

Sustainability assessment of SMART in terms of safety by using the IAEA INPRO methodology



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INTRODUCTION

From 2001 to 2008, with the support of the International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO), the International Atomic Energy Agency (IAEA) developed a methodology for assessing the sustainability of nuclear energy systems (NESs). The INPRO methodology covers seven issues that influence NES sustainability: safety, competitive-ness, proliferation, waste, environmental stressors, resources and infrastructure.

The INPRO methodology has been applied to NESs based on large reactors and sodium-cooled fast reactors several times, but not to small and medium-sized modular reactors (SMRs). Some initial attempts to evaluate SMRs have failed to fully consider design-related criteria, mainly due to lack of input data. SMRs, even with the same technology as large pressurized light water reactors, can provide significant benefits in terms of system sustainability, e.g., simplified infrastructure requirements, and smaller source terms if they are likely to be inadvertently released into the environment.

Therefore, it is necessary to apply the updated INPRO methodology for SMR designs. Application of the INPRO methodology is normally organized as a self-assessment exercise performed in a country developing a strategic plan for introduction / expansion / modification of the NES. In the present study, a newly launched task regarding application of INPRO methodology to SMART, especially in the area of reactor safety, will be briefly explained.

BACKGROUND OF THE TASK

The INPRO methodology consists of issues affecting the sustainability of NESs, such as economics, reactor safety, safety of fuel cycle facilities, infrastructure, waste management, environmental impacts, and nuclear proliferation resistance. It consists of basic principles, user requirements, and evaluation criteria, which are then divided into evaluation indicators and acceptance limits. Avoiding commercially sensitive information, evaluation criteria requiring detailed knowledge of the design consists of up to 100 (less number may be chosen depending on the scope of the evaluation).

In April 2020, IAEA requested the participation of the Korea Atomic Energy Research Institute in the following meeting: "INPRO Methodology for Sustainability Assessment of NESs Based on SMRs." The purpose of the meeting is to encourage SMR developers in different countries to self-evaluate their country's SMR design using INPRO methodology for evaluating the sustainability of NESs. While the USA, Russia and China, which are leading the development of SMRs, have already expressed their intention to participate, ROK has also expressed her willingness to actively participate the meeting.

Until now, IAEA member states have not applied the latest version of INPRO methodology to specific SMR designs, but in 2019 several member states expressed their interests in conducting INPRO sustainability assessment on different SMR designs. It is also expected that INPRO sustainability assessment studies focused on designing one or more specific SMRs will help determine whether new versions of INPRO methodologies are performing as intended.

INPRO Methodology

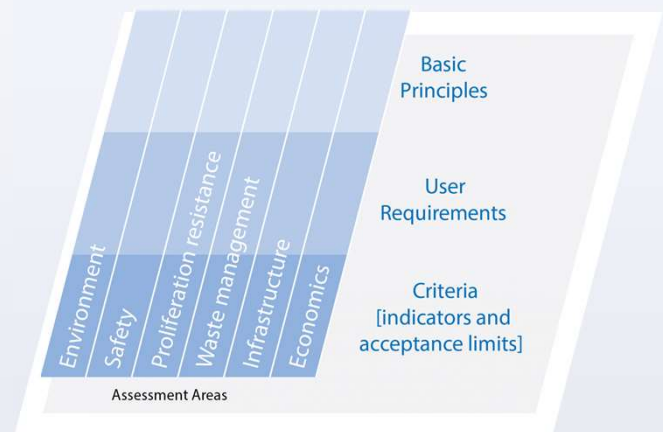


Fig. 1. Summary of IAEA INPRO methodology (Courtesy of IAEA)

THE GOAL AND OBJECTIVES OF THE TASK

The final goal of the task is to apply the INPRO methodology to SMART for sustainability assessment in the area of reactor safety. The technical challenges, if any, will be identified through the task when applying INPRO methodology to SMART.

Detailed objectives are as follows:

- Confirm satisfaction with basic principles of INPRO methodology
- Confirm satisfaction with user requirements of INPRO methodology
- Confirm satisfaction of evaluation criteria (indicators and acceptance limit) of INPRO methodology
- Comparison with domestic regulatory requirements (if necessary)

EXPECTED OUTCOMES

By applying updated INPRO methodology to SMART design, it can contribute to sustainable technological innovation to SMRs and is expected to play a leading role in applying INPRO methodology to SMRs. By using INPRO methodology to evaluate the sustainability of SMART design, it is expected that the sustainability of SMART will be objectively evaluated and it contributes to promoting overseas exports.

CONCLUSIONS

The present study is intended to evaluate whether SMART designs meet the basic principles, user requirements, and evaluation criteria, using INPRO methodologies for evaluating the sustainability of NESs. In particular, evaluation will be carried out in the reactor safety sector among several areas related to sustainability. Through this task, the technical challenges will be identified when applying INPRO methodology to SMART.

ACKNOWLEDGEMENT

This work was supported by the National Research Foundation (NRF) of Korea funded by the Ministry of Science and ICT, Republic of Korea (2021M2A7A1093202).