

## Development of Commercial Reactor Information System for Neighboring Countries

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### 1. Introduction

The damage due to nuclear accident is not limited to one country which operates that nuclear power plant, the example of which is Chernobyl accident which has an effect on the whole Europe nations. The Fukushima accident due to extreme natural disasters such as severe earthquake and succeeding tsunami, which occurred on March 11, 2011, is another example.

Neighboring countries can be damaged by radioactive materials that are delivered by an ocean current or an air current from an accident plant. Nuclear safety cooperation with neighboring countries should be proceeding to protect a nation and to minimize a damage of a nation from a nuclear accident in other countries. Another important point is to know the information of nuclear power plants at neighboring countries. It will help an evaluation of the accident and a preparing action to be taken to minimize the damage due to the accident.

Therefore in this study, nuclear information of commercial nuclear power plants(NPPs) at neighboring countries is collected and the web-based system containing the information is established.

### 2. Information Structures

#### 2.1 Target Reactors

Korea is one of the advanced nuclear power countries in the world. Another advanced country in Northeast Asia is Japan. Also China is a developing nuclear power country in the world. Taiwan and Russia abut onto the Korean Peninsula. So the above four countries are chosen for target countries. There are 102 operating nuclear power plants in total at the above four countries [1]. Table 1 shows a status of a nuclear power plants at each country.

Table 1. Number of NPPs

Nation	Japan	China	Taiwan	Russia	North Korea	Total
Operation	50	14	6	32	0	102
Long shutdown	1	0	0	0	0	1
Construction	4	27	2	11	0	44
Planned	10	26	0	7	0	43
Permanent shutdown	9	0	0	5	0	14
Total	74	67	8	55	0	204

Figure 1 shows a distribution of operating commercial NPPs [2]. Excluding twenty-seven Russian nuclear power plants which are far from the Korea Peninsula, seventy-five operating commercial NPPs are selected for target reactors.

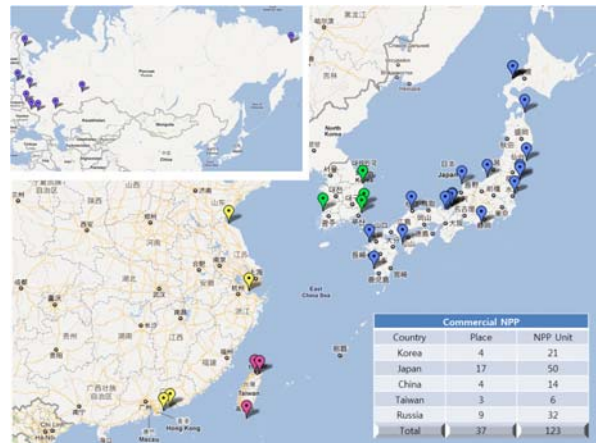


Fig. 1. Distribution of operating commercial NPPs

#### 2.2 Information Parameters

Many parameters are needed for analyzing nuclear power plant accidents and for preparing actions to be taken to minimize its effect.

First, the collected information is divided in three categories: general information, geographic information, and meteorological information.

General information contains a basic information of NPPs such as reactor type, containment vessel type, status, net capacity, date of construction start, date of first criticality, date of grid connection, date of commercial operation, longitude, latitude, address, contractor, operator, etc.. Also detailed information of NPPs such as reactor pressure vessel (shape, material, diameter, etc.), reactor core (fuel geometry, fuel material, fuel weight, average core power density, etc.), turbine (type, speed, etc.), main generator (active power, output frequency, etc.) is contained in general information.

To ascertain the site information, geographic information such as location, placement of units, photograph is collected.

Also meteorological information such as present weather (temperature, wind direction, wind speed, atmospheric pressure) is collected to give information for the evaluation of the accident

### 2.3 Information Collection Activity

The information is collected by literature research and webpage searching [3]. Some organizations such as IAEA, NEA have tried to keep up-to-date data about world's nuclear power plants [4, 5]. In addition to their data, more detailed data are collected which are necessary for safety analysis. Each NPP homepage is helpful for collecting information. And various online maps are used for viewing NPPs.

## 3. Information System

### 3.1 Country Profiles and Reactor Information

In Japan, there are twenty-six BWRs and twenty-four PWRs for operating NPP. Most of BWRs are located in eastern Japan and most of PWRs are located in western Japan. Five companies have provided nuclear power equipment such as steam generator. And nine electric power companies operate NPPs commercially, and one company is a producer and wholesaler of electricity from nuclear power in Japan. Table 2 shows a part of detailed information about Fukushima Daiichi unit 5.

Table 2. Example of NPP detailed information

NPP		Fukushima 1-5
General Information	Reactor Type	BWR (BWR4)
	Containment Vessel Type	Mark 1
	Net Capacity (MWe)	760
	Operator	TEPCO
Reactor Pressure Vessel	Reactor vessel shape	Cylindrical, Hemispherical End
	Reactor vessel centreline orientation	Vertical
	Reactor vessel material	Alloyed Steel
	Reactor vessel material specification	ASTA-A-533-B-CL-5
	Vessel cladding material	Stainless Steel
	Vessel cladding material specification	SS AND HIGH-NI-Steel
	Reactor vessel overall length/height [m]	21.9
Reactor Core	Fuel assembly geometry	Square
	Fuel Form	Pellets
	Fuel material	UO <sub>2</sub>
	Refuelling type	OFF-line
	Moderator material	H <sub>2</sub> O
	Fuel clad material	Zr Alloy
	Fuel clad material specification	Zr-2
	Average fuel enrichment [% of U235]	3.80
	Refuelling frequency [month]	13
	Part of the core refuelled [%]	24
	Average discharge burnup [MWd/t]	45000
	Active core diameter [m]	4.03

In China, there are fourteen operating nuclear power plant and locations of those NPP are shown in Figure 1. All NPPs are located in eastern China and southern

China. French, Russian and Canadian company supplied nuclear equipment such as reactor early stage of nuclear industry in China. Nowadays, China tries to achieve domestic manufacturing of nuclear power equipment and self-reliance of design and project management of nuclear power plants. Fourteen commercial reactors are operated by seven electric power companies.

In Taiwan, there are six operating NPPs : four BWRs located in northern Taiwan and two PWRs located in southern Taiwan. All plants are operated by Taiwan Power Company.

In Russia, thirty-two NPPs are operating. But most of them are located in western Russia. Only four NPPs are located in north-eastern Russia. And there are three NPP types : LWGR, PWR, FBR. Among them, NPP type of north-eastern Russia is LWGR.

### 3.2 Database System

The information collected will have more usefulness by developing a database system. As the database system is constructed on web base system, anyone can find information easily. And the database system shows real-time meteorological information at NPP sites by connecting a weather data of each country. Also various images of each NPP sites can be serviced to database system users by connecting an online map.

## 4. Summary

Nuclear information database system for neighboring countries is established on a web basis as a part of developing evaluation system of nuclear accident occurring in neighboring countries. This system includes the nuclear information such as general information, meteorological information, and geographical information of commercial reactors for neighboring countries to the Korean Peninsula.

When the nuclear accident due to natural disasters occurs at neighboring countries, the database system developed in this study will give the necessary information for the evaluation of the accident, the result of which will be used to prepare for the actions to be taken to minimize the damage by investigating its effect.

## REFERENCES

- [1] Korea Atomic Industrial Forum, <http://www.kaif.or.kr/>
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- [3] <http://en.wikipedia.org/>
- [4] Operating Experience with Nuclear Power Stations in Member States in 2010, IAEA, (2011).
- [5] OECD Nuclear Energy Agency, <http://www.oecd-nea.org/>