APPROACHES DEVELOPED TO BUILD TSO CAPABILITIES IN MOROCCO AND TO ASSESS THE SAFETY OF EXPERIMENTS IN ITS TRIGA RESEARCH REACTOR

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Abstract

The Moroccan National Centre of Nuclear Energy, Sciences and Technologies (CNESTEN) has been licensed to operate a 2 MW TRIGA Research Reactor since January 2009. This reactor is mainly used for training, basic and applied research, neutron activation analysis and radioisotope production. The TRIGA reactor is operated by CNESTEN Reactor Operation Unit whereas safety of operation and experiments is assessed by CNESTEN Safety Committee (SC). The main expected utilizations of the reactor for the short term are neutron activation analysis and production of I-131. In conformance to internal CNESTEN policies, the safety fields for both experiments were assessed by CNESTEN Safety Committee with regard to their relevant safety aspects. In order to achieve independent and robust safety assessment of experiments in the TRIGA reactor and to confirm the conclusions of Safety Committee, CNESTEN Safety and Security Pole (PSS) has organized, within the framework of international cooperation, three expert missions (one with the International Atomic Energy Agency and two with the Institut de radioprotection et de Sûreté Nucléaire-France). The first IRSN mission, held in December 2009, was an opportunity to confirm the interest of the CNESTEN organisation in which roles of the Reactor Operation Unit and the Safety and Security Pole are explicitly separated. The other main mission, shared between CNESTEN Safety and Security Pole (PSS) and IRSN during this visit, was the establishment of an approach which purpose is to categorise experiments into different classes. For each class of experiments, CNESTEN Safety and Security Pole, with the support of IRSN and in accordance with IAEA safety standards, had defined the field of safety issues that have to be considered as well as the review and approval route. The goal of the second IRSN mission, held in March 2010, was the assessment of preliminary elements from the I-131 production safety demonstration achieved by CNESTEN Reactor Operation Unit in accordance with the approach previously presented and of the Safety Committee (SC) conclusions. Finally, the mission has led to the proposal of several technical requirements regarding the safety of I-131 production operations. Besides, links between CNESTEN and IRSN are to be reinforced in the near future in order to consolidate TSO's competences of the CNESTEN Safety and Security Pole (PSS) in sight of the development of an electronuclear program in Morocco. In that perspective, several CNESTEN Safety and Security Pole (PSS) engineers would follow training and tutoring in safety analysis through a total immersion into IRSN operational divisions. This paper focuses on the development of TSO's competences of the CNESTEN Safety and Security Pole (PSS) and on the experience feedback learned from the assessment of new experiments (neutron activation analysis, production of I-131).

1. INTRODUCTION

The Moroccan National Centre of Nuclear Energy, Sciences and Technologies (CNESTEN) has been licensed to operate a 2MW TRIGA Mark II Research Reactor since January 2009. This reactor is mainly used for:

— Training;
— Basic and applied research;
— Neutron activation analysis and;
— Radioisotope production.

The main expected utilizations of the reactor for the short term are Neutron Activation Analysis and production of iodine 131.

The TRIGA reactor is operated by an internal CNESTEN unit called “Reactor Operation Unit”. In order to ensure an independent safety follow-up of commissioning, operation and experiments, CNESTEN has created a “Safety Committee” (SC), constituted by members specialized in nuclear safety, radiation protection, emergency planning and preparedness, reactor technologies and industrial safety. The missions of this committee were defined in accordance with the IAEA safety requirements N° NS-R-4 “Safety of Research Reactors” [1].

In order to give to the Safety Committee the tools which are necessary to play effectively its independent role, with the perspective to play the part of TSO for the future Safety Authority, CNESTEN set up an independent unit which is relevant to PSS called “Safety Analysis Unit (UAS)”. CNESTEN is currently building TSO capabilities of this unit in the framework of international cooperation. The Institute of Radiation Protection and Nuclear Safety (IRSN), the French TSO, is one of the main partners associated with regard to this action. The cooperation between CNESTEN and IRSN has recently led to two meetings in 2009 and 2010. Issues discussed during these meetings are presented hereafter.

2. APPROACH OF EXPERIMENT SAFETY ASSESSMENT

First of all, The Safety and Security Pole (PSS) had established an approach of categorization and review of experiments in compliance with the IAEA draft safety guide DS397 “Safety in the Use and Modification of Research Reactors” [2] , this approach defines the field of safety issues that have to be considered as well as the review and approval route of each experiment category. The above mentioned approach had been reviewed during an IRSN expertise mission and integrated in the CNESTEN policy “Instruction Sécurité N° 14 : Autorisation de réalisation des expériences au Réacteur TRIGA Mark II du CENM” [3].

