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27 May 2008

ARPANSA
30 MAY 2008
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Dr John Loy
Chief Executive Officer
Australian Radiation Protection and Nuclear Safety Agency
PO Box 655
MIRANDA NSW 1490

INDEXED

Dear Dr ^{John}Loy

ANSTO FACILITY LICENCE F00157 - SAFETY SUBMISSION E0083 — "FUEL ASSEMBLY DESIGN MODIFICATION TO INCORPORATE A STOPPER" — PROPOSED LICENCE CONDITIONS

I refer to your letter (Reference S2008/00001) dated 1 May 2008 in relation to this matter, and thank you for your invitation to make a submission on your proposed licence conditions.

Proposed licence condition 1

ANSTO shall, within six months of the date of imposition of the licence condition, develop a program of work, for review and approval by the CEO of ARPANSA, to characterise more fully the vibrational and other forces acting on the fuel plates and other structures in the core, the program to involve experimental work and theoretical calculation.

ANSTO has no objection to the proposed licence condition. As you have probably been advised by your inspectors, some in core and test loop vibration tests using dummy fuel assemblies have been carried out, prior to fuel loading. Those tests and the results obtained from them, will form part of the program of work pursuant to this licence condition.

Proposed licence condition 2

ANSTO shall complete a review of the design of the modified fuel assemblies within 2 years of the date of imposition of this licence condition in the light of the outcome of the work program required by the above licence condition and having regard to international best practice in nuclear safety.

ANSTO has no objection to the proposed licence condition.

Proposed licence condition 3

ANSTO shall amend the specification for the fuel to be manufactured by CERCA to include the carrying out of the test of longitudinal strength, described in OPAL-0109-TRP-011 once per at least 20 Fuel Assemblies. Acceptance of the fuel must require a measured longitudinal strength greater than 27 N/mm.

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ANSTO considers that this proposed condition would not provide a significant safety benefit. CERCA's extensive experience and detailed understanding of the swaging process produces a consistent reliable swaged joint. This is demonstrated by the consistent results achieved during all types of testing. CERCA and ANSTO consider that the present two different lateral pull tests adequately demonstrate the joint strength and that they conform to internationally-accepted best practice for the testing of the swaging process. In addition, high integrity fuel stoppers will limit movement to a few millimetres even in the unlikely event of a plate displacement. More detail on our reasoning in this regard is set out in **Attachment A**.

In your decision, you acknowledged that there is no internationally accepted longitudinal strength test, and implicitly acknowledged that no other regulator requires such testing to be carried out. The proposed condition would therefore appear to go beyond the requirements of subsection 32(3) of the ARPANS Act. At the same time, compliance with such a condition would impose significant financial costs on ANSTO. CERCA estimates this testing will add more than A\$21,000 to the annual fuel cost for OPAL without any significant safety benefit.

Given the lack of a significant safety benefit, we feel that the imposition of such a licence condition would be inconsistent with the Commonwealth Government's cost/benefit approach to regulation.

Yours sincerely

A handwritten signature in black ink that reads "Ron Cameron". The signature is written in a cursive, flowing style.

DR RON CAMERON
A/Chief Executive Officer

Att.

cc: Dr G Storr
Mr R Gilchrist
Mr T Irwin
Prof L Edwards
Mr S McIntosh

Attachment A**1. CERCA experience**

CERCA has fifty years' experience of manufacturing fuel for research reactors. Since 1960, CERCA has manufactured over 300,000 fuel assemblies of 70 designs for 40 research reactors in 20 countries. CERCA were involved from the start of the RERTR silicide fuel program in 1983, and were one of the three manufacturers (with NUKEM and BWXT) qualified in 1988 to manufacture silicide fuel assemblies. CERCA uses a very well-controlled automated process to produce high quality fuel with repeatable characteristics. CERCA routinely carries out lateral tests of the swage joint for customers, but do not perform longitudinal tests for any research reactor fuel they manufacture. CERCA's CEO recently reaffirmed this in a press interview (see *Nuclear Fuel 19 May 2008*).

2. International Experts

As noted in our submission, in 2007 ANSTO engaged three international experts to assess the fuel fault and the proposed modifications. Gregory K Miller and William D Richins are from Idaho National Laboratory, USA and have extensive fuel manufacturing experience. Fred Wijstma is Reactor Manager at HFR Petten. HFR Petten is used routinely for fuel testing, and Mr Wijstma has extensive experience of fuel behaviour under reactor operating conditions. All three experts concluded at the time that the proposed modified OPAL fuel assembly and the fuel specification met international standards. They did not recommend that routine longitudinal testing should be included in the specification. Mr Wijstma did recommend that additional lateral testing should be included in the specification, as is performed for HFR, and ANSTO immediately adopted this recommendation.

