Analysis of Russian Military Activity at the Zaporizhzhia Nuclear Power plant (ZNPP) During June & August 2025

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Contents

1 Introduction

McKenzie Intelligence Services were instructed by Shaun Burnie and Jan Vande Putte of Greenpeace Ukraine to conduct an imagery and all source analysis study of the Zaporizhzhia Nuclear Power Plant (ZNPP) located in southeastern Ukraine. Our analysis was to focus on activity in the vicinity of the nuclear plant and the associated cooling pond, located immediately to the west of the six reactor halls. Very high resolution imagery from the Airbus Pleiades Neo constellation was analysed and assessed during the compilation of this report. The aim of the study is to understand and highlight further militarisation of ZNPP and associated infrastructure.

Russian armed forces and Rosatom (the Russian state nuclear corporation) have occupied the ZNPP installation and surrounding area on the southern bank of the Dnipro River/Kakhovka reservoir since early March 2022, following the full-scale invasion of Ukraine on 24 February 2022 and violent assault on the plant in early March 2022. The reactors at ZNPP were shut down during 2022, with all of them offline by September 2022. Previous MIS analysis and reporting has identified an increased military and paramilitary presence at ZNPP since the initial occupation in March 2022.

2 Data and Methodology

The Airbus Pleaides Neo constellation consists of two platforms in a sun-synchronous orbit, collecting multispectral imagery in 7 bands of the electromagnetic spectrum at 30cm resolution. Three images from this constellation were acquired by Greenpeace for MIS to analyse dated 01 June 2025 and 15 October 2025. Analysis was conducted by our team of imagery analysts; all of which are former military intelligence analysts and are graduates of the UK MoD and NATO-recognised Imagery Analysis Course (UKIAC). This course includes in-depth study of industrial processes including power generation. The course also develops the analyst's expertise in military equipment and activity including maritime, land and air forces. The area of interest was studied in chronological order using all of the acquired imagery in order to develop a timeline of activity. Using our analysts' experience and understanding of military activity, all relevant activity was recorded and analysed to produce an assessment of activity on the ground. Where appropriate, imagery used for illustration purposes in this report is displayed in the natural aspect with a north arrow overlaid to orientate the reader. All measurements are approximate and are acquired using Geospatial Information Systems (GIS) mensuration features. All imagery unless stated is Copyright CNES 2025, Distribution AIRBUS DS. The probability yardstick language used in this study is explained below.

3 Executive Summary

- Enhancement and development of the military garrison at the Zaporizhzhia nuclear power plant continues.
- Russian forces at the installation are demonstrating an enhancement to the military posture at ZNPP with the addition of sangars at the plant and construction of further trenches and revetments around the cooling pond.
- Activity around the cooling pond includes felling of trees. Evidence of a large fire in some locations around the pond may indicate reckless activity or ill-discipline amongst the personnel deployed around the cooling pond.
- Water levels continue to drop within the cooling pond and associated canals. Work to mitigate the reduced volume appears to have taken place with the building of a dam in one of the canals to create a smaller source of cooling water.
- Small scale construction work appears to be ongoing at the plant.

4 Area and Installation Orientation

The Zaporizhzhia Nuclear Power Plant is located on the southern bank of the Dnipro River in southern Ukraine (Fig. 1), part of the industrial town of Enerhodar and close to the town of Vodyanoye. The plant is approximately 440km southeast of Kyiv and 160km north of the Crimean peninsula. The plant consists of six reactor and turbine halls which connect by way of pylons to an associated transformer yard which, prior to the invasion, was connected to ten transmission lines to the Ukrainian national grid. To the immediate west of the plant there is a large cooling pond and associated infrastructure, including spray modules and venturi cooling towers.

The plant is situated both within and outside of a secure, multi-layered perimeter. Within the perimeter are the reactor and turbine halls, an array of 12 spray ponds for cooling, likely auxiliary power generators and other essential industrial, operational and administrative facilities. External to the perimeter, a large cooling pond and network of canals have been constructed with the intention of providing the plant with water with which to cool the reactors. The transformer yard is also external to the secure perimeter.

