

Past Experience and Future Plan in Korea

(Experience in Implementing ICRP Recommendations)

“First ICRP Symposium
on the International System of Radiological Protection”



26 October 2011

K. Cho, J. Lee and S. Han*

***Radiation Research Department**



Korea Institute of Nuclear Safety

Contents

I Review of Nuclear and Radiation Use in Korea

II Introduction of ICRP 103 and new IAEA-BSS



I. Review of Nuclear and Radiation Use in Korea

Brief History of Reactor Development

Nuclear Reactor Development Program

1970s

Introduction of Nuclear Power



Construction of Kori #1 ('71-'78)

1980s

Promotion of Localization



Establishment of Localization Plan ('84)

1990s

Technology Self-reliance



OPR1000 Development ('95)

2000s

Development of Advanced Reactor



APR1400 Development ('01)

2010s

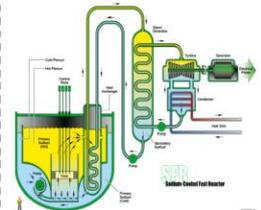
Improvement of Advanced Reactor



APR1400+ SMART

2020s

Development of Future Reactor



Gen IV Systems (SFR, VHTR etc.)

* OPR1000 (Optimized Power Reactor 1,000) is new name for the former KSNP

Status of Nuclear Power Plants



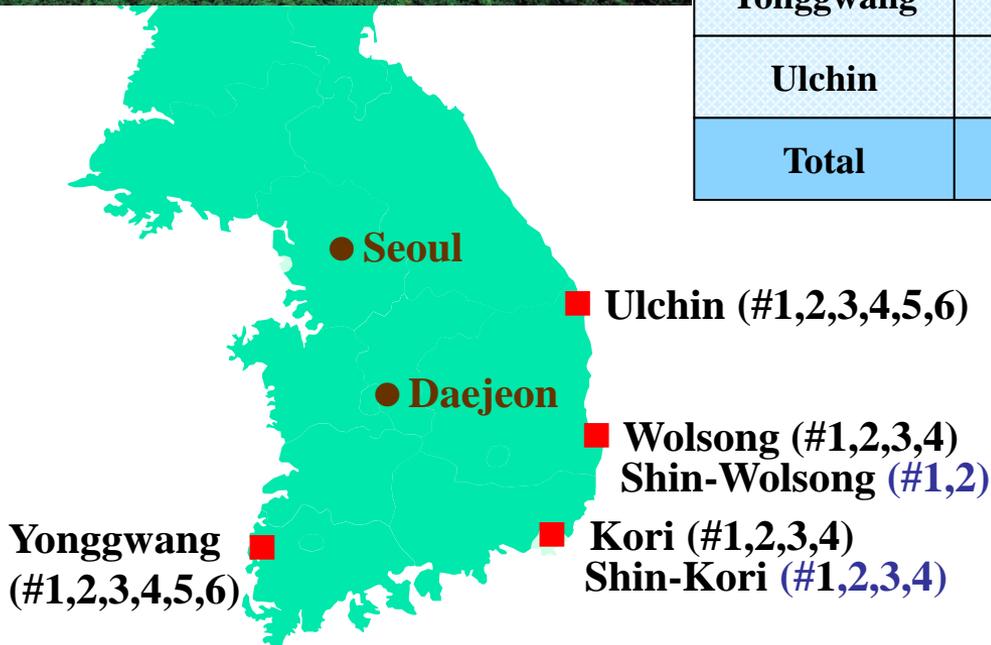
No. of Units (MW)

Site	In Operation	Under Const.	Total
Kori	4 (3,137)	3 (3,600)	8 (7,937)
Shin-Kori	1(1,200)		
Wolsong	4 (2,779)	2 (2,000)	6 (4,779)
Yonggwang	6 (5,900)	-	6 (5,900)
Ulchin	6 (5,900)	-	6 (5,900)
Total	21 (17,716)	5 (5,600)	21 (24,516)



Planned Projects

- Shin-Ulchin Units 1&2 (2,800MWe)
- Shin-Kori Units 5&6 (2,800MWe)
- Shin-Ulchin Units 3&4 (2,800MWe)



