Development of Research Reactor Information System for Neighboring Countries

Gil Su Lee*, Gwan-Young Kim, Jin bok Choi, Sei-hyun Lee, Myung Jo Jhung
Korea Institute of Nuclear Safety, 19 Guseong-dong, Yuseong-gu, Daejeon
**canwin@kins.re.kr*

1. Introduction

As shown in the Fukushima nuclear power plant accident, nuclear accidents bring a direct impact on neighboring countries as well as the country concerned. Because many neighboring countries in northeast Asia have numerous nuclear plants and research reactor, each country needs more detailed information about them for analyzing the effect from nuclear accidents.

Therefore this study investigated research reactors information of Japan, China, Taiwan, and North Korea such as reactor details, weather and geography information, related company and institute's information. And then the web based database is established based on such information. So by connecting web pages, details of research reactors in northeast Asia can be easily obtained.

2. Organization of Research Reactor Information

The status of research reactors is classified as operational, temporary shutdown, under construction, planned, shutdown, decommissioned, and canceled. According to the classification, the status of research reactor in northeast Asia is shown in Table 1.

Table 1. Status of research reactor in northeast Asia

	Operati-onal	Shut d-own	Under Constructio-n	Plan n-ed	Decommi-ssioned
Japan	13	8	0	0	3
China	14	4	0	0	0
Taiwan	1	2	0	0	3
Russia	47	6	1	0	43
N. Korea	1	0	0	0	1

The geographical distribution of operational research reactors are shown in Fig. 1.

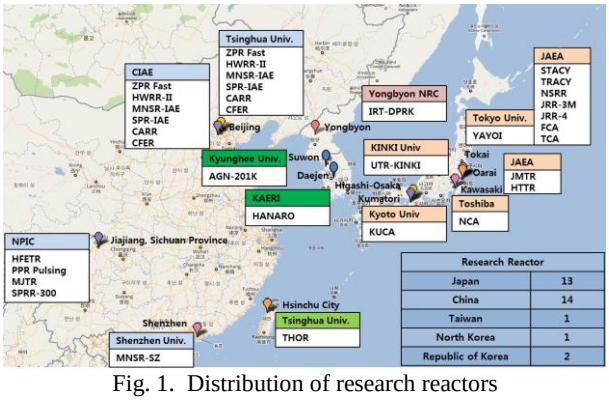

Fig. 1. Distribution of research reactors

In Japan, totally 13 research reactors are operating now. Among these research reactors, 3 critical assembly reactor type, 2 pool reactor type, and 2 tank reactor type reactors are being operated. The others are for specialized experimentation and research. Their capacity is distributed from 0.001kWe to 50,000kWe. Nine of them belong to JAEA (or JAERI) and the others belong to Kyoto Univ., Kinki Univ., Tokyo Univ., and Toshiba Co.

In the case of China, totally 14 research reactors are operating now. Reactor types of China's research reactor are critical fast, pool, tank, MNSR (Miniature Neutron Source Reactor), fast breeder, high temp gas, and so on. Their capacity is distributed from 0.05kWe to 125,000kWe. These reactors have been operated at CIAE, NPIC, Thinghua Univ., Shenzen Univ. [1].

In the case of Taiwan, a TRIGA (Training, Research, Isotopes, General Atomics) conversion reactor is operating now and its capacity is 2000kWe. A TRIGA reactor is a pool type reactor that can be installed without a containment building, and is designed for use by scientific institutions and universities for purposes such as education, private commercial research, non-destructive testing and isotope production [2]. It belongs to Tsinghua Univ.

In the case of Russia, most of research reactors are located in near Moskva. Their locations are far from Korea, so they are beyond the scope of this study [3].

In North Korea, a research reactor is located in Yongbyun. Its type is pool-type reactor and capacity is 8000kWe. It was provided from the Soviet Union in 1965.