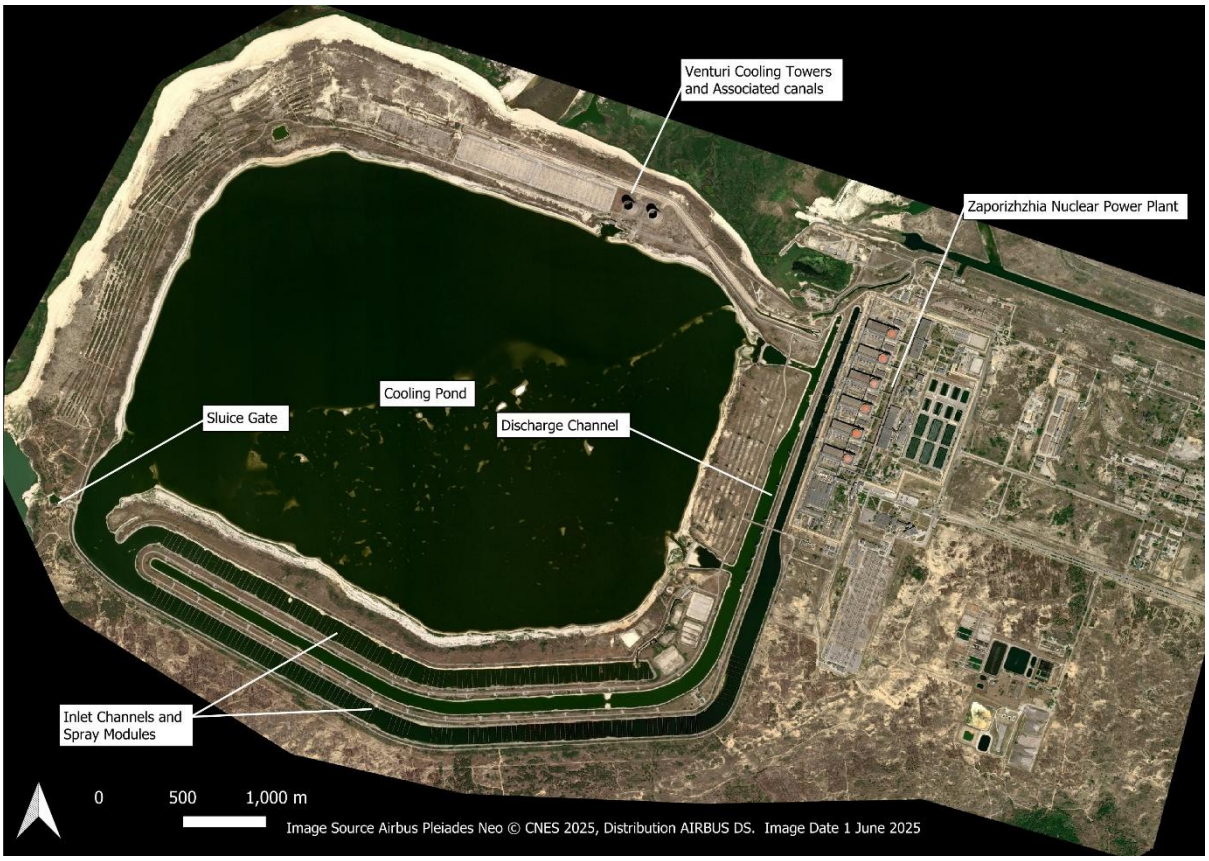

Fig.1 – ZNPP Installation Overview

The cooling pond to the west of the nuclear plant consists of two banks bordering the Kakhovka reservoir (currently dried up following the destruction of the dam further downstream) to the north and west; a bank which borders the ZNPP to the east and an inland bank to the south. The cooling pond consists of a large basin of water feeding three channels, two of which are equipped with spray modules. A sluice gate that could be opened to allow water to flow into the now dried up Kakhovka Reservoir is situated at the extreme west of the cooling pond. Along the northern bank there are two large spray ponds, separate to the basin and two venturi style cooling towers which feed a further channel integral to the northern bank.

5 Cooling Water Levels

A noticeable reduction in the volume of water contained in the cooling pond and channels was evident after reviewing both images. While it is not possible to calculate volume from the imagery, an analysis was conducted to determine the total surface area of the water in the pond, canals and closed cooling canal. The results of the analysis are listed at Table 1 below and illustrated at Fig.2.

