaning that these reactors had a greater margin to the critical flow velocity.

Testing of the fuel assemblies had been done using the original orientation of the fuel assemblies with "dummy" fuel plates in them. Those tests could not provide information on such reactor core effects as oxide formation, radiation effects etc. Dynamic effects, such as weight, stiffness and frequency of vibration, were the only considerations.

Installation of the stoppers would result in some change to the pressure drop across the core. This would be measured in the first instance and trip parameters adjusted prior to the reactor returning to power.

Operational Aspects

ANSTO had advised ARPANSA of the testing that would be undertaken to confirm the integrity of the fuel. In light of the fuel plate event though, there might be a need for ARPANSA to follow-up other operational aspects of OPAL and query ANSTO further.

In much documentation about design and requests for approval for fuel elements and assemblies, the fuel had been considered a passive system requiring a lower level of analysis (e.g. FMEA) than other "active" components. The description of the core as passive was questioned as it is the major source of heat and issues including swelling, vibration and plate movement were important for safety.

Items for further review could include:

1) Control rods, even though they had not been mentioned in the report of the fuel plate event;
2) An investigation and comment on the management system;
3) A definition of what "important for safety" actually means;
4) Quality Assurance procedures for sub-contactors who do not get captured under ARPANSA licensing processes.

It was recognised that an accumulation of small changes in any part of a process could end up being significant. The US DOE and NRC have provided guidance on these issues but ultimately it will depend on the competency of the people carrying out the investigations.

The fuel plate event had been reported to the IAEA as INES Level 2. This would be re-examined in the light of the final analysis and findings.

NEXT MEETING

The next meeting of the Nuclear Safety Committee would be held in Melbourne, as originally planned, on Thursday 21 February 2008 preceded by a tour of the Australian Synchrotron on the afternoon of Wednesday 20 February 2008. The meeting closed at 1 pm.