Other Nuclear Facilities and Activities

Fuel Cycle Facilities

- KNF: PWR & PHWR fuel fabrication facility
- KAERI: RR fuel fabrication facility, Spent fuel research & storage facility
 - ※ Uranium refining & conversion facilities at KAERI are under decommissioning

Reactor for Research and Education

- HANARO (at KAERI): 30MW research reactor
- AGN-201 (KH University): 10W reactor for education
 - ※ TRIGA Mark-II & III reactors in Seoul are under decommissioning

Other facilities and activities

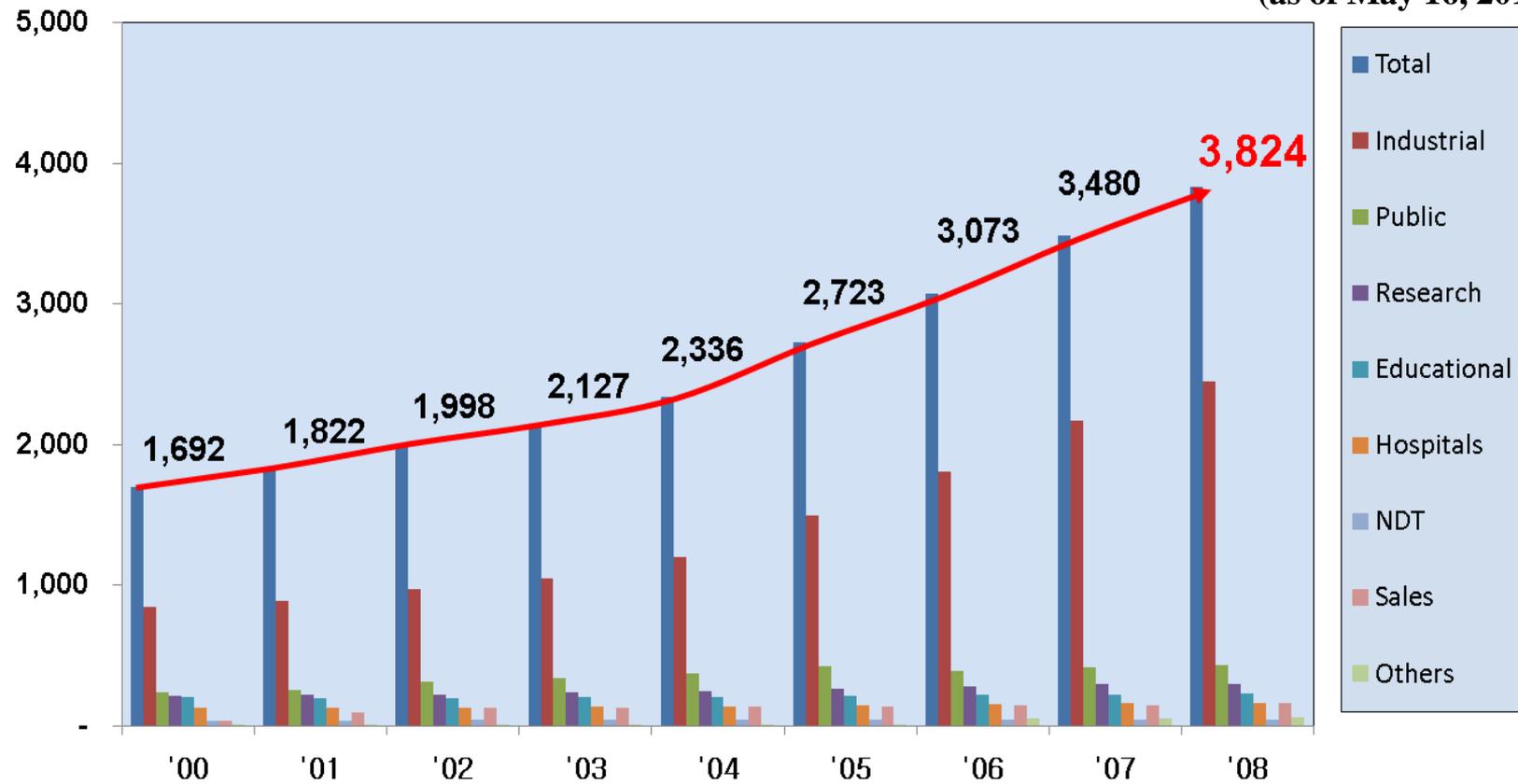
- Repository facility to dispose 100,000 drums(1st stage) under construction