Image Date	Cooling Pond and Channels	Discharge Channel
03 July 2022 (pre destruction of Kakhovka Dam)	9,599,617m^2	Not Measured
1 June 2025	8,767,820m^2	429,157m^2
12 August 2025	8,662,141m^2	365,360m^2
Reduction	105,679m^2	63,797m^2

Table 1 - Total Surface Area of Water In Cooling Pond & Channels

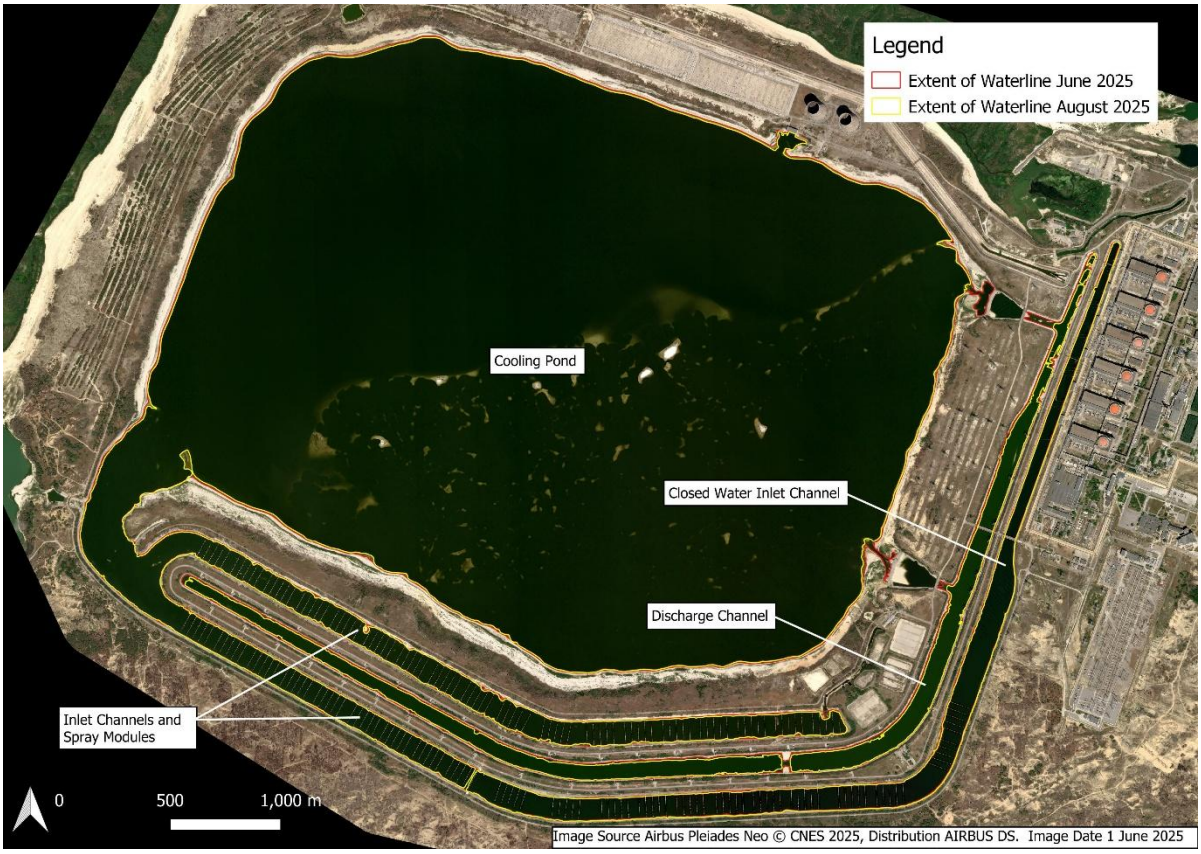

Fig.2 – Illustration of Receding Water Levels over Reporting Period

Within the intake channel and amongst the spray jet modules, construction of a small dam was identified, effectively creating a smaller closed channel Fig.3. The dam was not present in the June imagery although the start of work or preparations for the construction were observed. By 12 August, the dam was present and construction continued. By 15 October a further pontoon or boom had been positioned adjacent to the recently constructed dam (Fig.4). This object has the appearance of being inflatable suggesting it is floating on the water but attached to each bank on the plant side of the inlet channel. A series of cables or pipes are evident both on the pontoon/boom and on the recently constructed dam. The exact purpose of the boom/pontoon cannot be determined from the imagery. It is highly unlikely that it has been placed as a crossing for either vehicles or personnel; there are no approaches on the southern bank to suggest this is a crossing nor is it considered that the boom/pontoon would provide the support or stability for this purpose. There is no visible turbulence in the water on the boom side of the dam so it is unlikely that water was being pumped from the pond side to the plant of the dam at the time of image collection. There is a highly noticeable variation in the colour of water on either side of the dam with a light green hue visible on the pond side of the dam. This suggests a bloom of algae is present on the pond side of the dam. This algae bloom is also visible in the wider cooling pond and within the discharge channel. The plant side of the dam displays a darker return to the water.

