



# Update of Key Activities at North Korea's Yongbyon Nuclear Site

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*Analysis of satellite imagery dated January 11, 2016 shows what appears to be the emission of steam from the 5MWe reactor's turbine building (see figure1). This is a signature of turbine activity which, in turn, indicates that the reactor is generating heat and thus operational, albeit periodically and at reduced power. The gas centrifuge plant at Yongbyon, including its expansion, is likely operational as well. The new reactor under construction requires new scrutiny as to its type.*

## 5 Megawatt-Electric (MWe) Reactor

Over the last several years, North Korea has engaged in retrofitting and upgrading its small five megawatt-electric (MWe) reactor, likely to make plutonium for nuclear weapons. A historical analysis of satellite imagery gathered between the end of 2014 and the end of 2015 suggests that since October 2014, the reactor has operated at low power or intermittently. ISIS also gathered other information indicating that the reactor has operated intermittently during this period. For example, it operated for a limited time, sometimes a few weeks, followed by a shutdown. The reasons for this type of operation are not known.

During the last year, the outflow of hot water from the almost one meter diameter pipe that discharges water into the nearby river has not been visible. In earlier images, the water outflow was visible in several satellite images. Assuming no other discharge point, and ISIS has not found any so far, the absence of this important signature suggests that the reactor has operated, but its power has likely been far below optimal.

Consistent with on-going intermittent operation, Airbus imagery dated January 11, 2016, acquired and analyzed by ISIS, shows what appears to be the emission of steam from the 5 MWe reactor's turbine building. This is a signature of turbine activity which, in turn, indicates that the reactor is operational, although possibly at low power. Additionally, a very large truck is visible at the entrance of the reactor.

The January 11, 2016 imagery does not show a steady stream of water being discharged from the reactor's discharge pipeline, the main sign of full-power operation. Therefore, it is not possible to assess that the reactor has resumed full power operation, as North Korea has claimed. However, the steam from the turbine building and the presence of vehicles and a large truck at the site are both important signatures indicating on-going activity.

It is, therefore, very likely that the reactor is still operating intermittently or at low power as of January 2016.

## **Experimental Light Water Reactor (LWR)**

No new activities have been observed at the experimental light water reactor (LWR). As figure 1 shows, light snow is present on both the dome of the reactor and on the roof adjacent to the reactor. This is likely an indication that the reactor is not operational, although nothing suggests that construction has stopped.

The delays in the reactor's operation, however, require further analysis. The reactor may no longer be a North Korean priority and have a significantly delayed start date. North Korea may have also encountered technical challenges or decided to redesign the reactor.