Annual Trend of Radioisotope Uses

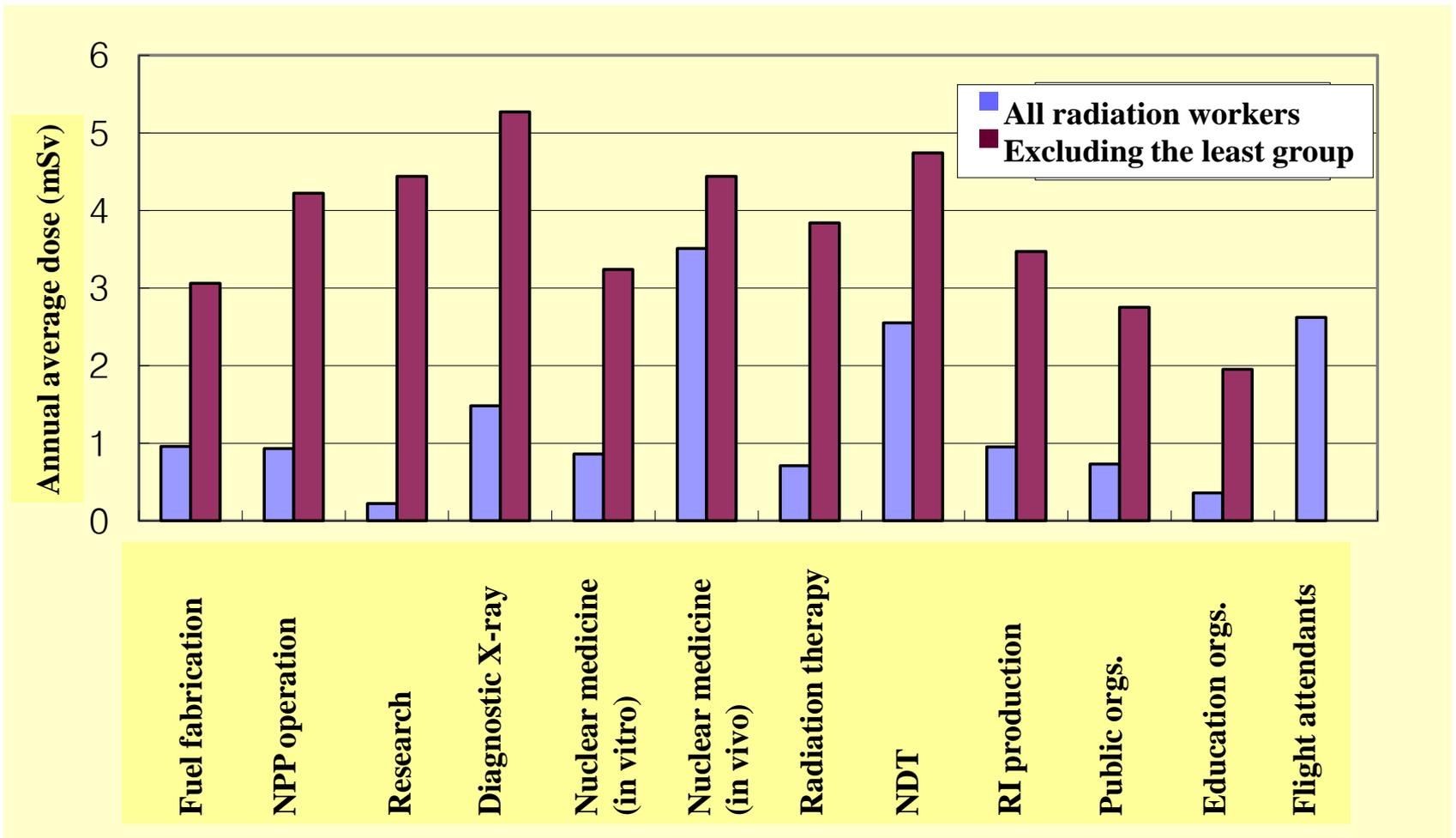
Registered Users : 3,124
Licensed Users : 1,177
Total Users : 4,301

