

## Development of Generic User Requirements and Criteria of Small Modular Reactor Technologies for Near Term Deployment in Cooperation with IAEA

Joo Hyung Moon\*

*Korea Atomic Energy Research Institute,*

*111, 989beon-gil, Daedeok-daero, Yuseong-gu, Daejeon, 34057, Republic of Korea*

*\*Corresponding author: moonjooh@kaeri.re.kr*

### 1. Introduction

The International Atomic Energy Agency (IAEA) held a meeting entitled: “Technical Meeting on Generic User Requirements and Criteria (GURC) of Small Modular Reactor (SMR) Technologies for Near Term Deployment,” at the IAEA’s headquarters in Vienna, Austria, from 8 to 11 August 2022. The purpose of the meeting is to provide a forum for the exchange of information on GURC for SMRs (with a focus on newcomer and developing countries), including design characteristics, technology needs, infrastructure development, domestic legal or regulatory frameworks, disposal of spent fuel and flexible financing.

Participants from Australia, Belgium, Brazil, Canada, China, Czech Republic, Egypt, Estonia, France, Indonesia, Islamic Republic of Iran, Jordan, Kenya, Republic of Korea, Pakistan, Philippines, Romania, Russian Federation, Sri Lanka, Ukraine, United States of America, and Uzbekistan (total 22 Countries) were actively joined the meeting, and some of them presented their own presentation regarding the GURC of SMR. The author performed in this meeting an oral presentation entitled: “General Requirements and Criteria of SMART.”

In the present paper, objectives, history and activities of the meeting will be briefly reported.

### 2. Objectives and Scope

The purpose of this meeting is to:

- Discuss electric utility requirements for nuclear power in Member States (MS) where SMRs are a technology option for near term deployment,
- Understand the usefulness of a coordinated approach on GURC for SMR technology given the importance of harmonization,
- Discuss the approach to develop an IAEA’s document on top-tier GURC for SMR technology that provides a framework to cover near-term deployable SMR designs and could serve as a reference for utilities organizations to develop more detailed GURC.

This meeting features presentations and discussions on the need of MS particularly that of embarking countries interested in SMRs to have a national capacity in expressing their generic users’ requirements and criteria for SMR technology, including plant size and thermal output, energy resilience, cost competitiveness,

time to market, nuclear safety, security and safeguards, and so forth. Technical aspects covered in this meeting are as follows: design simplification, plant footprint, operational flexibility, specific deployment indicators, non-electric applications, R&D needs to facilitate licensing of the designs and other considerations, and adaptability to the integrated energy systems. International utilities organizations also share their views on the same aspects, from the perspective of experienced nuclear utilities. Some SMR vendors or technology developers also provide their approach with a wide set of requirements.

### 3. History and Action Items

The development of GURC for SMR was endorsed and supported by the Technical Working Groups (TWGs) on SMR in 2019. Consequently, consultancy meeting (CM) on GURC for SMR was kicked off in 2020 to plan the development of guidance for MS to prepare their GURC for SMR, and then technical meetings (TMs) were held in 2021 and 2022. In June 2022, the Nuclear Harmonization and Standardization Initiative (NHSI) was launched to facilitate the safe and secure deployment of SMRs and other advanced nuclear technologies to maximize their contribution to reaching net zero carbon emissions by 2050. The NHSI recognized that harmonization of regulatory requirements and standardization of manufacturing would create a large market and allow SMRs to emerge and be competitive. Harmonization of high-level user requirements is one of action items for NHSI, where both Electric Power Research Institute (EPRI) [1] and European Utility Requirement (EUR) [2] are involved. Table I summarizes the history of GURC for SMR. The IAEA aims to present a draft of common document in cooperation with EPRI and EUR in the next technical meetings by 2024.

