

Analysis of IAEA's findings on the DPRK Nuclear Activities (2016~2019)

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1. Introduction

Nuclear program of the DPRK has been crucial threat to international nuclear nonproliferation regime. Various organizations have analyzed the DPRK's nuclear activities, but it is difficult to confirm direct nuclear activities due to the inability to access actual location such as Yongbyon in the DPRK. As an international organization, the IAEA, also uses open source information to submit reports to the United Nations on the application of safeguards measures to DPRK every year. The purpose of this paper is to summarize and analyze the details of the DPRK's nuclear activities, which have been addressed in major reports in the last four years published by the IAEA.

2. Major Reports of IAEA on DPRK's Nuclear Activities

The IAEA adopts a report on "Application of Safeguards in the DPRK" by the Board of Governors before the General Conference every year, and reports it to the General Conference in September. In addition, a report on major activities for every year has been prepared and published as an Annual Report. The status of the DPRK's nuclear activities, especially 5MWe Reactor and Radiochemical Laboratory in each year described in each report is as follows.

2.1. Reports on Application of Safeguards in the DPRK

The IAEA has not been able to conduct all necessary safeguards activities provided for in the DPRK's NPT Safeguards Agreement since 1994. Any verification activities were not able to be implemented in the field but the IAEA has continued to monitor the DPRK's nuclear activities and to evaluate all safeguards relevant information including open source information such as satellite imagery. Activities on 5MWe Reactor and Radiochemical Laboratory in the reports were summarized as below table.[1][2][3][4]

Year	5 MWe Reactor
2016	There were indications consistent with the reactor's operation (steam discharges and the outflow of cooling water). Between mid-October and early December 2015 there were no such indications. (sufficient for the reactor to have been de-fuelled and subsequently re-fuelled)

2017	There were indications consistent with the reactor's operation (steam discharges and the outflow of cooling water). Based on past operational cycles, the current cycle could be expected to continue until late 2017.
2018	There have been indications consistent with the reactor's operation (steam discharges and the outflow of cooling water). Since December 2015, when the current operational cycle started, there have been indications consistent with several short periods of reactor shutdown. None of these periods were of sufficient duration for the complete reactor core to have been discharged.
2019	Until mid-August 2018, the Agency observed indications that were consistent with the operation of the reactor. From mid-August through late November 2018, there were indications that the reactor was not in continuous operation. Since early December 2018, there have been no indications of the reactor's operation. (the reactor has been shut down for a sufficient length of time for it to have been de-fuelled and subsequently refuelled)

Year	Radiochemical Laboratory
2016	From the first quarter of 2016, there were multiple indications consistent with the Radiochemical Laboratory's operation, including deliveries of chemical tanks and the operation of the associated steam plant. Such indications ceased in early July 2016. In previous reprocessing campaigns, the Radiochemical Laboratory's operation involved the use of the spent fuel discharged from the 5 MWe reactor.
2017	No observed indications of the Radiochemical Laboratory being in operation.
2018	Between late-April and early-May 2018, there were indications of the operation of the steam plant. The duration of the steam plant's operation was not sufficient to have supported the reprocessing of a complete core from the 5 MWe reactor.
2019	No observed indications of reprocessing activities at the Radiochemical Laboratory.

2.2. Annual Reports

The Annual Report consists of 1) Nuclear Technology, 2) Nuclear Safety and Security, 3) Nuclear Verification, and 4) Technology Cooperation. Of these, the verification of the DPRK's nuclear activities is described in the Nuclear Verification part. [5][6][7]

Year	5 MWe Reactor
2016	During 2016, the Agency continued to observe indications which were consistent with the operation of the 5 MWe reactor. This followed a period between mid-October and early December 2015 when there were no such indications. This period was sufficient for the reactor to have been de-fuelled and subsequently re-fuelled.
2017	During 2017, the Agency continued to observe indications that were consistent with the operation of the 5 MWe reactor which commenced the current operational cycle in early December 2015.
2018	The Agency observed indications that were consistent with the operation of the 5MWe reactor until mid-August 2018. From mid-August through November 2018 there were indications of intermittent reactor operation, and in December 2018 there were no indications of reactor operation. Starting in the first quarter of 2018, activities were observed near the Kuryong River, which may have been related to changes to the cooling system for the LWR under construction and/or the 5MWe reactor.