(as of May 16, 2010)

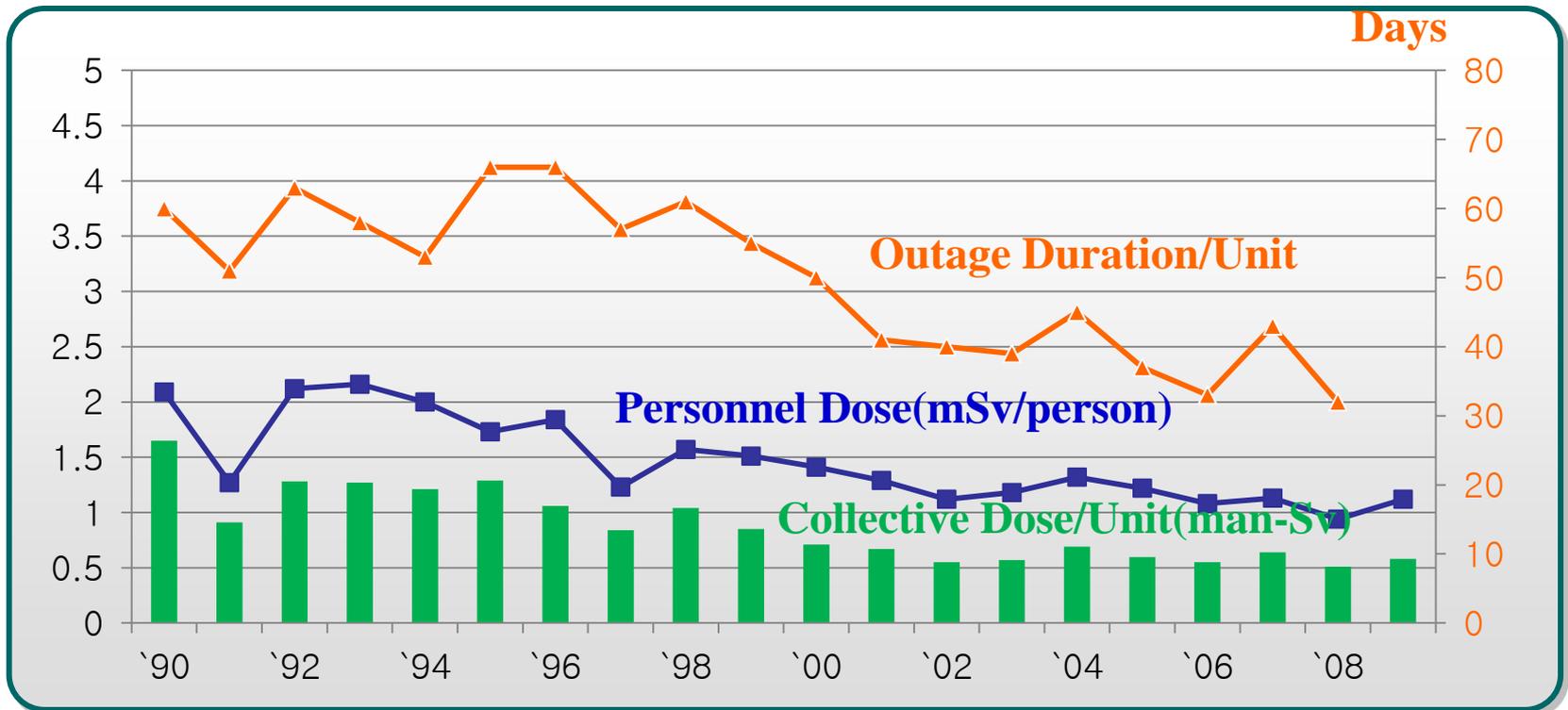
(EA)