### 4. Activities of TM on GURC for SMR

#### 4.1 Oral Presentations

Total 18 presentations were provided during 4 days meeting. Topics can be divided into the following 4 sections:

- S1. Introduction on the user requirements

Table I. History of GURC for SMR

Date	Meeting
July 2019	2 <sup>nd</sup> TWG on SMR
November 2020	1 <sup>st</sup> CM on GURC for SMR
May 2021	TM on GURC for SMR
September 2021	2 <sup>nd</sup> CM on GURC for SMR
April 2022	3 <sup>rd</sup> CM on GURC for SMR
June 2022	NHSI
August 2022	TM on GURC for SMR

- S2. User requirements taken into account by the vendors
- S3. User requirements in embarking and expanding countries
- S4. Regulatory aspect of user requirements

User requirements based on the EPRI and EUR's experiences and the IAEA's effort in the framework of the NHSI were introduced in S1. User requirements taken into account by the vendors, including ROK and Russian Federation were also provided in S2. Safeguards and security of SMRs were covered in this section. User requirements in Australia, China, Indonesia, Egypt, Ukraine, and Pakistan were followed in S3. Finally, regulatory aspect of user requirements from Brazil, Jordan and Romania were dealt with in S4.

The author delivered a 30 minutes talk in S2 entitled: "General Requirements and Criteria of SMART," where design characteristics and top-tier requirements of SMART were presented. Regulatory criteria of SMART were also included, where it was mainly focused on the regulation of the Nuclear Safety and Security Commission (NSSC), or "Regulations on Technical Standards for Nuclear Reactor Facilities, etc.," and Korea Electric Power Industry Code (KEPIC). It was emphasized that general requirements and criteria were faithfully implemented in the design of SMART.

#### 4.2 Group Activities

Participants in this meeting (in-person only) conducted group activities to list up the requirements that a user could have regarding a near term deployment of SMR using rules of thumb. They were divided into 3 groups to discuss top 18 GURC elements for SMR technology. Table II shows the list of each topic. Equivalently 45 minutes of discussion for each topic were given and a designated rapporteur presented a summary of discussion on the next day to share the results with the rest of the group for each topic. All participants tried to put themselves in the user's head but not necessarily a traditional nuclear user such as the utility which will operate a SMR. They were asked to remain commercially neutral by not narrowing down the choice by a requirement specific to one design of SMR. Any requirements that would fit under the topic were addressed as many as possible.

Table II. Top 18 GURC Elements for SMR Technology

	Group 1	Group 2	Group 3
Day 1	Grid	Performance	Layout
	Cost	Constructability	Design Process and Docs
Day 2	Code and Standards	Operation & Maintenance	Quality Assurance
	Environmental Impact	Safeguards & fuel	Design Basis
Day 3	Safety	Heat Sink	Turbine Generator
	Non-electric Applications	Decommissioning	Waste

## 5. Conclusions

In this meeting, through many oral presentations and group activities, GURC for SMR technology for embarking countries interested in SMRs were intensively collected and reviewed. Experiences from EPRI and EUR were highly appreciated during the meeting and participants actively expressed their interests on the deployments of SMR. The author explained that general requirements and criteria are faithfully implemented in the design of SMART and SMART is a real reactor for immediate deployment.

## ABBREVIATIONS

CM	Consultancy Meeting
EPRI	Electric Power Research Institute
EUR	European Utility Requirement
GURC	Generic User Requirements and Criteria
IAEA	International Atomic Energy Agency
KEPIC	Korea Electric Power Industry Code
MS	Member States
NHSI	Nuclear Harmonization and Standardization Initiative
NSSC	Nuclear Safety and Security Commission
ROK	Republic of Korea
SMART	System-integrated Modular Advanced Reactor
SMR	Small Modular Reactor
TM	Technical Meeting
TWG	Technical Working Groups

## ACKNOWLEDGEMENT

This work was supported by the National Research Foundation of KOREA (NRF) funded by the Korea government (Ministry of Science and ICT) (No. NRF-2020M2D7A1079178).

## REFERENCES

- [1] EPRI. (2014). Advanced Nuclear Technology: Advanced Light Water Reactor Utility Requirements Document, Revision 13.
- [2] EUR. (2016). European Utility Requirements for LWR Nuclear Power Plants, Revision E.