Petten, 11 October 2016

SUMMARY OF THE IAEA INTEGRATED SAFETY ASSESSMENT OF RESEARCH REACTORS (INSARR) MISSION TO HIGH FLUX REACTOR (HFR)

Petten, the Netherlands
4-11 October 2016

INTRODUCTION

Following a request from the Inspectorate of the Ministry of Infrastructure and the Environment, which is the Dutch regulatory authority (ANVS), the IAEA conducted an INSARR mission at the HFR research reactor. The reactor is a 50 MW tank in open pool type which was commissioned in 1961, and is mainly used for production of medical radioisotope and research in the field of nuclear fuels and materials. The reactor is located in Petten, owned by the Joint Research Centre (JRC), European Commission, and operated by the Nuclear Research and consultancy Group (NRG).

The objective of the INSARR mission was to review the operational safety of the reactor, covering reactor management, safety committee, safety culture, management system, training and qualification, site evaluation and protection against external hazards, safety analysis report (SAR), safety analysis, operational limits and conditions (OLCs), conduct of operations, maintenance and ageing management, safety of the utilization programme, experiments and modifications, operational radiation protection and waste management, emergency planning, and decommissioning plan. The review was performed following the methodology established by the IAEA Guidelines for Research Reactors Safety Review (INSARR Guidelines, 2013 Edition), which are based on the IAEA safety standards. This INSARR mission is the third since 2005.

The mission team was composed of three IAEA staff members: Mr A. Shokr (Head, Research Reactor Safety Section (RRSS) - Team Leader), Mr D. Rao (RRSS, Deputy Team Leader); and Ms D. Engström (Safety Culture Specialist, Operational Safety Section(OSS)), and six external experts: Mr H. Abou Yehia (IRSN, France), Mr T. Hargitai (Consultant, Hungary); Mr J. Du Bruyn (Senior Manager, SAFARI-1 Research Reactor, South Africa), Mr N. De Lorenzo (INVAP, Argentina), Mr S. Lynch (Nuclear Regulatory Commission, USA), and Mr P. Basu (Consultant, India). Mr G. Rzentkowski, Director, IAEA Division of Nuclear Installation Safety (NSNI) participated in the last two days of the mission, and led the mission exit meeting. The main technical counterpart of the mission was Mr J. Offerein, HFR Reactor Manager. The following ANVS staff also attended several technical sessions of the mission: Mr R. Schipper, Ms M. Steenhuisen, Mr M. van Bourgondiën, Mr G. Auwerda, Ms S. de Koff, Ms A. van Limborgh, Ms Y. Dubbers, and Mr C. Jansen. Representatives from JRC also attended the entry and exit meetings and participated in some sessions of the mission.

CONDUCT OF THE MISSION

The entry meeting started with a welcome address by Mr N. Unger, NRG Managing Director. During the entry meeting, the IAEA Team Leader reviewed the objectives of the mission, its

scope, and the expected results. The meeting included a presentation from HFR Reactor Manager on the current status of the HFR reactor and the main achievements since the 2011 INSARR mission. The entry meeting was also attended by NRG and ANVS senior staff.

In addition to the documents provided to the IAEA team before the mission, the counterparts made several presentations during the mission which covered the review areas of the INSARR mission. These presentations provided an overview of the status of the reactor facility and its associated documentation, and were followed by detailed discussions within the framework of the mission activities. The conduct of the mission included the following activities:

- Examination and assessment of the reactor safety and technical documentation;
- Walkthrough of the reactor facility;
- Discussions with the HFR reactor management and operating personnel, and NRG technical staff;
- Interviews with NRG and HFR staff for review of the safety culture programme;
- Discussions among the IAEA team members;
- Preparation of the mission report.

During the first day of the mission, the IAEA team and the technical counterparts made a walk-through of the reactor and its associated facilities. During the visit, the reactor was operating at 45 MW, and the team observed the very good housekeeping of the reactor building and noted the on-going installation of a new security barrier within the perimeter of HFR and the relocation of the truck entry for ensuring better access and handling conditions. The team discussed with the HFR operating personnel various aspects regarding the reactor operational safety and made recommendations and suggestions for further improvement.

Four and one half out of six days of the mission time were dedicated to a series of technical sessions and plenary discussions with the technical counterparts, walkthrough the facility, interviews for the review of the safety culture programme, preliminary drafting of the mission report, and final discussion with the technical counterparts about the main findings and conclusions of the mission, with a general agreement on the IAEA recommendations.

The exit meeting was held on Tuesday, 11 October 2016 with the participation of the NRG Managing Director, Director of NSNI/IAEA, representatives from JRC and ANVS, and HFR management and technical staff.

CONCLUSIONS AND RECOMMENDATIONS

The IAEA team appreciated the competence of the NRG staff and noted the implementation of a mature management system, and good practices in the areas of training and qualification of personnel, periodic safety review, and addressing the relevant lessons learned from the Fukushima accident. The team also noted that maintenance and aging management programmes, as well as safety provisions of experiments and modifications are generally in line with the IAEA safety standards.

