

Den Haag, 15 January 2010

**EXECUTIVE SUMMARY OF THE IAEA MISSION TO REVIEW THE
SAFETY ASPECTS OF THE HFR PRIMARY COOLING PIPING REPAIR
(11-15 January 2010)**

The High Flux Reactor (HFR), Petten is a 45 MW tank-in-pool research reactor, commissioned in 1961. The reactor is used for the production of medical isotopes and research on nuclear fuels and materials. In 2005 several inward deformations were observed in the wall of the primary cooling piping. During the In-service Inspection programme in August 2008 a pinhole was revealed by a small gas bubble jet at one of the inward deformations of the primary cooling system reducers, which are embedded in the concrete biological shield. This inspection led to the conclusion that the reactor no longer complied with its license conditions. However, due to the strong need for medical isotopes and taking into account the results of the safety analysis made by NRG and the corresponding safety assessment made by KFD, a ministerial order was issued authorizing the licensee to operate the reactor from February 2009 to March 2010 under specific conditions, including enhanced water leakage monitoring.

In February 2009 KFD requested an IAEA mission to review its safety evaluations concerning the safety case submitted by NRG. The IAEA mission team concluded in February 2009 that the assessment made by KFD regarding the interim operation of the HFR reactor in the degraded condition of its primary cooling system was justified from a safety point of view. The team also provided recommendations for enhancing the operational safety of the reactor.

In August 2009 KFD requested the IAEA to conduct a peer review mission of the final repair plan for the reducers. The review was made in relation to KFD safety assessments and on the basis of technical documents and safety analyses submitted by NRG in December 2009. Based on the scope of the request defined by KFD, the IAEA mission team reviewed the following items:

- Assessment of the last In-service Inspection results and review of the general repair plan;
- Review of the possible selected repair methods, their qualifications and test results, including the jacket pipe repair;
- Repair of the reducers and review of welding qualifications;
- Provisions adopted to perform the repair work, including the dismantling process, radiological and labour safety;
- Tests carried out using three mock-ups representing the zones to be repaired;
- Commissioning programme and work planning;
- Implementation status of the recommendations of the previous IAEA mission in February 2009.

On the first day, the IAEA mission team discussed with KFD the general aspects of the repair programme and related technical issues, in the presence of representatives from NRG. The major part of the mission was dedicated to the assessment of technical documents provided by NRG, who made detailed presentations on all topics of the repair. These presentations were followed by extensive and open discussions.

As a result of these discussions and the assessments made, the IAEA mission team formulated the following main recommendations:

1. Major steps of the regulatory process should be integrated by NRG as important hold points in the time schedule of the repair programme, commissioning and return to operation of the reactor.
2. A summary report presenting the overall and updated safety case for the repair programme should be submitted to KFD. This report should present the selected repair options with their justification, and should reflect the updated status of all technical and organizational activities, with associated hold points related to the implementation of the repair programme.
3. A radioactive waste management programme should define the volume, activity and final disposition of the radioactive waste generated during the implementation of the repair activities.
4. NRG should submit to the regulatory authority the results of the inspection of the reducers, after removal of the surrounding concrete, and also the results of the proposed option for the reducer repair (partial repair or complete replacement).
5. A commissioning programme should be established to check the satisfactory performance of the repaired parts of the primary cooling system as well as the reactor facility before return to operation.
6. An adequate support structure should be installed in the sub-pile room to provide protection against potential collapse of the reactor vessel and pool structure and to compensate for the removal of the concrete surrounding the reducers of the primary cooling system.
7. Special emphasis should be given to avoid damage to the reducers during the concrete drilling operation and also to the beam tubes during handling operations in the pool.
8. The choice of polyurethane as a sealing material for the jacket pipe should be reassessed, with regard to potential corrosion of the primary cooling pipe. The use of concrete for this purpose was suggested as an option by the team. The choice of polyethylene tape around the primary cooling pipe should also be reassessed for the same reason.
9. In the interest of ALARA, NRG should consider the possibility of keeping a limited amount of water in the reactor pool as additional means to reduce the dose rates to workers during repair work.
10. A dose mapping profile should be established and maintained. A radiation protection officer should be present during the repair process.
11. NRG should establish and implement an inspection process of the pool liner with the objective to reduce the existing pool leakage.

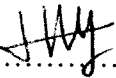
In the opinion of the IAEA mission team, the lessons learned from the coolant piping degradation event and the conclusions from the investigations made, should be documented by NRG and applied for new research reactor projects.

The team appreciated the strong motivation of NRG for the implementation of the repair programme and the good preparation by KFD and NRG for the mission. The team noted with satisfaction the use of mock-ups, as a good practice, to train the staff and to establish the optimum repair techniques.

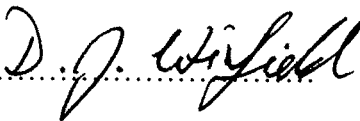
In conclusion, the IAEA mission team would like to highlight the satisfactory follow-up and supervision strategy of KFD related to the preparation and implementation of the repair programme. The team also considers that the provisions proposed by NRG concerning this programme are satisfactory from the safety point of view, provided that the above mentioned recommendations are taken into account. A follow-up of the implementation of the recommendations formulated by the present mission should be made.

IAEA team members:

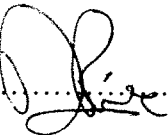
H. Abou Yehia (IAEA, Team Leader)


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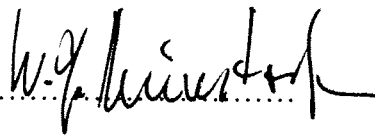
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