Reactor types are characterized as follows: Pool type reactors, also called swimming pool reactors, are a type of nuclear reactor that has a core immersed in an open pool of water. The reactor core is situated in an open water pool. Most of research reactors are pool type. Tank type research reactors are similar to pool reactor, except that cooling is more active. Light water and heavy water can be existed at tank in pool designs that use heavy water moderation in a small tank situated in a larger light water pool for cooling. Other designs are moderated by heavy water or graphite. A few are fast reactors, which require no moderator and can use a mixture of uranium and plutonium as fuel. Homogenous type reactors have a core comprising a solution of uranium salts as a liquid, contained in a tank [4].

3. Research Reactor Information System

Through this study, detailed technical information is organized as well as the general information such as reactor status, weather and geographical information, reactor type, owners, capacity. Detailed technical data was summarized as in following example. The example of detailed technical information is shown in Table 2 [5].

Table 2. Example of detailed technical information

	Name	HWRR-II	HFETR
TECHICAL DATA	Max Flux SS, Thermal	2.40E+14(n/cm^2/s)	6.20E+14(n/cm^2/s)
	Max Flux SS, Fast	5.20E+12(n/cm^2/s)	1.70E+15(n/cm^2/s)
	Moderator	HEAVY WATER	LIGHT WATER
	Coolant	HEAVY WATER	LIGHT WATER
	Forced Cooling	600 M3/HR	YES
	Coolant Velocity in Core	3.7 M/S	10 M/S
	Reflector	D2O, GRAPHITE	BE
	Reflector Number of Sides	3	6
	Control Rods Material	CD	CD, IN, AG
	Control Rods number	14, FOR EARTH QUAKE	18
EXPERIMENTAL DATA	Horizontal Channels	7	
	Horizontal Max Flux	3.20E+09(n/cm^2-s)	
	Horizontal Use	NEUTRON SCATTERING	
	Vertical Channels	33	11
	Vertical Max Flux	2.40E+14(n/cm^2-s)	4.20E+14(n/cm^2-s)
	Reflector Irradiation Facilities (Channels)	5	4
	Loops Number	1	1
	Loops Max Flux	5.00E+13	2.90E+14
	Loops use	IRRADIATION TESTING OF FUEL	TESTING OF FUEL ASSEMBLY FOR PWR

And also through this study, the information of research reactors is organized and then it is possible to establish Web DB. Web pages contain geography data such as longitude and latitude, address of reactor, location of reactor at Google satellite map [6]. Weather information which are wind velocity, temperature, monthly rainfall average be marked on the Google map. These web page contains the general information such as contact point of research reactor and so on. And by connecting technical web page, specific technical information of research reactors can be obtained.

To get information of particular research reactor, first of all, select the country in a map and then point the particular reactor. Following these sequences can access of the research reactor information for neighboring countries. The web page example of research reactor information system is shown in Fig. 2.

Fig. 2. Web page of research reactor information system

4. Summary

In this study, DB system of research reactor at neighboring countries has been developed for the first stage of final goal which is to build the neighboring countries' nuclear accident evaluation system. In other words, by gathering general information, detailed information, weather and geographical information for research reactors currently in operation and then the DB system based on web is established.

Following the result of this study, when the nuclear accident is happened in neighboring countries by a severe natural disaster, it is possible to estimate the damage of disaster and minimize the damage. And also it is possible to prepare nuclear accident based on the DB system.

REFERENCES

[1] Liu Tiancai, "The Status of Research Reactor in CIAE" Symposium on The Technology of Peaceful Nuclear Energy in Jordan (2008)
[2] Wikipedia (http://en.wikipedia.org)
[3] Igor T. Tretiyakov, "Status of Research Reactors in Russia and Prospects for their Development", The 2nd International Symposium on Nuclear Energy (ISNE-09), Amman, Jordan, (2009)
[4] World Nuclear Association (WNA) (http://www.world-nuclear.org/info/reactors.html)
[5] IAEA Research reactor Database system (RRDB) (http://nucleus.iaea.org/RRDB/RR/ReactorSearch.aspx)
[6] Google satellite map (http://maps.google.com/)