Occupational Radiation Exposure in Korea



Occupational Dose in NPPs



Years	'90	'91	'92	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03	'04	'05	'06	'07	'08	'09.9
Collective Dose/Unit (man-Sv)	1.65	0.91	1.28	1.27	1.21	1.29	1.06	0.84	1.04	0.85	0.71	0.67	0.55	0.57	0.69	0.60	0.55	0.64	0.51	0.58
Personnel Dose (mSv/person)	2.09	1.27	2.12	2.16	2	1.73	1.84	1.23	1.57	1.51	1.41	1.29	1.12	1.18	1.32	1.22	1.08	1.13	0.94	1.12
Outage Duration/Unit (Days)	60	51	63	58	53	66	66	57	61	55	50	41	40	39	45	37	33	43	32	-



II. Introduction of ICRP 103 and new IAEA-BSS

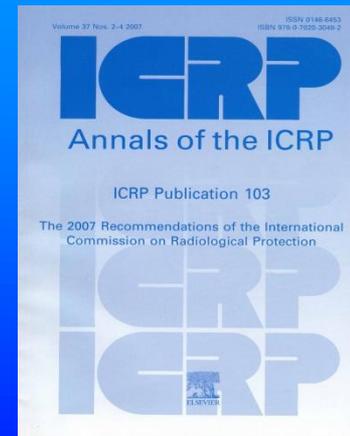
ICRP & its Recommendations

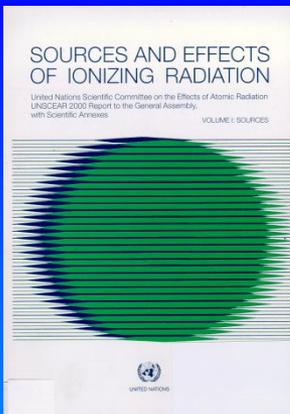
- ❖ Since 1991, **nearly 30 different numerical restrictions** on dose have appeared in a number of publications

coherent

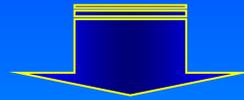
comprehensible

**ICRP Publication 103
2007 Recommendations**

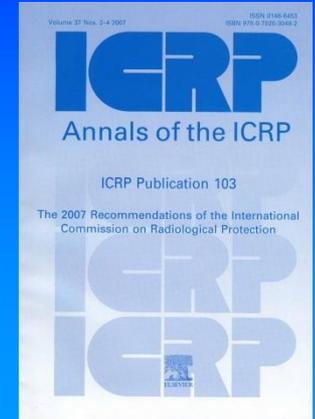




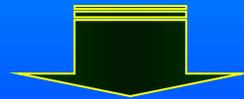
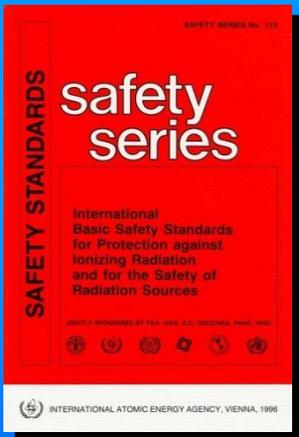
UNSCEAR, BEIR etc



ICRP 2007 Recommendations



IAEA Basic Safety Standards



National Legislations





Implementation Takes Time...

- **ICRP 1977 Recommendations (Publication 26)**
International standards 1984
National standards ~1989
- **ICRP 1990 Recommendations (Publication 60)**
International standards 1996
National standards ~2000
- **ICRP 2007 Recommendations (Publication 103)**
International standards 2011
National standards 2012

Previous Experience of ICRP Implementation

Publication of ICRP 60 (1990)



Mid-term (1992~1997) research to incorporate recommendations into the relevant national atomic energy laws and regulations by KINS



Draft of regulations (1997)



Minister's Notice on Radiation Dose (practical ICRP 60 implementation through step by step approach; 1998~2003)

Implementation Step of ICRP 60 in Korea

Year	Dose Limit
1998	Annual dose limit of 1 mSv for the general public
1998 ~ 2002	(1st step Implementation) Dose limit of 200 mSv for five consecutive years Annual dose limit of 50 mSv (radiation workers)
2003	(Full Implementation) Dose limit of 100 mSv for five consecutive years Annual dose limit of 50 mSv (radiation workers)

ICRP 60 dose limit was fully implemented in 2003.

