Transactions of the Korean Nuclear Society Spring Meeting
Jeju, Korea, May 12-13, 2016

Current Status of Yongbyon Nuclear Complex

Yongsoo HWANG
Korea Institute of Nuclear Non-proliferation and Control, 1534, Yu Sung Dae Ro, Yu Sung Gu, Daejon, Korea
**Corresponding author yhwang@kinac.re.kr*

1. Introduction

The DPRK has developed Yongbyon Nuclear Complex in Figure 1 since 1960's. Currently it is composed of the reactor facility, fuel fabrication facility including the enrichment center, and the radiochemistry center.

Even though many facilities are not modern and economic in the western standards, Yongbyon Nuclear Complex is fully equipped with the entire life cycle of the nuclear installation.

The key facilities have been added step by step. For example, the DPRK's nuclear reactor fleet started with the 2 MW IRT-2000 reactor in the middle of 80's. It started with a small scale radioactive isotope separation center nearby. But nowadays the DPRK is constructing a much more larger isotope separation center in the vicinity of its enrichment center along with a potential new UF6 conversion center.

2. Major Issues

2.1. Human Capacity

The ambitious and planned human capacity building programs for the nuclear energy and its application to the WMD program has started fro the end of 1950's. The DPRK concentrated to cultivate the top class nuclear physicists from Kimilsong University at the beginning followed by the education of nuclear engineering in Kimchaek University. At the time of the relatively large scale of the nuclear implementation, the special university in Yongbyon became the birth place of the new generation staff members. It has been believed that throughout this national educational system around 8,000 scientists, engineers, and technical staff members have been trained for the operation of Yongbyon Nuclear Complex. Among them 200-300 workers are the core group experts to develop the national programs for the nuclear weapon development.

2.2. Reactors

The DPRK introduced an IRT-2000 in the middle 1960's from the old Soviet Union. Even though after the collapse of the old Soviet Union, the DPRK experienced the difficulty to assure the sustainable supply of the HEU fuel, with the help of Argentina to modify an old IRT-2000, the DPRK upgraded the output from 2 to 8 MW and redesigned the reactor core to use 36 % enriched uranium for fuel. The original purpose of this research reactor was to produce medical radio-isotopes with the corresponding operation of the radio-isotope separation center.

A certain Western society media claimed that the IRT-2000 was not in operation for a long time. However, at this moment, it has been operated sporadically to produce the isotopes and possibly tritium for weapon application.

The 5 MWe reactor, a stereo type of a Magnox gas cooled reactor, resumed the current operation cycle at the end of August in 2013. Even though its cooling tower was destroyed by the DPRK it is now believed that it has an entire new cooling system with a new pump house supplying water from the nearby Guryong River. It is now believed that the same new pump house will supply the cooling water to a newly constructing 100 MW pilot PWR.

2.3. Fuel Fabrication Facility

The attention to the fabrication center was not serious until the DPRK guided Dr S Hecker to the new enrichment center. The original centrifuge capacity of the center at that time was 2,000 units equivalent to 8,000 SWU. The DPRK manufactured a rotor with maraging steel has much better separation capacity compared with the major Iranian centrifuges. After the doubling its capacity the DPRK reaches the 16,000 SWU capacity. In addition, many western analysts believe that the DPRK possesses a certain number of clandestine enrichment facilities in her territory. The other issue is where the DPRK operates the UF6 conversion centers and what are the capacity of each conversion center. As well discussed in the Iranian nuclear deal, the capacity of UF6 is a critical issue to judge the nation's capacity to produce HEU in a short time span.

2.4. Reprocessing Facility

The DPRK has developed the full capacity of PUREX reprocessing. The reprocessing building whose size is much bigger than that of the enrichment experienced the series of upgrade. One big upgrade was to introduce the mechanical de-cladding process instead of the old Eurochemic based chemical one. The other success is to additionally introduce a pulsed column instead of a mixer settler. The maximum annual capacity of the reprocessing plant would be 200 tones, which is big enough to reprocess all the spent nuclear fuel from the 5 MWe Magnox type reactor. Typically it took between 2 years and 2 and half years for the one cycle operation of the 5 MWe reactors which discharges several thousands fuel pins at the end of its operating

cycle. Since it has been around more than 2 and half years since the start of the current operation cycle of the 5 MWe, theoretically, the DPRK can stop the reactor operation and withdraw the spent fuel from the reactor. Then the fuel will be cooled more months and ready for the next round reprocessing campaign. The active attention is required to monitor the DPRK actions for the reprocessing in the 1st half of 2016.

2.5. Others

The DPRK is doing other activities in Yongbyong Complex. One of the major actions is to produce the fuel for the Magnox reactor and the IRT-2000 reactor. Also, it is believed to developed the test sample fresh fuel rods/assemblies of the upcoming pilot scale PWR. The test runs can be done in the Magnox reactor.

As discussed briefly already, the DPRK is producing the isotopes in Yongbyong. The biggest concern is to fully develop the technologies and facilities to produce a significant amount of tritium. Among four technical routes for the production of tritium, the DPRK is believed to focus on the Li-6 based technology even though it is not clear officially at this moment whether the DPRK achieved the full success story at this moment. In reality it is not easy at all to produce the tritium from a special heavy water reactor. But still there is a way to use a PWR to produce a limited amount of tritium. The DPRK is expected to continuously develop the technology to produce tritium for a booster and a real hydrogen bomb.

3. Conclusions

The general description over Yongbyon Nuclear Complex is given in this paper. More detailed context of the current status of the center will be discussed in the main symposium purely based on the open source information study.

ACKOWLEDGEMENT

This study is supported by the KINAC research program which is originally supported by the Nuclear Safety and Security Commission (NSSC), Republic of Korea. All the information in this paper comes from the open source literatures et al.

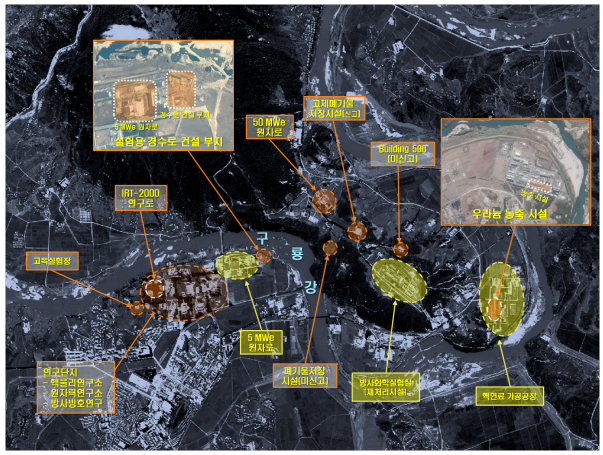

Figure 1. Overview of Yongbyon Nuclear Complex

Figure 2. Three-D View of the Nuclear Fuel Manufacturing Facility (The Enrichment Building Is Blue Colored in This Picture)

NOTICE

Figures 1 & 2 can be published in the form of the 2016 KNS Spring Conference Proceedings. However, it is not prohibited to copy the image of two figures without the prior written consent paper by KINAC for other purposes)