

Development of Safety Review Guidance for Research and Training Reactors

Kju-Myeng OH, Dae-Soo Shin, Sang-Kyu AHN, Hoon-Joo Lee

Korea Institute of Nuclear Safety, 19, GUSUNG-DONG YUSONG-GU, TAEJON

k313okm@kins.re.kr

1. Introduction

The KINS already issued the safety review guidance for pressurized LWRs. But the safety review guidance for research and training reactors were not developed. So, the technical standard including safety review guidance for domestic research and training reactors has been applied mutatis mutandis to those of nuclear power plants. It is often difficult for the staff to effectively perform the safety review of applications for the permit by the licensee, based on peculiar safety review guidance. The NRC and NSC provide the safety review guidance for test and research reactors and European countries refer to IAEA safety requirements and guides. The safety review guide (SRG) of research and training reactors was developed considering descriptions of the NUREG-1537 Part 2, previous experiences of safety review and domestic regulations for related facilities. This study provided the safety review guidance for research and training reactors and surveyed the difference of major acceptance criteria or characteristics between the SRG of pressurized light water reactor and research and training reactors.

2. The Safety review guidance for research and training reactors

2.1 The basic direction of the SRG for research and training reactors

This SRG deleted the chapters related with the financial qualifications, decommissioning and possession-only license amendments and highly enriched to low-enriched uranium conversions, comparing with NUREG-1537 part 2.

The radiation protection program and waste management chapter was divided into 2 chapters, radiation protection and radiation waste management. Quality assurance and startup plan sections contained in chapter 12 were upgraded to chapters in abreast with Enforcement Regulation of the Atomic Energy Act.

This SRG added the 2 chapters, experimental facilities and utilization and other license considerations.

In NRC, NUREG-1537 Part 2 does not adopt 10 CFR 50 App. A, "General Design Criteria" contrary to the nuclear power plants. But regulations on technical standards for nuclear reactor facilities, etc. similar to NRC's General Design Criteria were applied to domestic research and training reactors.

This SRG adopted newly regulatory guides and technical standards considering the applicability of NRC's regulatory guides and technical standards described in NUREG-1537 part 2. The example is as follows.

- IEEE 7-4.3.2-1993 ⇒ IEEE 7-4.3.2-2003
- RG 1.152 Rev. 1 ⇒ RG 1.152 Rev. 2

2.2 The structure of the SRG for research and training reactors

This safety review guidance consists of 18 chapters and each chapter and section is made of subsections for areas of review, acceptance criteria, review procedures, and evaluation findings for each section of the SAR to be reviewed and evaluated.

- Areas of review. This subsection describes the scope of the review, including a description of the systems, components, analyses, data or other information.
- Acceptance criteria. This subsection states the purpose of the review, the applicable KINS requirements, and the technical bases for determining the acceptability of the design or the programs within the scope of the review.
- Review procedures. This subsection discusses how the review is performed and is generally a description that the reviewer follows to verify that the applicable safety criteria have been met.
- Evaluation findings. This subsection presents the type of conclusions needed to accept the particular review area.

2.3 The major domestic regulations contained this SRG for research and training reactors

- Site characteristics: Notice of the MOST No. 2000-8, Technical standards for the location, structure and installation of reactor facilities
- Human engineering: NUREG-0700 Rev. 2, NUREG-0711, Rev.2
- Radiation protection: Notice of the MOST No. 2002-23, Standards on radiation protection, etc. and Notice of the MOST No. 2003-06, Regulation on assessment and management of personal dose
- Emergency planning: Notice of the MOST No. 2004-11, Standards for establishment, etc. of the radiological emergency plan for the nuclear related enterprises
- Environmental monitoring: Notice of the MOST No. 2005-19, Regulation on preparation, etc. of radiation environmental report of nuclear power utilization facilities and Notice of the MOST No. 2004-17, Regulation on survey and evaluation of environmental radiation in the vicinity of nuclear power utilization facilities
- Fire Protection: Notice of the MOST No. 2003-19, Regulation on establishment and implementation of fire protection program and Notice of the MOST No. 2003-20, Technical standards for fire hazard analyses
- Reporting: Notice of the MOST No. 2005-7, Regulation on the reporting and public announcement of the accident and incident for nuclear facilities.

3. Conclusion

The safety review guide (SRG) of research and training reactors was developed, considering descriptions of the NUREG-1537 Part 1, previous experiences of safety review and domestic regulations for related facilities. This SRG is reviewed by KINS itself and related organizations and then conditionally approved by the Technical Review Committee for Nuclear Safety of KINS (Application after the completion of recent revisions of Nuclear Energy Law, etc. related to research and training reactors). The related safety review guide (SRG) will be utilized in mainly reviewing the modification of any permitted matters and be able to be applied to Periodic Safety Review, if adopted afterwards, for research and training reactors.

