

**SUMMARY OF THE  
IAEA FOLLOW-UP INSARR MISSION TO THE HIGH FLUX REACTOR (HFR)  
PETTEN, THE NETHERLANDS, 8 - 11 APRIL 2019**

## **INTRODUCTION**

Following a request from the Authority of Nuclear Safety and Radiation Protection (ANVS), the IAEA conducted a Follow-up Integrated Safety Assessment of Research Reactors (Follow-up 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 radioisotopes and conducting research in the fields of nuclear fuels and materials. The reactor is located in Petten, owned by the Joint Research Centre (JRC) and operated by the Nuclear Research and Consultancy Group (NRG).

The main INSARR mission was conducted during the period from 4 - 11 October 2016 and the follow-up mission was conducted from 8 to 11 April 2019. The objective of the follow-up mission was to review the implementation of the recommendations provided by the main INSARR mission. These recommendations covered several safety areas including reactor management, safety committee, training and qualification of operating personnel, safety analysis and safety documents, siting and protection against external hazards, operational limits and conditions (OLCs), conduct of operations, maintenance and periodic testing, safety of utilization and modifications, operational radiation protection programme, and decommissioning planning. The follow-up mission was performed by 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.

The follow-up INSARR mission was conducted in parallel with the Follow-up Independent Safety Culture Assessment (ISCA) mission. The main ISCA mission was conducted in 2017. The two follow-up missions mutually benefited from each other, including by consolidating the team conclusions on the implementation of the recommendations of the review areas that were covered by the scope of both missions - specifically the management system, safety committee, and training and qualification.

The mission team was composed of an IAEA staff member: Mr A. M. Shokr (Head, Research Reactor Safety Section (RRSS) - team leader) and three international experts: Mr D. Rao (India), Mr H. Abou Yehia (France), and Mr G. Storr (Australia). The main technical counterpart of the mission was Mr O. Wouters, HFR Reactor Manager. The discussions during the mission were held with the participation of NRG and HFR senior managers and staff, including Mr J. Offerein, Director of Operations. Mr R. Jansen, Senior Coordinator Policy, Regulations and International Affairs for Nuclear Safety ANVS, was the counterpart from ANVS and attended the entry meeting. Staff members of ANVS attended almost all the sessions of the missions as observers. Mr P. Szymanski, Director of JRC, has also participated in the entry and exit meetings.

## **CONDUCT OF THE MISISON**

The entry meeting started with a welcome address by Mr H. Cuijpers, NRG Managing Director, Mr Offerein, Mr P. Szymanski, and Mr R. Jansen. In their opening remarks, they highlighted the background of request for the Follow-up INSARR and ISCA missions, the importance to safety of international peer reviews, and the cooperation of NRG and ANVS with IAEA on safety of nuclear installations. During the opening session, the HFR management provided an overview of the safety status of the reactor and the major activities implemented

since the main INSARR mission. The IAEA team leader reviewed the mission objectives, scope, and expected results.

For the conduct of the mission, the following activities were performed:

- Examination and assessment of technical documentation;
- A detailed walkthrough of the reactor facility;
- Discussions with the NRG and HFR management and the reactor operating personnel;
- Discussions among IAEA team members;
- Preparation of the mission summary report.

During the first day of the mission, the IAEA team and the counterparts conducted a detailed walkthrough of the reactor and associated facilities. The walkthrough was an opportunity to verify in the field the physical status of the reactor facility and the progress made regarding the implementation of some of the INSARR recommendations. During the walkthrough, the reactor was in shutdown mode undergoing routine maintenance, in-service inspection of the reactor pool's internal components, and for the installation of a new trolley of the polar crane. With respect to the installation of the crane, the team observed that good engineering practices were followed particularly with respect to nuclear and industrial safety, including protection of fuel and reactor pools and their internal components against incidental dropping of heavy loads, control of the work performed by the external contractors and housekeeping. The team also noted that a new platform and connecting staircases had been installed which will be used for activities related to radioisotope production. The platform was being used during the shutdown for the staging of the mechanism used for the installation of the new trolley of the polar crane.

Most of the mission time was dedicated to a series of technical meetings and plenary sessions with the technical counterparts, including discussions on the implementation of the recommendations of the main INSARR mission and addressing its observations and suggestions.

On Wednesday 10th April, the IAEA team leader briefed the ANVS representatives on the results of the INSARR follow-up mission.

The follow-up mission conclusions and recommendations were discussed with the NRG and HFR management, the technical staff and the reactor operating personnel during the exit meeting held on 11 April 2019 with the participation of the NRG Managing Director, JRC Director, and observers from ANVS. There was general agreement by the counterparts on the mission recommendations.

## **CONCLUSIONS OF THE MISSION**

The IAEA team noted a high level of implementation of the recommendations of the main INSARR mission. The team assessed that a total of 17 out of 20 recommendations have been either fully implemented or where minor actions remain (and their full implementation is ongoing). Actions have been taken and some others are planned for the three remaining recommendations.

The team also assessed that five out of the eight INSARR 2011 recommendations (that were still open at the time of the 2016 main INSARR mission have now been implemented), and work is ongoing to complete the implementation of the remaining three recommendations.

The team also noted the continued implementation by NRG of an effective integrated management system covering the HFR operation, and following the INSARR recommendations, the adoption of a policy on periodic assessment of safety culture and establishment of relevant procedures within the management system. The team also noted the

conduct of training on application of the system for the HFR staff. These actions, in addition to those taken or planned in responding to the recommendations of the ISCA mission, will provide for further development and maintenance of a strong culture for safety.

The team concluded that this high level of implementation of the INSARR recommendations contributes to further enhancement of the reactor operational safety, through improved organizational effectiveness, operating programmes, documentation, and safety aspects of technical modifications of the facility.