Research Plan for the introduction of ICRP 103 & new BSS

Year	Detailed Research Plan
2007.3 - 2008.2	- Analysis of the ICRP 103 recommendations - Identification of requirements
2008.3 - 2009.2	- Comparative analysis of existing laws and ICRP 103 - Identification of troublesome on implementation
2009.3 - 2010.2	- Research on the solution of the troublesome - Issuance of the first draft of national laws
2010.3 - 2011.2	- Opinion hearing and analysis on the first draft - Feasibility study on the applicability of new requirements
2011.3 - 2012.2	- Issuance of the final draft new laws and regulations
2012-13	- Formal legislation process

Major contents of first draft of national laws for the introduction of ICRP 103 & new BSS



Set up of Dose Constraints and Reference Level



Change in the tissue and radiation weighting factor



Practical application of the exclusion and exemption principles



Active participation of the stakeholders



Change from process-based system to situation-based system

Who is responsible for setting dose constraints?

- **Regulatory body**
 - Shall require optimization with DC.
 - Shall establish or approve DC to **the representative person of the public.**
 - Approving the DC for good practice and preventing of total dose that exceed dose limits.
- **Registrants and licensees**
 - Ensure the process of optimization within a practice is subject to appropriate DC
 - **Establish occupational DC**
 - Make every efforts that the representative person dose not exceed the DC
- **Dose constraints are not dose limits.**
 - Dose constraints may be used as operational tools in the optimisation process, and exceeding them **may provoke actions**

Set up of Dose Constraints and Reference Level

- The conjunction of dose constraint and reference level for optimization of protection
 - As **criteria** on a level of individual dose
 - Desirable to emphasize **source related** dose constraint
- Necessity of the in-depth analysis
 - On the determination and incorporation of **quantitative guidelines of dose constraint and reference level**
 - Consideration of the **working environments**
 - Detailed classification of situations for strengthening of **the principle of optimization**

Set up of Dose Constraints and Reference Level

- **Non-Power sector** :Development of
New KINS Technical Standards
 - Initially focus on the high radiation risk facilities such as NDT and medical facilities
 - ICRP 101 : Representative person, Optimization

- **Nuclear Power sector** :
 - Review the possibility of the rationalization of the existing Minister's Notice No. 2008-31 "Standards for the Radiation Protection" Article 16 (Detriment protection for the environment)

Minister's Notice No. 2008-31

Article 16 (Detrimental protection for the environment)