Good progress was also noted concerning the implementation of the recommendations of the 2011 INSARR mission. All the recommendations and suggestions of the mission were considered, and about 60 % of these have been fully implemented. These were mainly in the areas of reactor management, maintenance and ageing management, training and qualification, environmental monitoring, experiments and modifications. Significant progress has been achieved in the implementation of another 25 %. Efforts still need to be exerted by NRG to finalize the implementation of these recommendations. Efforts also need to be taken on the remaining recommendations, in which no actions were taken. Remaining actions are mainly related to leakage from the pool liner, installation of seismic instrumentation, identification of the root cause of Argon-41 release, and update of the SAR in accordance with the IAEA safety standards to contain all the necessary technical information demonstrating the safety of the facility.

The activities of the INSARR mission resulted in recommendations and suggestions for further safety enhancement. These covered the organizational aspects, safety analysis and safety documents, and technical modifications to the facility, and are mainly provided as follows.

Organizational aspects

- Concerted efforts have been taken by NRG to promote and further develop a strong safety culture. To supplement these efforts, the NRG senior management should ensure that self-assessments and independent assessments of leadership for safety and safety culture are conducted on regular basis. The planned IAEA Safety Culture Assessment peer review is a positive step towards this goal. The requirements of such assessments should be documented in the management system along with information on communication (to all staff) and use of the results.
- To ensure the effectiveness in managing the HFR operation safety, NRG is recommended to:
    - Revise the reactor operating organizational structure to avoid the overlap and potential conflicts of the duties and authorities of the HFR Installation Manager and the HFR Reactor Manager;
    - Fill in the position of Maintenance Manager, which has been vacant since 2014 and is currently occupied by the Operation Manager;
    - Evaluate, with respect to safety, the situation of having the same person carrying out the functions of Reactor Manager for HFR and Low Flux Reactor (LFR, currently in decommissioning stage). Actions are taken accordingly to ensure adequate supervision of activities important to safety in both facilities;
    - Consider establishing administrative procedures and practical arrangements to ensure the independence of the radiation protection function during the reactor operation shifts. This will supplement the actions taken by NRG in response to the 2011 INSARR recommendation on the independence of this function.
- For enhancing the effectiveness of the reactor safety committee, it is recommended that the committee is informed by the NRG management on the implementation of the actions associated with its recommendations.

- For further enhancement of the training and qualification programme, it is recommended to establish a requirement on requalification of certified operating personnel if they are away, for an extended period of time, from the activities that they are licensed for. Training on application of the management system should be conducted for HFR staff.

- Effective coordination and cooperation between JRC and NRG should be ensured in development of the revised version (and subsequent revisions) of the HFR decommissioning plan. Arrangements should be defined and established to ensure the availability of HFR knowledgeable personnel and up-to-date documentation required for safe decommissioning. These should be addressed in the updated versions of the decommissioning plan.

Safety analysis and safety documents

- The OLCs should be revised to:
  - Include periodic verification by measurements of the reactivity shutdown margin, taking into account the relevant enveloping conditions of the proposed core configuration.
  - Include the list of radiation monitoring equipment, their locations, and the associated alarm setting values, as well as the required actions in case of alarm triggering;
  - Establish technical and administrative requirements during prolonged shutdown periods;
  - Include periodic monitoring of the radioactivity contents of the underground water using the existing sampling wells near the facility.
- Seismic safety analysis of HFR was performed using a conservative ground response spectrum. To confirm that sufficient safety margins exist, the piping and other service lines important to safety should be checked for adequate seismic capacity.

- The contents of the operation cycle reports should be improved to include the necessary information that allows the reactor management to verify the reactor operational safety and to perform trending of the reactor safety performance.

- A procedure should be developed to evaluate postponed modifications before re-initiating work, taking into consideration the impact of subsequent modifications and experiments and need for re-approval. Similar considerations are valid for postponed experiments.

- Actions should be taken to reduce the accumulation of the reactor safety documents pending revision. The relevant management system process should be revised to make it easier for the document owners to revise them timely.

Technical modifications of the facility

- The leakage rate and paths from the reactor pool should be determined, and accordingly adequate corrective actions should be implemented to limit the water leakage.
- To complement the safety reassessment performed following the lessons from the Fukushima accident, it is recommended to define and implement measures aimed at minimizing accidental water leakage through the sub-pile room and the pipes penetrating the reactor

pool. This is to reduce the risk of core un-coverage, taking into consideration combination of an earthquake and loss of electrical power supply.

- The corrective actions resulting from the facility seismic walk down and subsequent evaluation should be implemented in a timely manner. A programme for monitoring site characteristics during the operation phase, in accordance with the IAEA safety standards No NS-R-3, should be developed and implemented. This should be oriented to evaluate possible impacts on the safe operation of the reactor.
- Engineering measures should be implemented to protect the liner of the pool floor from possible damaging effects of accidental conditions that may occur during handling the heavy loads, such as transfer casks.
- Adequate radiation monitors for neutron dose should be installed at the beam tube area. It is suggested to install on-line stack monitor for aerosols, iodine, and particulates.

Additionally, the IAEA team encourages ANVS to follow-up on the implementation of the results of this INSARR mission in a timely manner, and to request a follow-up mission in accordance with the IAEA INSARR Guidelines.

Finally, the IAEA team is pleased to note the commitment of the NRG senior management to further enhance safety and to promote safety culture, and appreciated the openness and transparency of the NRG staff during the mission and their motivation for safety enhancement.

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