A Consideration of Emergency Action Level Initiation Condition for Research Reactor HANARO

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1. Introduction

Because reactors are used for different purposes and their safety characteristics are designed differently, it is difficult to apply emergency publicity standards for certain accidents such as power generation reactors. However, applying the safety characteristics inherent to the research reactor in accordance with the emergency notification standard proposed by the IAEA, the technical basis of the emergency notification standard can be standardized to some extent. Therefore, in this study, based on the emergency level (EAL) proposed by the IAEA, the applicability of the research reactor HANARO was investigated.

2. Emergency Action Level

2.1 IAEA Emergency Action Level

The IAEA threat class II research reactor emergency standards are classified into core safety function disturbance and fission product barrier damage for safety system accidents. In addition to raising the radiation level due to these accidents, Incidents of fire, natural disasters, fuel handling, and spent fuel storage are described.
This study investigated the applicability of the Emergency Report Standard for Emergency Causes and Radiation Levels of HANARO to the IAEA Emergency Announcement Criteria.

2.2 Application of Emergency Action Level

IAEA emergency situations can be classified into three categories: critical safety system failures, fission product barrier losses, and radiation dose escalation. Table 1, Table 2 and Table 3 show the HANARO applicability results for the start conditions of each IAEA EAL. The results are based on Hanaro SAR and the Emergency Plan.

Table 1. Key Safety System Obstacles

IAEA initiation conditions	Applicability analysis for HANARO
Failure to stop nuclear reaction	Not applicable under Hanaro SAR
Inadequate core cooling	-The beam tube rupture is applied as a limitation accident of HANARO -Cooling channel blockage accident is applied.
AC or DC power loss	Not applicable under HANARO SAR
Includes system equipment Safety system Loss or worsening control	Not applicable under HANARO SAR

Table 2. Loss of fission product barrier

IAEA initiation conditions	Applicability analysis for HANARO
Significant damage risk of core or irradiated fuel	Applicability analysis for HANARO
High concentration radioactivity in water tank or reactor building	This starting condition applies because of the possibility of a small leakage of radioactive material from the fuel during output operation due to manufacturing defects or other causes.

Damage to reactor	The release of large quantities of radioactive material from the containment of reactor buildings can not be expected from research reactors. No accident cases. Not applicable.

Table 3. Increase of Radiation Level

IAEA initiation conditions	Applicability analysis for HANARO
Exhaust emission above the limit	Environmental releases are important in terms of on-site and off-site protection measures. Applied the chimney monitor indicator to HANARO
High radiation level of control room etc. required for continuous safety system operation and maintenance	Control room is applicable. Since the control room is important for maintaining the reactor control function, the loss of the operator's ability due to the increase in the radiation level in the control room is applied.
High radiation levels in areas requiring frequent access for safety system maintenance or control	Nuclear (Emergency) Emergency Plan is unilateral. It does not take into consideration that all workers in other areas except the control room are evacuated or introduced immediately.
High radiation levels in non-core areas (eg., laboratories)	Not considered under the nuclear emergency plan.
Raising the radiation level of the reactor building	Since it is necessary to take into consideration on-site and out-of-site protection measures due to provisional hazards and surface release due to the increase of radiation levels of nuclear reactors after emergency ventilation system shutdown.
Unplanned increase in reactor radiation levels	This is applicable because there may be an increase in the radiation level due to unforeseen unplanned incidents in core fuel.
High radiation dose rate at or above site boundaries	Actual standards for inhabitant protection measures on site, and the actual measured radiation dose rates at site boundaries are applied.

The results of the applicability analysis as one can be summarized as shown in Table 4 for the emergency start conditions.

Table 4. Summary of EAL Initiation Conditions for HANARO

Incident classification	HANARO Application Emergency release criteria Starting condition
Core Safety System	○ Beam tube breakage accident (loss of coolant accident) ○ Cooling channel cut-off accident (loss of coolant flow rate)
Fission product barrier	○ Fuel defect accidents
Increase in radiation level	○ Emissions above the limit ○ Jay's loss of residence ○ Increase of radiation level in Reactor building ○ Unplanned increase in reactor radiation levels ○ High radiation dose rate at the site boundary

3. Conclusion

It is important to establish the ability to timely recognize the emergency classification according to the severity of the accident in order to respond promptly to the radiation emergency preparedness and emergency response of nuclear facilities. This function is only possible if emergency guidelines have been prepared in advance for nuclear safety facilities. Therefore, based on the results of this study, specific and quantitative emergency standards are required depending on the severity of the accident.

REFERENCES

[1] IAEA, “Generic Procedures for Response to a Nuclear or Radiological Emergency at Research Reactors”, EPR-RESEARCH REACTOR, Sep. 2011.