1. Regulations to be applied to the **design** of the nuclear power plant

a. Annual dose limits at the exclusion area boundary by the gaseous effluents

1) Absorbed dose by gamma rays: 0.1 mGy

2) Absorbed dose by beta rays: 0.2 mGy

3) Deep dose : 0.05 mSv

4) Skin dose : 0.15 mSv

5) Organ dose by particulate, H-3, C-14 and radioactive iodine : 0.15 mSv

b. Annual dose limits at the exclusion area boundary by the liquid effluents

1) Effective dose: 0.03 mSv

2) Thyroid dose: 0.75 mSv

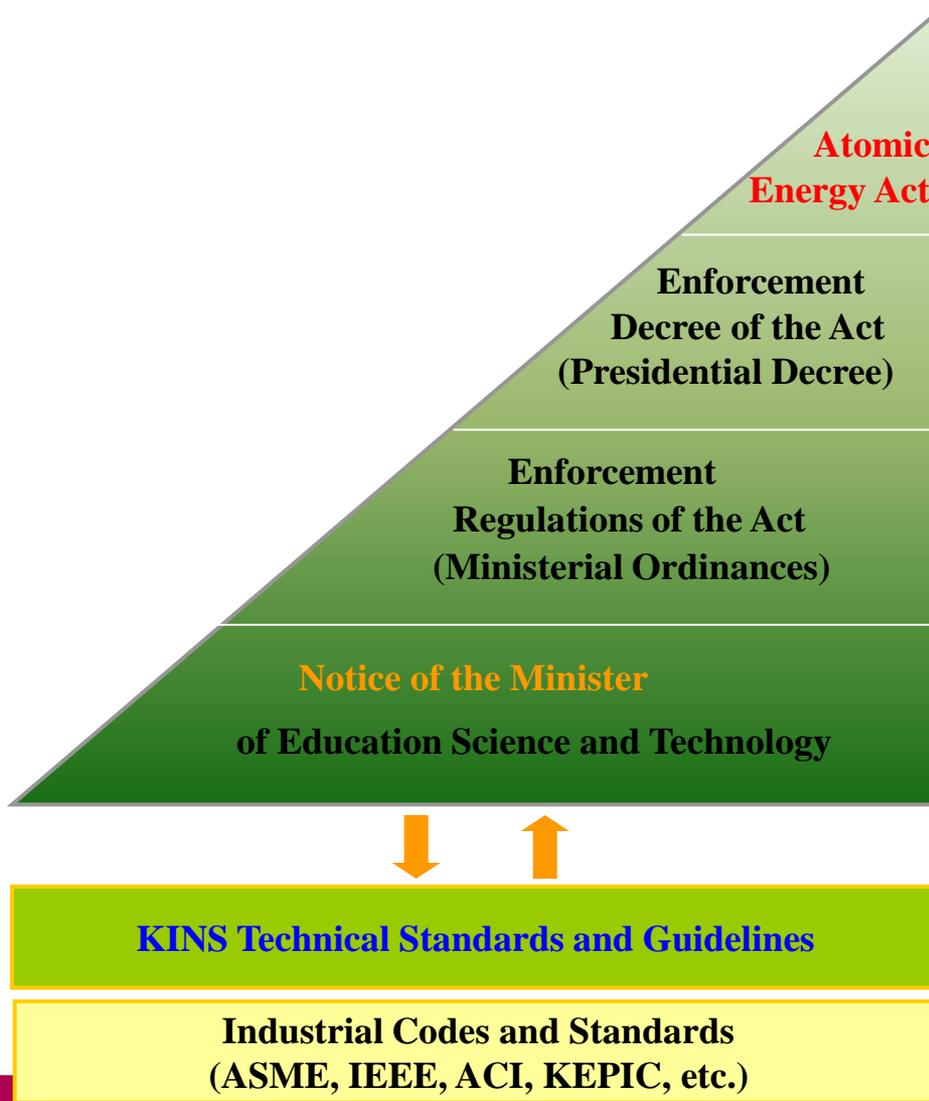
2. Regulation to be applied to the **operation** of many nuclear power plants within the same site boundary

a. Annual dose limits at the exclusion area boundary

1) Effective dose: 0.25 mSv

2) Thyroid dose: 0.75 mSv

National Legislation Framework of Korea



- The Act provides the bases and fundamental matters regarding the development and utilization of nuclear energy and safety regulations
- The Decree provides particulars entrusted by the Act and necessary for the enforcement of the Act
- The Regulation provides the technical standards and particulars entrusted by the Act and the Decree such as detailed procedures and format of documents
- The Notice provides detailed particulars for the technical standards and guidelines
- Detailed particulars of the technical standards and guidelines, which supports the implementation of the Minister's Notice and plays the bridge role between the Minister's Notice and Industrial Code and Standards
- Codes and Standards for materials, design, test, and inspection of components and equipment

Major contents of first draft of national laws for the introduction of ICRP 103 & new BSS



Set up of Dose Constraints and Reference Level



Change in the tissue and radiation weighting factors



Practical application of the exclusion and exemption principles



Active participation of the stakeholders



Change from process-based system to situation-based system

Change in the Weighting Factors

- **Development of revision of the existing Minister's Notice No. 2008-31 "Standards for the Radiation Protection" Tables 1 to 4**
- **Objective: To reflect the latest discovery of biological influences**
- **Expected effects: Recalculation of dose coefficients, Annual Limits on Intakes (ALI), Derived Air Concentration (DAC), Derived limits and Auxiliary limits including the criteria for liquid or gaseous effluents, and etc.**
- **Side effects:**
 - **Negative impact of confidence according to frequent changes of weighting factors**
 - **Confusion and difficulties in applying regulations**

