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Recent Regulatory Activities to Improve ALARA Performance of Nuclear Power Plants in Korea

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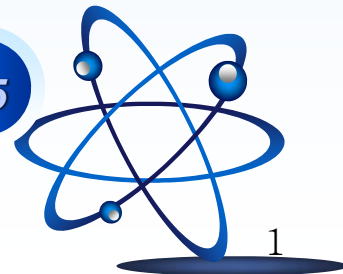
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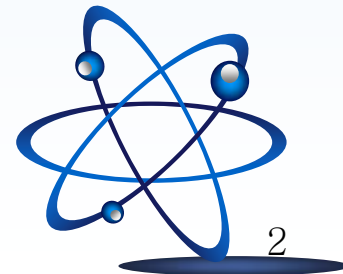
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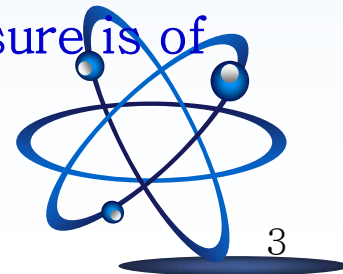
1. Necessity for Performance of ALARA

- 20 NPPs in Korea are under operation at 4 sites
 - 6 reactors from Westinghouse in the U.S.
 - 4 CANDU-type PHWR's from Canada
 - 2 Framatom reactors from France
 - 8 Korean standard NPPs designed based on the CE-type model
- Additional NPPs are under construction at Kori, Wolsung and Uljin
 - APR 1,400 MW type
 - OPR 1,000 MW type
- Radiation exposures to the radiation workers mainly take place during the maintenance periods
- ALARA activities
 - have continuously reduced the radiation exposure dose per radiation worker
 - reducing the collective dose and individual dose
 - minimized the generation of radioactive wastes
- ALARA endeavors should be continued in the future.



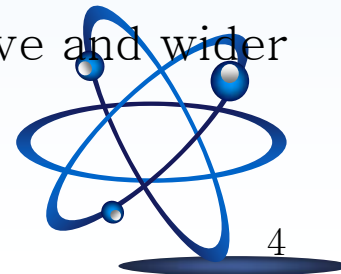
2. Safety review & inspection guidance relevant to ALARA

- Safety review & inspection guidance relevant to ALARA for the PWR-type commercial reactors was developed and approved in 2000.
- Safety review & inspection guidance relevant to ALARA contain;
 - NSSS materials
 - Radiation protection program
 - Shielding materials
 - Radiation monitors
 - HVAC systems
 - Education and training programs
 - Operators of the NPP maintain organizations and human forces, and secure budgets sufficient for the reduction of radiation exposure to the radiation workers.
 - The administrators for the reduction of radiation exposure is of the utmost importance.



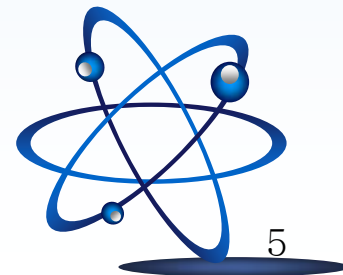
3. Background of and necessity for development of the reg. standards

- Article 97, Paragraph 1, Subparagraph 4 of the Atomic Energy Act
 - The legislative basis for the performance of ALARA at nuclear power plants in Korea.
 - Stipulate ALARA in very brief and declaratory contents.
- KINS started developing the **safety review & inspection guidance** for performing ALARA effectively in 1997, the development of which was completed in 2000.
 - The safety review & inspection guidance is a very limited guidance
 - Applicable to the safety review of construction and operation of the PWR-type commercial nuclear power plants only
 - Applicable neither to the PHWR-type nuclear power plants nor accident situations or dismantlement of the plants.
 - No stakeholders or independent experts participated in the development and approval of the guidance.
 - 10 years since the development of the guidance, and the guidance itself does not reflect the latest technologies.
- KINS started the development of **the reg. standards & the reg. guides** in 2007.
 - Reflect the opinions of the stakeholders for more objective and wider regulatory activities.