Year	Radiochemical Laboratory
2016	From the first quarter of 2016, there were multiple indications consistent with the Radiochemical Laboratory's operation, including deliveries of chemical tanks and the operation of the associated steam plant. Such indications ceased in early July 2016. In previous reprocessing campaigns, the Radiochemical Laboratory's operation involved the use of the spent fuel discharged from the 5 MWe.
2017	No observed indications of reprocessing operations at the Radiochemical Laboratory during 2017.
2018	Between late April and early May 2018, there were indications of the operation of the steam plant. The duration of the steam plant's operation was not sufficient to have supported the reprocessing of a complete core from the 5 MWe reactor.

3. Limitation of Information

The IAEA as the international organization has published the results of the analysis in the above two reports to the extent that it is formally identifiable. Because of these restrictions, the DPRK's nuclear activities analyzed in the IAEA reports are very limited and are not significantly different from those of existing other institutes such as 38North and ISIS. In addition, because there is a limit to the analysis of satellite images and other open source information, the IAEA always states with the analysis, "Without access, the organization cannot confirm any nature and purpose of activities."

4. Key Contents in Analysis of IAEA's Findings in recent years

Among the nuclear activities of recent years analyzed by the IAEA, the most notable is the activity in the radiochemical laboratory (reprocessing facility). According to the analysis of the IAEA, indicators of operation of the steam production facility in the radiochemical laboratory were identified from late April to early May 2018. It is analyzed that the operation of the steam production facility during this period is not sufficient to reprocess the entire core of the 5MWe reactor.

This operation needs to be noted in the following points. As North Korea's nuclear program is related to the production of plutonium as a nuclear material for nuclear weapons, the supply of weapons-grade uranium through uranium enrichment has been smoothly started since 2009 when it began to enrich uranium as claimed by North Korea. This means that the production of plutonium that can be operated and obtained for a period of time is less necessary, so it is possible that 5MWe reactor was used for the production of other material such as tritium through irradiation of target instead of the plutonium production. Is that there is It is possible that some of the spent fuel was reprocessed, and the remaining targets were processed at an isotope production facility that is presumed to have been newly built in a uranium enrichment facility south of the radiochemical laboratory.

3. Conclusion

Annual Reports is basically summarizing the reports of Application of Safeguards in the DPRK. This is the reason that both reports have no major differences. However, small differences between reports is caused by the period of reporting. Except minor changes as explained above, from the IAEA's reports, there is two check points can be analyzed.

First, the officer from the DPRK clarified its reprocessing campaign in 2016. [8] Base on the

previous general operation of 5MWe reactor in the DPRK, the best operation period for producing Pu for 5MWe reactor is about more than 2 years. But the IAEA said there were not sufficient operating time of steam plant of the Radiochemical Laboratory to processing a complete core in 2018(expected next reprocessing campaign since 2016). There is a question whether part of core had been reprocessed. That means that it could produce less Pu than previous campaign for something else.

Second is that there were steady construction activities in 2018 near Kuryong River which is related to cooling system of 5 MWe reactor and ELWR. At that time, the denuclearization dialogue had been restarted and the Two-Korea's Summit and the US-DPRK Summit were held. Basically its nuclear activities were not included in its moratorium of nuclear test and missile test. Complete construction and success of ELWR operating is very important point for its stance during negotiation of denuclearization. In this regard, it is likely to try to operate its ELWR successfully as soon as possible.

From the IAEA's report itself, it is not easy to get sufficient information and evidence of the DPRK's nuclear activities. But it is very official documents for the DPRK's nuclear activities. Continuous and steady study should be followed with other open source information for baseline assessment of the DPRK's nuclear program.

REFERENCES

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