

Status and Application of Spatial Information Technology as a Nuclear Verification Tool

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1. Introduction

The spatial information like satellite imagery and GIS data has been widely used for site development planning and monitoring in the area where the access is not allowed with any reason. The IAEA adopts this new method of analysis for enhancing its verification capability and is utilizing to search if there is any undeclared nuclear activities in the nuclear facilities worldwide. The ROK entered the group of the leading countries in the field of space technology with the successful launching of the KompSat I and II, and holds its high position in the IT technology which can draw useful analytic results from the satellite imagery. It implies that the ROK has some potential and related infra required for using the satellite imagery for the purpose of nuclear safeguards. However, we are in the very early stage to apply these advanced techniques to nuclear verification, because we don't have enough work forces enough to deal with these useful tools. It is necessary to review some previous examples about establishing satellite imagery analysis system like the IAEA. In this report, the IAEA's activities related verification using satellite imagery is reviewed and some examples on safeguards application is presented. A way to use satellite images for national inspection also is suggested.

2. Spatial Information as Verification Tool

2.1 Satellite imagery and the fuel cycle

Some specific features can be found in the nuclear power reactor sites, heavy water production facilities, or nuclear research complex, etc., and these will be analyzed by imagery analyst. It should be noted that each type of activity has its own characteristic, e.g., enrichment versus reactors versus reprocessing, so well trained analyst will be able to discern mostly the activities detected in the satellite images. The results also can be highly dependent on the scale of the activity, i.e. laboratory, pilot, demonstration, or mass production scale. Some types of fuel cycle technologies have unique elements that could be associated with a single type of activity. It implies that there are many opportunities for the use of satellite imagery for entirely different cases.

The satellite imagery can assist the analyst to make decision about whether the some doubtful activities reported by other information source is breaching the safeguards agreement signed by the member state. Practically, sole use of satellite imagery is not effective

to find clandestine nuclear activities, but it can be powerful when coupled with the other information sources. It should be also considered that the images of higher quality need to be used to get more accurate results.

Following activities can be identified using satellite imagery coupled with other available information:

- 1) Operation status of nuclear facilities where the location and type are already known
- 2) Uranium mining and milling operation
- 3) Acquisition of natural uranium by in situ leaching
- 4) Thorium extraction
- 5) Conversion activities
- 6) Identification of enrichment activities
- 7) Reprocessing plants in grand scale
- 8) Heavy water production

2.2 IAEA's Activities on Satellite Imagery Analysis

It is well known that the IAEA has been focused its efforts on strengthening verification capabilities since the launching the Additional Protocol. With that measure, the Agency acquired a right to access open information broadly, and started to equip the system for using satellite imagery on the nuclear verification. The SASGI recommended that the Agency obtain and utilize satellite imagery from commercial sources in 1994. The Department of the Safeguards developed a work plan, which comprises assessment of commercial satellite imagery availability, safeguards applicability, and legal issues, etc. According to the work plan, the Agency asked some member states to help it through MSSP to establish an independent analysis capability and required system.

In 2000, the Agency was able to set up a working unit, but with very limited functions. The SIAL(Satellite Imagery Analysis Laboratory) is now equipped fully with all the state of the art technologies, and has been successfully integrated into the Agency's safeguards system. Now the SIAL is doing its analysis task of which results can be referenced for the IAEA's state evaluation using more than 10 types of satellite imagery on around 400 nuclear facilities worldwide.

2.3 Application on National Inspection: Checking on Correctness of Report by Facilities

During the implementing the Agency's work plan, the possibility of contribution that satellite imagery would make to the evaluation of information supplied by the member states according to the Additional Protocol was evaluated. It was finally agreed that

satellite imagery could make a good contribution to the verification of the correctness and completeness of the information reported to the Agency by the member state.

For many of the reporting requirements, satellite imagery could be used by the Agency to verify the accuracy of the locations reported. In this regard, satellite imagery could further be used in planning site visits. The application of satellite imagery to detect changes over time at the reported facilities also falls into this category of applications. There are uses of satellite imagery in connection with an AP that offer the possibility of tangible cost savings by either reducing the number of visits or eliminating the necessity of a visit. These uses include the monitoring of remote and unmanned sites such as those containing high level wastes, and to verify the operational status of a reported site, such as a uranium mine.

Unlike the Agency's role that it should consider all types of facilities and all possibility of undeclared activities, the country SSAC has very limited duty about verification, mainly reporting. However, it ought to maintain the correctness and completeness of the report to Agency. Especially, some information like the facility site plot plan happens to be reported with incorrect data. As a national authority, the SSAC's role is needed to be interpreted more broadly. It has very well organized national control system and is doing national inspections by itself, contributing to enhancing nuclear transparency. The ROK has prepared all the infra required for satellite imagery application to any filed, with its own earth observation satellite and advanced image analysis technologies. In this regard, it would be expected that the ROK can provide more correct data for AP reporting to the Agency with its advanced spatial information techniques. This presents also another possibility for collaboration with the IAEA about the satellite technology.

3. Conclusions

The satellite imagery application can contribute to the effectiveness and the efficiency of the IAEA's Strengthened Safeguards System when coupled with other open information sources. Various types of nuclear activities can be detected using satellite imagery analysis technique. As a national authority for controlling nuclear activities in its territory, the SSAC has some potential to apply the spatial information to safeguards if it's equipped with necessary infra such as earth observation satellite and analysis techniques. It is required that the satellite imagery technology should be adopted in more area in nuclear safeguards.

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