4. Reg. standards & reg. guides under the Korean regulatory system

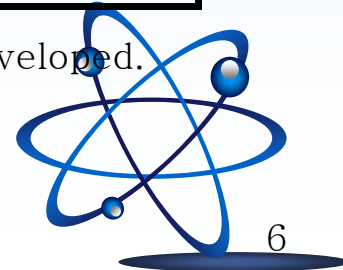
- 115 of the reg. standards and 192 of the reg. guides in 18 fields have been developed
- Deliberation and resolution of the 7 subcommittees consisting of 80 experts
 - 20 experts of KINS, and 60 independent experts from the reg. authorities, industries and the academy
- Submitted to MEST for approval
- Reg. standards : "Rules for business"
 - Contain the detailed standards for implementing the technical rules
- Reg. Guides
 - Acceptable methods and specifications for satisfying the Reg. Standards.



Contents of Reg. Standards

Part I. Site & Environment Ch. 1 Site Ch. 2 Radiation Environments	Ch. 13 Radiation Protection Ch. 14 Accident Analysis Ch. 15 Human Factor Engineering Ch. 16 Severe Accident & Risk Analysis
Part II. Design Ch. 3 General Design Ch. 4 Structure Design Ch. 5 Nuclear Reactor Ch. 6 Reactor Coolant System Ch. 7-1 Engineered Safety Features Ch. 7-2 Containment Building System Ch. 8 Instrumentation & Control Ch. 9 Electrical Power System Ch. 10 Auxiliary Systems Ch. 11 Steam & Power Conversion System Ch. 12 Radioactive Waste System	Part III. Operation Ch. 17 Operation Ch. 18 Initial Test Ch. 19 Technical Specifications Ch. 20 Emergency Preparedness Part IV. Dismantling Ch. 21 Dismantling Part V. Quality Assurance Ch. 22 Quality Assurance

※ Ch. 19, 20 and 22 are fully defined in the notices; Ch. 21 will be further developed.



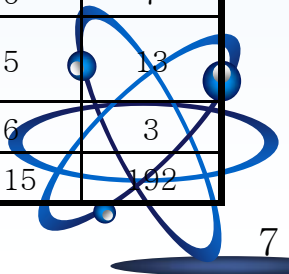
Structure of Reg. Standards & Guides

□ Reg. Standards & Guides in Korea

- Reg. Standards : **Implementation of technical standards**, detailed standards (115 items)
- Reg. Guides : **Acceptable methods and specifications** for satisfying the Reg. Standards (192 items)

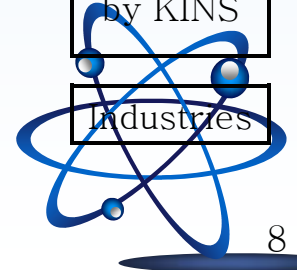
Structure of Reg. Standards & Guides

Chapters	Number of Items		Chapters	Number of Items	
	RS	RG		RS	RG
1. Site	6	10	10. Auxiliary Systems	8	8
2. Radiation Environment	6	3	11. Steam & Power Conversion System	4	–
3. General Design	12	19	12. Radioactive Waste System	6	8
4. Structure Design	10	31	13. Radiation Protection	6	11
5. Nuclear Reactor	6	6	14. Accident Analysis	4	2
6. Reactor Coolant System	5	9	15. Human Factor Engineering	3	5
7.1 Engineering Safety Features	5	4	16. Severe Accident & Risk Analysis	6	7
7.2 Containment Building System	7	7	17. Operation	5	13
8. Instrumentation & Control	6	28	18. Initial Test	6	3
9. Electrical Power System	4	18	Total	115	192