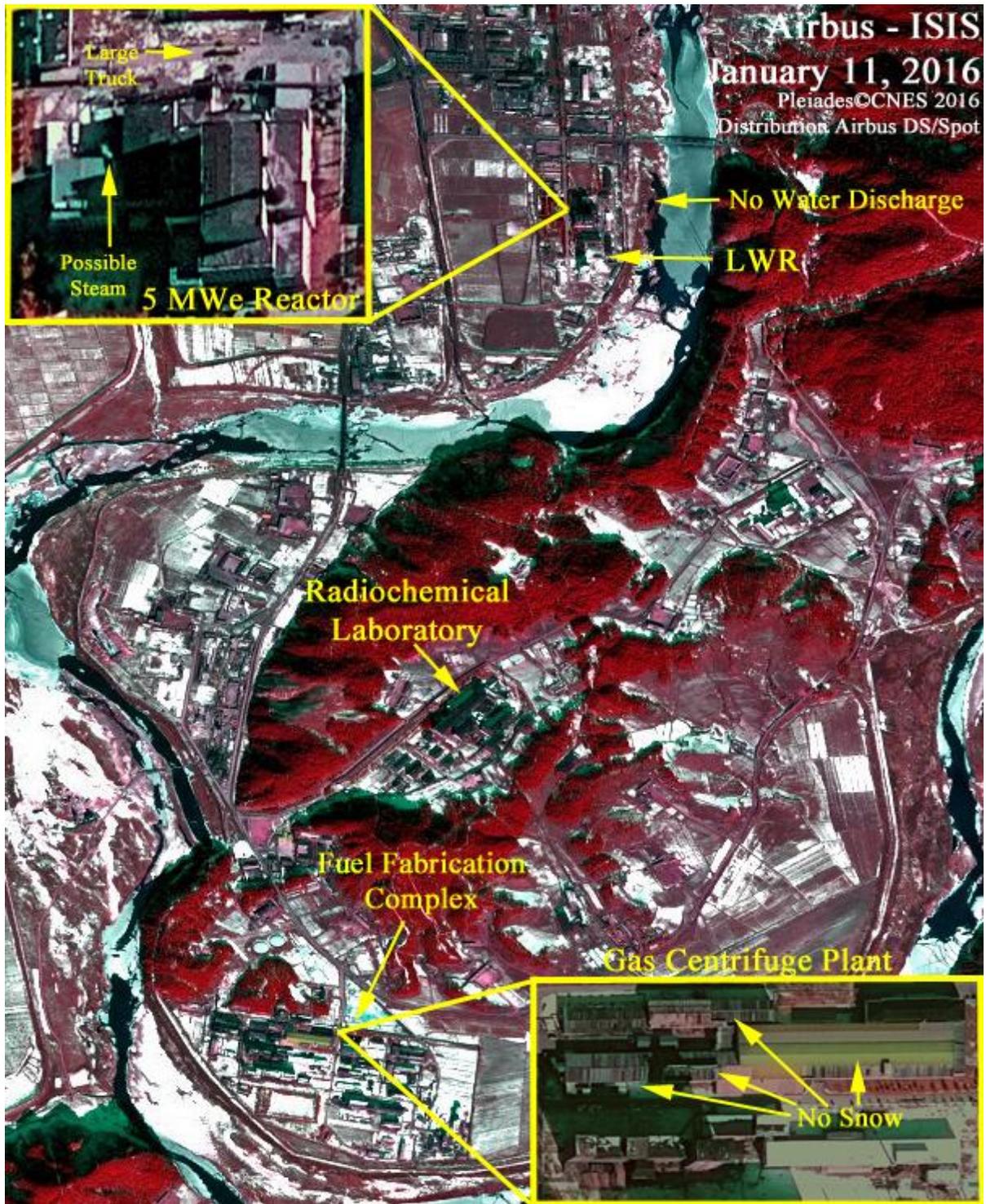
There are also growing indications that the reactor may not be a light water reactor modeled after the KEDO reactors that were being supplied by South Korea under the 1994 Agreed Framework. Publicly, many have shared this view ever since visitors to North Korea announced the construction of this reactor in 2010. This type of reactor has a thick, relatively small pressure vessel that is extremely challenging to make. However, as of 2010, the reactor was at its early stages of construction, thus the visitors were not able to see any direct evidence about the type of reactor.

The available evidence suggests a reactor with a larger core vessel than that typical of a KEDO-type LWR. Leading alternative candidates are a light water cooled, graphite moderated reactor, similar to Russian designs, or a large research reactor. Although ISIS is not in position to settle this issue at this time, it requires more scrutiny.

## **Enrichment and Reprocessing Plants**

No new external activities are visible at the Yongbyon gas centrifuge plant, which is located at the fuel fabrication complex in the southern part of the Yongbyon nuclear site. However, at least one signature suggests that the Yongbyon gas centrifuge plant is operational. The presence of snow allows for a comparison of the roofs of the complex. No snow is present on the roof of the main centrifuge building and the two buildings to its left (one of which has a new roof). The lack of snow on these roofs could be due to the combined effect of the sun and heat being emitted from inside the buildings. North Korea is likely heating the inside of the centrifuge hall in order to assure the correct functioning of the centrifuge machines. These machines are very delicate and require a stable temperature of about 23° C (75° F). Additionally, the centrifuge plant also emits heat from its autoclaves, which are used to heat the uranium hexafluoride in a cylinder into a gas prior to its entry into the cascades. The lack of snow on the roofs is consistent with the centrifuge plants being operational.

In the January 11 image, no new activity is observed at the Radiochemical Laboratory, or reprocessing plant. At some point, North Korea is expected to shut down the 5 MWe reactor, discharge the spent fuel, and chemically process it in the Radiochemical Laboratory to extract several kilograms of plutonium for nuclear weapons.



**Figure 1.** Airbus imagery showing North Korea's Yongbyon Nuclear Complex on January 11, 2016. This is a false color image in which healthy vegetation appears red.