Preliminary testing of North Korean ELWR likely under way

Operations testing may be under way at North Korea’s ELWR. Nick Hansen assesses the evidence and examines the implications for the direction of the country’s civilian and military nuclear programmes

Key Points
• Satellite imagery suggests that preliminary testing of North Korea’s experimental light water reactor (ELWR) at Yongbyon may have begun.
• Signatures of testing in late February follow logically from numerous indicators of increased activity at the ELWR that were visible throughout 2017, although reactor criticality is only likely to occur later in 2018 or in 2019.
• The ELWR was built and optimised for electricity production, but has ‘dual-use’ potential and can be modified to produce fissile material for nuclear weapons.

For the first time since North Korea’s experimental light water reactor (ELWR) was structurally completed, evidence of a testing programme at the reactor has been visible. An emission rising from the ELWR’s stack on 25 February 2018 – visible in DigitalGlobe imagery – implies testing of the machinery in the nuclear island (the ‘heart’ of a nuclear power plant).

On 3 January, Jane’s Intelligence Review reported findings from the Center for International Security and Cooperation at Stanford University (CISAC) after a year-long project to study activity at the Yongbyon Atomic Energy Research Centre, where the ELWR is housed. The CISAC study revealed that, throughout 2017, there had been notable activity around the ELWR, including its connection to the local power grids and completion of a complex river cooling water supply, needed to ready the reactor for pre-operations testing. The ELWR may continue with pre-operations testing for some time – a year or more – to confirm the safety and reliability of the reactor components and to perfect the reactor’s cooling system. Equally, it is also possible that the reactor may go critical with little to no warning in 2018.

In the latest development on 25 February, the emission from the ELWR’s stack is significant, as the stack is intended to vent non-condensable gases that are released and carried from the primary circuit, including any leakage of noble gases from the fuel elements in the core. Given that this is the first observation of such activity, it is likely that North Korea is testing the flow path for the non-condensables for future operation. Nevertheless, this is a significant first indicator of any type of activity (testing or otherwise) in the nuclear island, although this does not imply that the reactor is in operation.

Test activities

The 25 February 2018 DigitalGlobe image for the first time revealed a thin white effluent wafting above the tall stack on the northeast corner of the ELWR building. Because of the image geometry, the top of the stack was in the shadow of the building that fell on the edge of a concrete pad where it met a grass area. The effluent obscured this edge, and the opening at the top of the stack was also partially obscured by the effluent. The stack shadow falling on the edge of the roof of one of the
spent fuel buildings also showed a hint of this thin effluent, but most of the effluent shadow was obscured by the building.

Airbus imagery from 24 February and 1 March does not appear to show effluent on either date, possibly indicating that the 25 February test was a short-duration event. Such a test could have run for up to three days, given the lack of available imagery between 25 February and 1 March. Moreover, the melting snow on the dome and adjacent roof on 1 March was likely caused by the sun and not heat from inside the reactor building.

The most striking activity on the 1 March snow-covered imagery was the pedestrian and vehicle traffic between the ELWR personnel entrance and the off-loading yard across the street. This represents more activity than is normally visible at the ELWR. The horizontal crane in the off-loading yard was moved between the two dates, and a heavy mobile crane was also present in the yard. The transformers appeared the same on snow-covered images on 2 December 2017, 9 January 2018, and 3 February, and this was caused by their dark colour and shadows.
At the ELWR on 1 March, the snow has been shovelled or trampled down, and one vehicle was parked in front of the entry way. The one road that had not been cleared was the road and driveway into the north building entrance, where previous activity was observed by CISAC in 2017. This may indicate that the heavy equipment and/or fuel rods have already been moved into the reactor building.

Significantly, there appears to be no obvious hot water discharge into the river, which would indicate that the reactor is not running, and thermal imagery of the site from 25 February is inconclusive. According to the January CISAC study, three elements of activity were visible throughout 2017 to suggest that the ELWR – structurally complete by early 2013 yet inactive since – could soon be active.

From the local spring to autumn seasons in 2017 (around April to October), significant activity was continually observed adjacent to the reactor's fuel port of entry. A three-phase power line was emplaced outside the ELWR's power transfer substation by September 2017. Additionally, an extensive construction and dredging project was completed in late 2017 to restrict the course of the Kuryong River north of the ELWR and channel the river to supply cooling water into the ELWR's cooling intake cisterns. This project consisted of new river channels, a gate or weir, and a new sand dam that crosses the expanse of the river.

Although the Kuryong River had periods of flooding during the summer season that washed out three earlier dam projects for the ELWR's cooling water, the river freezes during the winter months and runs at a very low level during drought conditions in the summer. This severely limits the water flow required in the cooling system of the nearby 5 MWe (megawatt electric) reactor and the ELWR. Jane’s cannot assess with any certainty whether this new system of channels and dams will survive the summer floods.

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