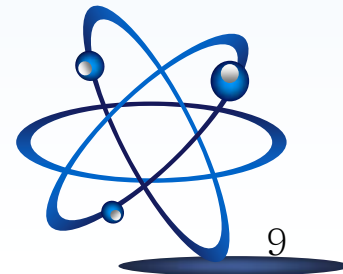
Legislative framework in Korea

Act	■ Basic principle relevant to the promotion of nuclear power and the safety regulations	System and procedures	Managed by the Government
Enforcement Decree	■ Requirements entrusted by the acts, and those required for the enforcement		
Enforcement Rules	■ Requirements entrusted by the acts and the decrees, and those required for the enforcement (procedures, forms)		
Technical Rules	■ Description of the technical level entrusted by the acts and the decrees based on the principle	Technical standards	Support of KINS
Notice from the Minister	■ Definition of the technical standards, or the procedures and the forms pursuant to the acts and the decrees		
Regulatory Standards	■ Definition of analysis and detailed requirements for the technical standards ■ currently under development (115 items)	Documents performing the regulatory tasks	Managed by KINS
Regulatory Guide (Appendix)	■ Allowable methods, conditions and specifications for satisfying the technical standards ■ Currently under development (192 items)		Report to Government
Safety Review and Inspection Guidance	■ Guideline describing in-depth methods and procedures for the review and the inspection based on the technical standards and the regulatory standards		Managed by KINS
Industrial Code	■ KEPIC, ASME, IEEE, ASTM etc.		Industries



5. Reg. standards & Reg. guides of radiation protection

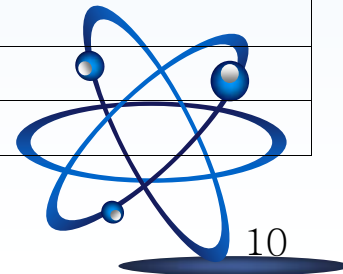
- In the fields of radiation protection
 - Reg. standards make up 15 out of the 115 standards
 - Reg. guides make up 14 out of the 191 guides
- Deliberated and resolved at the technical standard committee
- Submitted to MEST for approval



Reg. Standard's title of rad. Protection field

Chapters	Number	Regulatory Standard Titles
1. Site	1.4	Meteorological Status
2. Radiation Environment	2.1	General Standard
	2.2	Fundamental Requirement
	2.3	Environmental Condition
	2.4	Radioactive Material Release
	2.5	Radiation Environment Effect
	2.6	Environmental radiation/radioactive material monitoring plan
3. General Design	3.11	Radiation Protection Optimization
	3.12	Radiological Source Term

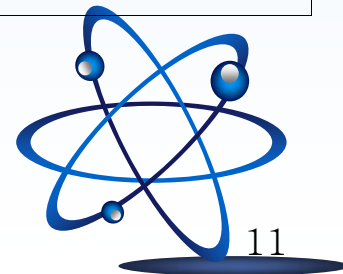
13. Radiation Protection	13.1	General Standard
	13.2	Radiation Protection Design Features
	13.3	Radiation Shield
	13.4	Radiation Protection Plan
	13.5	Radiation Detection and Measurement & Radiation Dosimetry
	13.6	Radiation Safety Management



Reg. Guide's title of rad. protection fields

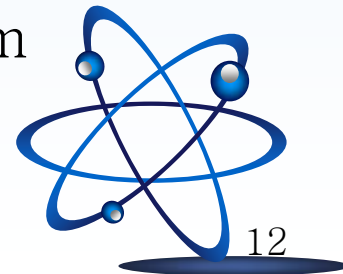
Chapters	Number	Regulatory Guide Titles
1. Site	1.3	Investigation and Evaluation of Site Meteorology & Atmospheric Diffusion Characteristic
2. Radiation Environment	2.1	Investigation of Ocean Characteristic near the Site
	2.2	Out Site Dose Calculation
	2.3	Investigation and Evaluation of Environmental Radiation and Radioactive Material on Nuclear Facility Circumstance

13. Radiation Protection	13.1	Radiation Shield Safety Evaluation
	13.2	Radiation Monitoring System
	13.3	Individual Dosimeter
	13.4	Optimization of Occupational Radiation Exposure Performance Procedure
	13.5	Internal Dose Assessment Program
	13.6	Airborne Monitoring & Safety Control
	13.7	Radiation Protection Education and Training
	13.8	High Level Radiation Area Control
	13.9	Radiation Safety Management Plan for Outage
	13.10	Source Term for Radiation Shield Evaluation



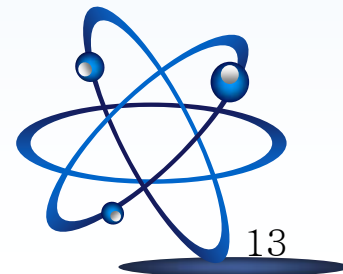
6. Major details of the reg. standards & the reg. guides of ALARA (1)