In the INEL report 'Analysis of the ATR Fuel Element Swaging Process', Richins and Miller state *'Based on early considerations of the swaged connections and on ATR operational experience, if the swaged connections in an ATR fuel element can sustain a pullout force of this magnitude (ie 27N/mm), they can also sustain the loading conditions experienced during reactor operation.'* The loading conditions in ATR (flow 13m/s) are in excess of the conditions in OPAL.

It is noted also that ARPANSA engaged Dr James Snelgrove as a consultant. Dr Snelgrove led the fuel development activities of the RERTR program from 1981 to 2004 and is one of the worlds leading experts in research reactor fuel. Dr Snelgrove considered that "this (fuel) specification contains everything that one would normally expect to find in a specification for fuel plates and fuel elements; i.e. in my opinion it meets international best practices".

3. Testing of swaged joints

In accordance with international practice, the INVAP General Specification of Fuel Element for the reactor (RRRP-0109-3BECN-056) includes the requirement:

"The attachment by roll-swaging of fuel plates to the side plates shall withstand a load of at least 27N/mm of joint".

When CERCA were invited to tender for OPAL fuel, CERCA produced their own specification document (J-45-A-1096), approved by ANSTO, which includes exactly the same requirement.

A full side plate has 21 grooves for the 2 outer plates and 19 inner plates. During fuel manufacture, CNEA demonstrated compliance with the lateral strength requirement by manufacturing a test piece consisting of a section of side plate with three grooves and one section of aluminium plate swaged into the central groove. During the investigation of the fuel fault, inconsistencies in the CNEA process were identified when swaging all 21 plates for a fuel assembly. It is therefore clear that this three groove/single plate test may not be representative of the CNEA fuel manufacturing process. In addition, following the fuel displacement event,

CNEA carried out tests in a longitudinal direction and found that the strength in the longitudinal direction of CNEA fuel is significantly lower than its lateral strength.

Before CERCA commenced manufacture of fuel for OPAL, they performed a parametric study and optimised the swaging process for the OPAL design. Roll swaging is performed on a computer-controlled milling machine providing good control and consistency. During fuel manufacture, CERCA demonstrate compliance with the joint strength requirement by testing a complete fuel box section with **both side plates and all 21 fuel plates**. This is considered to be a robust and representative test.

At ANSTO's request, Mr Wijtsma reviewed the CERCA testing of OPAL fuel. He recommended that an additional lateral pull test be included in the routine manufacturing test process to assess individual plate pull out strength. This test is now incorporated in all CERCA fuel manufactured for OPAL.

Following the fuel fault, in response to a request from ANSTO, CERCA performed a longitudinal test. The results showed that for the CERCA swaging process, the longitudinal strength was of the same order as the lateral strength.

Because of ARPANSA concerns that the "one-off" CERCA longitudinal test may not be representative of fuel manufactured by CERCA, ANSTO arranged for CERCA to conduct a further four longitudinal tests at ANSTO's expense. The results of these tests confirmed the consistency of the CERCA roll-swaging process.

CERCA consider that their full fuel assembly section lateral strength test together with the additional individual lateral pull test is more than adequate to demonstrate the strength of the CERCA roll-swaged joint. Additional longitudinal testing would be expensive and would be disruptive to the CERCA manufacturing schedule. CERCA estimates that this additional testing would add more than A\$21,000 to the annual cost of fuel for OPAL without any significant safety benefit. Although many customers have very strict specifications for fuel manufacture, no customers require longitudinal pull tests and we agree with your comment, "that there is no internationally established longitudinal strength test"..

4. Fuel design

As noted in the decision, ANSTO does not rely only on swaging. It is accepted that the fuel design provides two mechanisms for preventing significant fuel plate movement from the fuel assembly, namely the swaging of the fuel plates into the side-frames and the stoppers. In combination with the two internationally accepted tests applied to fuel manufactured for OPAL, ANSTO considers that the fuel design is sufficient to allow safe operation of the reactor without an extra ongoing longitudinal strength test. This is supported by key elements contained in our submission.