Major contents of first draft of national laws for the introduction of ICRP 103 & new BSS



Set up of Dose Constraints and Reference Level



Change in the tissue and radiation weighting factor



Practical application of the exclusion and exemption principles



Active participation of the stakeholders



Change from process-based system to situation-based system

Application of the Exclusion & Exemption

- Distinction **Exclusion/ Exemption** : Not absolute
 - Regulatory authorities in different countries

↓

 - May take different decisions about whether to exempt or exclude a specific source or situation
-
- Further guidance in the foundation document
“Scope of Radiological Protection Regulations”
– ICRP 104 (2008)

Application of the Exclusion & Exemption

- **Development of revision of the following three existing Minister's Notices to incorporate the ICRP 104 and the contents of new IAEA BSS:**
 - **Minister's Notice No. 2008-31 "Standards for the Radiation Protection" : Article 9 and Table 5 for the exemption**
 - **Minister's Notice No. 2008-33 "Notice on the materials for the exclusion from the radioisotopes"**
 - **Minister's Notice No. 2008-35 "Notice on the use and capacity for the exclusion from the radiation generators"**

Major contents of first draft of national laws for the introduction of ICRP 103 & new BSS



Set up of Dose Constraints and Reference Level



Change in the tissue and radiation weighting factor



Practical application of the exclusion and exemption principles



Active participation of the stakeholders



Change from process-based system to situation-based system

Stakeholder Involvement

- **Active involvement of stakeholders**
 - **Active participation of the stakeholders will be emphasized in all the decision-making process**

- **Review of the possibility of the strengthening of the existing Article of the Atomic Energy Act:**
 - **Article 104-5 (Gathering of Resident's Opinion)**

Major contents of first draft of national laws for the introduction of ICRP 103 & new BSS



Set up of Dose Constraints and Reference Level



Change in the tissue and radiation weighting factor



Practical application of the exclusion and exemption principles



Active participation of the stakeholders



Change from process-based system to situation-based system

Emergency Exposure Situation

- **Review of the possibility of the revision of the Act on Physical Protection and Radiological Emergency, Enforcement Decree and Enforcement Regulation:**
 - **Regulations on the occupational exposure, emergency criteria and protective actions after the involvement of emergency response activities**
 - **Related contents of new IAEA BSS**

Existing Exposure Situation

- **Review of the possibility of the incorporation into the Natural Radiation Safety Management Act**
- **Requirements for commodities and radon**
- **Reference level for the living in residual contaminated area**
 - ➔ **New IAEA BSS**

Provisional Conclusion

- In general, **the impact** of the ICRP 103 and new IAEA BSS on our regulations **does not appear to be as significant** as the one that was resulted from the introduction of ICRP 60 recommendations.

Provisional Conclusion

- **Power reactors: 21 in operation & 5 under construction**
- **Research reactors: 1 in operation**
- **Radiation generators & radioactive sources are used at over 4,000 facilities**
- **Radwaste disposal facility will be constructed by Dec. 2012**



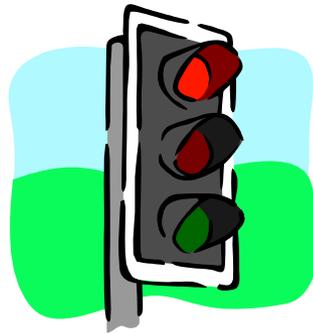
**The impact of the ICRP 103 & new IAEA BSS
will be significant**



**Deliberate review & analysis
on the ICRP 103 & new IAEA BSS should be continued**

Provisional Conclusion

- The consequent impact on regulations, mainly in relation to :
 - Selection of values for dose constraints and reference levels
 - Unify protection approaches for practices and intervention: Exposure situation-based system
 - New approximation to Emergency and Existing exposures: reconsideration of the radiation protection system for interventions laid down in current regulations
 - Practical application of the exclusion and exemption
 - Involvement of stakeholders and glossary



Thank you for your attention !