- Reg. Standards 13.11 "Radiation Protection Optimization" stipulates that the ALARA program shall be **documented**, and contain the following factors:
 - (1) **Objective** of radiation protection at the nuclear power plants
 - (2) Operation **policies and commitment** for ALARA of radiation exposure
 - (3) **Authorities and responsibilities** for the performance of ALARA
 - (4) **Organization and manpower** for managing the radiation protection
 - (5) **Procedures of performance** of the ALARA program
 - (6) **Assessment and feedback** of the ALARA program



6. Major details of the reg. standards & the reg. guides of ALARA (2)

- Dose constraints.
 - Radiation workers : less than 20 mSv
 - Allows for operation dose constraint specific to certain job.
 - General public upon the operation of NPP : 0.5 mSv
- The risk constraints for potential radiation exposure
 - 2×10^{-4} for the radiation workers
 - 10^{-5} for general public
- The alpha value (the dose-monetary coefficient)
 - 170,000 U.S. Dollars per man-Sv
 - To assess quantitative optimization.



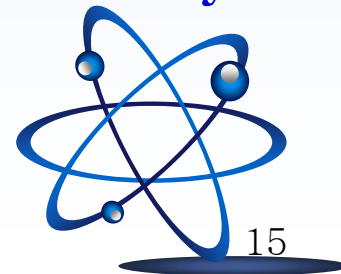
6. Major details of the reg. standards & the reg. guides of ALARA (3)

- Reg. Guide 3.4 "Radiation Protection Optimization"
 - The **ALARA committee** shall be installed as a permanent organization
 - The licensee operating multiple nuclear power plants emphasized **progressive activities of the headquarters** for aligning general protection policies
 - The goal of the collective dose to the radiation workers : **0.8 mSv per design power of Gwe**
- The detailed requirements for the ALARA design guide include
 - Reduction methods of radioactivity **source term**
 - Plant **positioning and shielding**
 - **Independent** design review organization
- **Expert organization** for radiation protection
 - Establish a system which documents experiences, consequences and particulars for major radiation work through ALARA review, and then reflects the documented data on subsequent operations or other plants.



7. Conclusions (1)

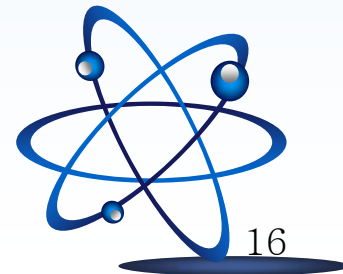
- Development of reg. standards and the reg. guides will
 - Enhances **communication** between the regulators and the licensees
 - Improves **transparency** of the regulation procedures
 - **Democratization** of the regulatory administration.
 - Useless **disputes** will be eliminated
 - Improve the **efficiency** and **public acceptability** of the regulations



7. Conclusions (2)

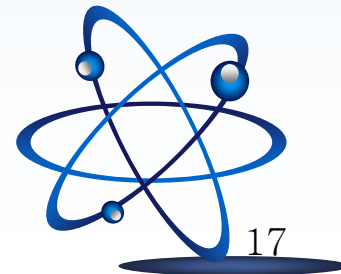
- Voluntary commitment of endeavors of the licensees and the operators

- The managers in the nuclear power industry
 - Shall create the work environments providing a self-confidence in the jobs
 - Shall be capable of explicitly describing the importance of ALARA to the managements.



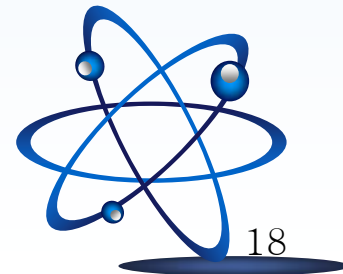
7. Conclusions (3)

- The regulators shall search for measures
 - providing a practical support to ALARA by continuously **communicating** with the managers, the workers and the engineers at the sites with an **open mind**.
 - to effectively **transfer the opinions** of the engineers and the radiation workers to the managers and the management, and shall keep the **trust intact** with the managers and the management.
- The regulatory authority shall operate measures and tools for effective **communication**.



7. Conclusions (4)

- ALARA is the most **important and essential** requirement in the radiation protection system.
- ALARA is a field **not easily achieved**, since it is **hard to quantify**.
- ALARA is a field where **virtues of harmony and moderation** are critically required.
- ALARA is a field that demands **engineering knowledge, technologies and methodologies** as well as **experiences, wisdom and creativity**.



Thank You