The team assessed that the following measures have been taken by NRG, following the INSARR recommendations, to enhance the reactor organizational effectiveness:

- Revision of the HFR operating organizational structure to avoid the overlap and potential conflict of the duties and authorities of the installation manager and reactor manager and filling in all the vacant positions, in particular appointment of the maintenance manager;
- Improvement of the effectiveness of the reactor safety committee through establishment of work procedures to provide for follow-up by the committee on the implementation of the actions associated with its recommendations;
- Coordination and cooperation with JRC with respect to development of the decommissioning plan (2017 revision);
- Improvement of the training and qualification programme by establishment of requirements on retraining and requalification of the operating personnel if the personnel are absent for an extended period of time from the activities that they are certified for.

With respect to operational safety programmes and documentation, the team assessed that the following measures have been taken by NRG following the INSARR recommendations:

- Performing the following activities and planning to include them in the OLCs:
  - Periodic verification (once per year) by measurements of the values of reactivity shutdown margins;
  - Establishment of technical and administrative requirements during prolonged shutdown periods of the reactor;
  - Identification of the actions to be taken in case of alarms triggered by the radiation monitoring equipment, as well as the location and the associated alarm settings values;
  - Performing periodic (twice a year) monitoring of radioactivity contents of underground water using existing sample wells that are located around the reactor facility;
- Revision of the management system processes to:
  - Facilitate timely revision of the reactor documents important to safety, and reduction of the accumulation of the reactor documents pending revision;
  - Ensure that the postponed modifications are subjected to evaluation of the impact of the sub-sequent modifications and to reapproval before initiation of the relevant work.
- Improvement of the contents of operation cycle reports providing the reactor management with information to verify and perform trending of the reactor operational safety performance;
- Completion of the safety assessment aiming at minimizing accidental water leakage through the sub-pile room and the pipes penetrating the reactor pool;
- Inclusion of the civil engineering structures in the maintenance programme, and revision of the work order procedures to include quality checks concerning completion of maintenance and return to service checks.

In responding to INSARR recommendations, several actions have also been taken by NRG with respect to technical modifications of the facility aimed at safety improvements. These include:

- Installation of a new trolley of the polar crane qualified to nuclear standards;
- Installation adjacent to the reactor pool of a new platform and connecting staircases to be used for activities related to radioisotope production;
- Confirmation that safety margins are available in the seismic capacity of pipes in the safe shutdown paths;
- Renewal of the radiation monitoring and alarm system at the beam tubes that are still in operation (HB4 and HB5), and establishment of operating procedures for beam tube operation;
- Determination and control of the water leakage rate and paths from the reactor pools. In this regard the team highlighted the importance of continued monitoring and investigating leakage paths and rates and implementing, if needed, corrective actions.

The team also ascertained that all the suggestions of the INSARR missions of 2011 and 2016 were considered by NRG. The majority of the suggested actions have been implemented and resulted in improvement of the:

- Operational radiation protection programme: Enhanced exchanges between the quality, safety, and environment department and the reactor management on operational radiation protection issues, significant reduction (reported to be more than 50%) of the Ar-41 releases through the reactor stack, and reduction of the volume of the stored ion-exchange resins;
- Quality of probabilistic safety analysis;
- Exchanges with ANVS on the status of postponed Category I and II modifications.

Some of the INSARR recommendations have not yet been implemented, although some actions have been taken (or planned) in this regard. The team concluded that these recommendations, remain valid and further actions need to be taken by NRG to implement the recommendations. These recommendations are related to:

- Classification of the reactor structures, systems and components (SSCs) with respect to safety and establishment of the associated quality and seismic requirements. This classification should be consistently used across all programmes and activities, including maintenance, modification, ageing management, and continued safe operation;
- Revision of the safety analysis report (SAR) in accordance with the IAEA safety standards;
- Implementation of the technical and administrative measures that have been identified to prevent uncovering of spent fuel in the case of accidental situations that may occur during mis-handling of heavy loads and which affect the integrity of the pool floor;
- Implementation of the results of seismic walkdown, and installation of an automatic shutdown signal in the case of seismic events;
- Inclusion of HFR specific knowledge (e.g. design safety features, safety analysis, SAR, and OLCs) in the training of the staff of the Research and Development and Irradiation Solution Units;
- Consideration of establishment of practical arrangements to ensure the independence of the radiation protection function during the reactor operation shifts.

The process of review of the implementation of the INSARR recommendations, including review of documents and discussions, resulted in the following additional recommendations:

- NRG, JRC and the relevant authorities should develop a policy which ensures effective and sustainable ongoing coordination and cooperation for decommissioning of the HFR facility This would include development and revision of the decommissioning plan;
- The “type of treatment” of documents submitted to the safety committee that are currently defined as “only for information” should also be reviewed by the committee as they are important to the reactor safety, including, for example, incident reports and potentially unsafe situations, annual and quarterly reports on safety performance, HFR cycle reports, and regulatory inspection reports.

Detailed discussions on the bases for these recommendations and on the follow-up of the INSARR recommendations will be provided in the Follow-up INSARR mission report.

In preparation for the IAEA mission on HFR ageing management and continued safe operation (planned for 2020), discussions and exchanges of information and experience were held between the IAEA team and HFR technical staff on the scoping and screening methodology for the SSCs.

Finally, the IAEA team appreciated the openness and transparency of the NRG staff and HFR operating personnel and acknowledged their technical knowledge and excellent preparation for the mission. The team also would like to express its appreciation to the ANVS, NRG and HFR management for their commitment to safety and continuous improvement.



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Mr G. Storr



Mr D. Rao



Mr H. Abou Yehia