ARGONNE NATIONAL LABORATORY • UNIVERSITY OF CHICAGO

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Technical and Administrative Preparations Required for Shipment of Research Reactor Spent Fuel to Its Country of Origin

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Australian Experience with Dry Storage of Research Reactor Spent Fuel

Allan Murray

Embassy of Australia
Washington, DC

International Atomic Energy Agency
Vienna, Austria

Argonne National Laboratory
Illinois, USA

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Notes on
Australian Experience with Dry Storage of Research Reactor Spent Fuel

The Australian Nuclear Science and Technology Organisation (ANSTO) currently has nearly 1600 spent fuel elements in interim storage. Fuel discharged from the 10 MW HIFAR research reactor is initially stored underwater in the reactor storage block for up to one year. Following this, it is housed in the fuel pond to allow for heat dissipation and fission product decay. The fuel is then relocated for long term storage to the HIFAR spent fuel storage facility (building 57) which contains 50 storage holes containing 1086 elements. Additionally seven transport containers (Dounreay flasks) hold 175 of the earliest elements to be placed in dry storage. Both the building 57 storage and Dounreay flasks are at capacity.

The HIFAR spent fuel storage facility is an engineered dry storage facility built in 1968 at Lucas Heights and designed to store 1100 spent fuel elements. The facility consists of 50 holes, 16 metres in depth, drilled into sandstone and lined with 14 centimetre internal diameter sealed stainless steel tubes. HIFAR spent fuel elements are stored two to a can with eleven cans placed in each lined hole.

The tubes in the storage facility are filled with dry nitrogen to inhibit corrosion of the fuel cladding. Periodic monitoring of the nitrogen gas when the nitrogen is replaced is undertaken to measure if there are any traces of krypton-85, a long-lived fission product. The lack of any released krypton in the holes indicates there is no significant deterioration of the fuel elements.

To further assess the integrity of the spent fuel dry storage, a program of investigation was begun in July 1995. This program included:

- Gas sample analyses, with krypton-87 being detected in 3 holes, including one that contained 4 elements that had been disassembled in 1967.
- Removal of all 22 elements from holes #5 and #20, and inspection of the holes and their liners by camera (video available). Both holes were filled with water and ultrasonically checked for variations in wall thickness. Each were found to be in good shape.
- Inspection of 8 elements from these holes in the hot cells. There were four intact spent fuel elements examined from storage hole #5 which

showed little or no deterioration to their condition. Some slight Cl-36 contamination was picked up in the MK2 fuel elements and appeared concentrated in the brazen areas. The other four disassembled spent fuel elements from hole #20 had been initially examined in 1967 and two had been retrieved for examination in 1983. Although some slight deterioration in their condition was noted, the fuel elements had not shown any major deterioration around the exposed fuel. The majority of the corroded areas were not on the fuel plates but on the fringe outer aluminium plate and brazed areas. Cl-36 testing together with SEM analyses proved that chlorine was the main cause of the corrosion. The other two elements have shown more corrosion. The major contributing factor was moisture present in one of the storage holes.

Based upon the ANSTO experience, some recommendations for spent fuel dry storage conditions include:

- Conditions must be specified for both the cover gas requirements and drying procedures established to prevent excessive degradation.
- All spent fuel storage holes must have effective sealing to maintain a dry atmosphere. Routine gas analysis needs to be done on a regular basis.
- Chlorine, especially in the presence of moisture, is a corroding influence.
- Sealing of disassembled (or failed) fuel elements in air tight containers is required to provide a secondary barrier.

References

The following references have been useful in ensuring ANSTO adopts best international practice in the storage and management of spent fuel.

Survey of Experience with Dry Storage of Spent Nuclear Fuel and Update of Wet Storage Experience, Technical Report Series No. 290, IAEA, Vienna, 1988.

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