The experiments to be conducted in the TRIGA RR were categorized in 3 levels commensurate with hazards that they could lead to and in accordance with the Final Safety Analysis Report (FSAR) and the Operating Limits and Conditions:

— Experiments which present hazards covered by similar experiments previously approved by Safety Committee;
— Experiments which lead to modifications in comparison with experiments previously authorized; experiments classed in this category have to be assessed and approved by the SC;
— Experiments which require changes to the OLCs or which entail hazards different in nature or more likely to occur than those considered in the Final Safety Analysis Report; experiments classed in this category have to be assessed by the SC and approved by the Safety Authority.

The experiments are assessed by Safety Committee in the basis of a safety document prepared by Reactor Operation Unit. The content of this document is mainly as follows:

— The assessment of compliance of the experiment with licensing conditions and FSAR;
— The presentation of required operational procedures and commissioning process ;
— The assessment of doses received by reactor staff in normal operation and presentation of radiation protection measures;
— The calculation of radiological consequences in accident conditions;
— The management of radioactive waste and effluents generated;
— The presentation of special requirements for training and, if necessary, relicensing of reactor operators.

3. SAFETY ASSESSMENT OF I-131 PRODUCTION EXPERIMENT

In the early of 2010, the Reactor Operation Unit had established the first draft of safety demonstration of I-131 production experiments, in accordance with the above mentioned approach. The demonstration was based on:

— The assessment of thermal effect on each part of a capsule (hosting the I-131 sample) for three different encapsulation configuration;
— The impact of the capsule insertion into the core on the core reactivity and the neutron flux pertubations;
— The presentation of technical arrangements implemented to extract the irradiated sample from the core and its insertion in a transportation package;

Then, the Safety and Security Pole carried out an independent assessment of this demonstration by performing recalculation of data given by the operator (e.g. reactivity impact of the insertion of a sample into the core, thermal effect) with specific computation tools and the assessment of radiological consequences in case of target capsule rupture in the basis of work and conclusions of the IAEA CRP ”Modelling and Analysis of Radionuclides Transport and Source Term Evaluation within Containment / Confinement and Release to the Environment, for Research Reactors” [4]. The results of this assessment and the safety demonstration achieved by the Reactor Operation Unit had been discussed during the second IRSN expertise mission.

In conclusion of this second mission, CNESTEN Safety and Security Pole and IRSN came to an agreement on the identification of specific safety issues which deserved to be studied in detail, in accordance with the experiments safety assessment approach mentioned above and on the way to deal with them. The mission has led to the proposal of several technical requirements regarding the safety of I-131 production operations. In addition, IRSN suggested to punctuate the approval route of the experiment: a first authorization would be given for a reduced mass of sample on the basis of a consolidated safety demonstration of the results of its experimental commissioning, then a second authorization would be given for a nominal mass of sample on the basis of the results of the first experiment.

4. BUILDING TSO CAPABILITIES USING INTERNATIONAL COOPERATION

For many years, several countries have acquired a huge experience in the construction, the commissioning, the operation and the decommissioning of nuclear plants. As a result, initial safety principles evolved in particular through the experience acquired over this period. The organization of international cooperation for countries willing to launch into nuclear technology is a good mean to update with the state of the art of the “safety culture”. In addition, this approach leads to a standardization of safety practices to a high level.

Regarding the case of Morocco, the follow-up ensured by CNESTEN for the construction, the commissioning and the operation of Nuclear Studies Centre at la Maâmora

(CENM), including the TRIGA reactor, has played a key role in building capabilities in the area of safety.

A Nuclear and radiological Safety and Security law will soon be adopted by Morocco, this law foresees the creation of a new unique and independent Regulatory Body which will need to rely on the support of CNESTEN as TSO for safety assessment and review. In this perspective, CNESTEN is reinforcing its human resources and developing skills in framework of international cooperation, mainly with the IRSN, IAEA, European Commission and USA.

5. CONCLUSION

CNESTEN started since many years the development of infrastructure needed and capabilities necessary to ensure an independent follow-up on safety level of Nuclear Studies Centre at la Maâmora (CENM), including the TRIGA Reactor. The setup of an effective safety committee with required skills in different safety assessment areas and the adoption of an approach regarding the safety review process of experiments constitute important steps to fulfill the national regulations and the IAEA safety standards.

In order to ensure continuously the follow-up of safety of utilization of the TRIGA reactor and to play a role as TSO to the future independent Regulatory Body, CNESTEN is reinforcing its human resources and developing its capabilities through training involvement in many projects and activities of CNESTEN concerned staff in framework using international cooperation mainly with IRSN, IAEA, EC and USA.

REFERENCES

[1] IAEA, safety reuirements N° NS-R-4 “Safety of Research Reactors”.

[2] IAEA, draft safety guide N° DS397 “Safety in the Use and Modification of Research Reactors”.

[3] CNESTEN, Instruction Sécurité N° 14 « Autorisation de réalisation des expériences au Réacteur TRIGA Mark II du CENM ».

[4] CNESTEN, Final Report in framework of IAEA CRP ”Modelling and Analysis of Radionuclides Transport and Source Term Evaluation within Containment / Confinement and Release to the Environment, for Research Reactors”.