REFERENCES

- [1] NUREG-1537, Guidelines for preparing and reviewing applications for the licensing of non-power reactors.
- [2] IAEA Safety requirements No. NS-R-4, Safety of research reactors.
- [3] NSC's Guide on safety design review for test and research reactor facility of light water type.

연구용·교육용 원자로시설 안전심사지침 목차

원자력법시행규칙 SAR 목차	NUREG-1537 목차	연구용·교육용 원자로시설 심사지침 목차(안)	비고
제1장 시설	제1장 시설	제1장 시설	
제2장 부지특성	제2장 부지특성	제2장 부지특성	
제3장 구조물, 계통, 및 기기의 설치	제3장 구조물, 계통, 및 기기의 설계	제3장 구조물, 계통, 및 기기의 설치	
제4장 원자로	제4장 원자로	제4장 원자로	
제5장 원자로냉각 계통	제5장 원자로냉각재 계통	제5장 원자로 냉각계통	
제6장 공학적안전설비	제6장 공학적안전설비	제6장 공학적 안전 설비	
제7장 계측 및 제어 계통	제7장 계측 및 제어 계통	제7장 계측제어계통	
제8장 전력계통	제8장 전력계통	제8장 전력계통	
제9장 보조계통	제9장 보조계통	제9장 보조계통 - 제어실	"공" 신설
제10장 증기 및 동력 변환계통	제10장 실험시설 및 이음	제10장 실험시설 및 이음	신설
제11장 방사성폐기물 관리	제11장 방사선방호 계획 및 폐기물관리	제11장 방사성 폐기물관리	
제12장 방사선방호 - 품질보증 - 기동계획	제12장 운전 - 품질보증 - 기동계획	제12장 방사선방호	"공" 추가
제13장 조직	제13장 사고분석	제13장 운전	
제14장 초기시험	제14장 기술지침서	제14장 초기시험	"공"- "공" 확대
제15장 사고분석	제15장 재결능력 (삭제)	제15장 사고분석	
제16장 기술지침	제16장 기타 허가고려 사항 (안영)	제16장 기술지침	
제17장 품질보증	제17장 해체 및 소유 (삭제)	제17장 품질보증	"공"- "공" 확대
제18장 인간공학	제18장 고충축우라늄 저충축 전환 (삭제)	제18장 기타 허가 고려 사항	신설

Fig. 1 The structure of the SRG for research and training reactors

발전용 및 연구용 원자로시설 안전심사지침의 주요 차이점

	가압경수로형 원자로시설 안전심사지침	연구용 원자로시설 안전심사지침
지리, 인구 통계	• 원자로 반경 1.6, 3.2, 4.8, 6.4, 8.0 및 16.0km의 인구분포 현황 • 16km부터 80km 이내 인구분포 현황	• 원자로 반경 1, 2, 4, 6 및 8 km 이내의 현재 및 추정 인구분포 • 원자로 반경 8km까지 사업 활동, 부지, 도시 경계 및 농지의 특성
지역 기후	• 24시간 최대강우량	• 48시간 예상최대강우량 무계 • 100년 주기의 snowpack 무계 ※ snowpack : 설과빙판(雪氷氷層). 여름에 조금씩 녹는 얼음으로 같은 고원
지진	• 반경 320km 내 위치한 모든 구조구에 대해 MM 진도 IV 이상 또는 규모로 3.0 이상으로 보고된 모든 지진	• 반경 200km 내에 위치하는 모든 구조구에 대해 MM 진도로 IV 이상 또는 규모로 3.0 이상으로 보고된 모든 지진
일차 방사성핵종	• 주요 방사성핵종은 Xe, Kr, I, Cs, Rb, N-16, H-3, Co, Sr 등임.	• 주요 방사성핵종은 N-16 및 Ar-41임.
핵연료 설계	• 핵비동위원소 (DNBR) 최소값 : W-3, WRB-1 및 CB-1상관식 사용에 대해 각각 1.30, 1.17 및 1.19 임.	• 핵비동위원소 (DNBR) : 어느 핵연료 채널에서든 2 보다 커야 함.
핵연료 취급저장	• $K_{eff} < 0.95$	• $K_{eff} < 0.9$
운영기술 지침서	• NUREG-1431 또는 1432 참조	• ANSI 15.1 참조
규제 지침	• Reg. Guide 1.1 - 1.205 등 약 200종 적용	• Reg. Guide 2.1 - 2.6까지 총 6종 적용 • Reg. Guide 1.152 공통 적용
참조기준	• ANSI, IEEE 등 대부분 안전기준 적용	• ANSI 15.xx Series, IEEE7-4.3.2, ANSI/ANS 10.4 등 제한적으로 적용

※ 주 Reg. Guide 1.152 : Criteria for Digital Computers in Safety Systems of Nuclear Power Plants

Fig. 2 Comparison the difference of major acceptance criteria or characteristics between the SRG of pressurized light water reactor and research and training reactors