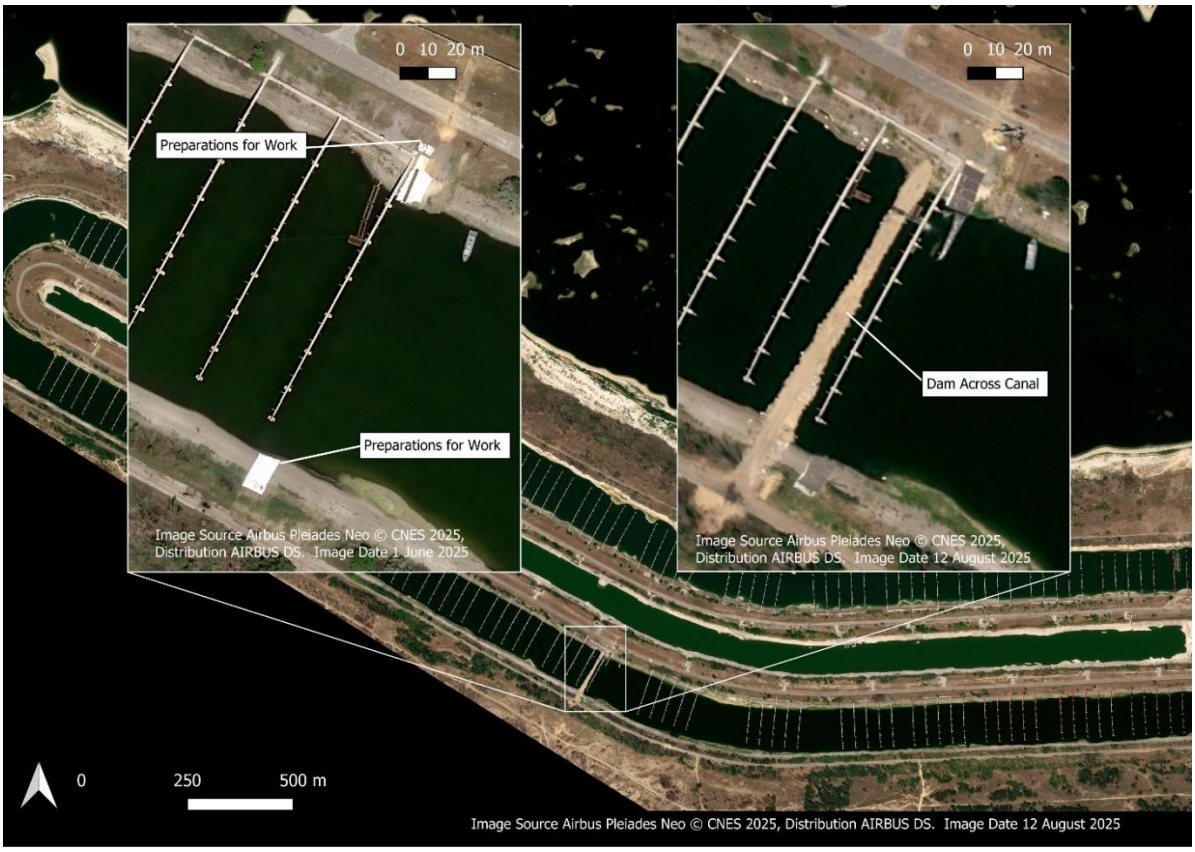

Fig.3 – Construction of Dam Within Intake Channel

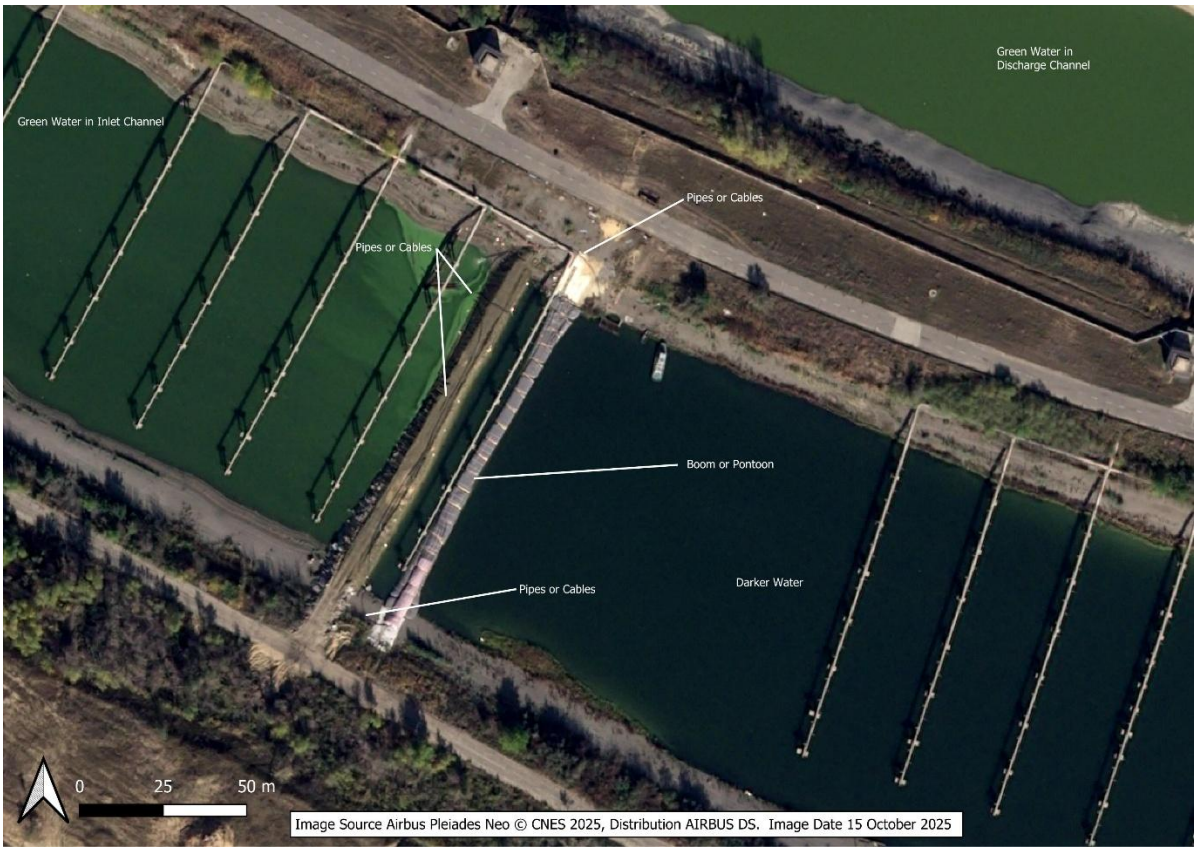

Fig.4 – Boom or Pontoon Within Inlet Channel

6 Observed Activity

Various areas of military and other significant activity were observed at ZNPP and on the banks around the cooling pond throughout the reporting period. For reporting purposes, these zones are broken down as follows and illustrated at Fig.5:

- Area of Sluice gate – Paragraph 6.1
- Western Bank – Paragraph 6.2
- Northwestern Bank – Paragraph 6.3
- Northern Bank – Paragraph 6.4
- Southeastern bank – Paragraph 6.5
- Southern Bank – Paragraph 6.6
- Nuclear Power Plant – Paragraph 6.7

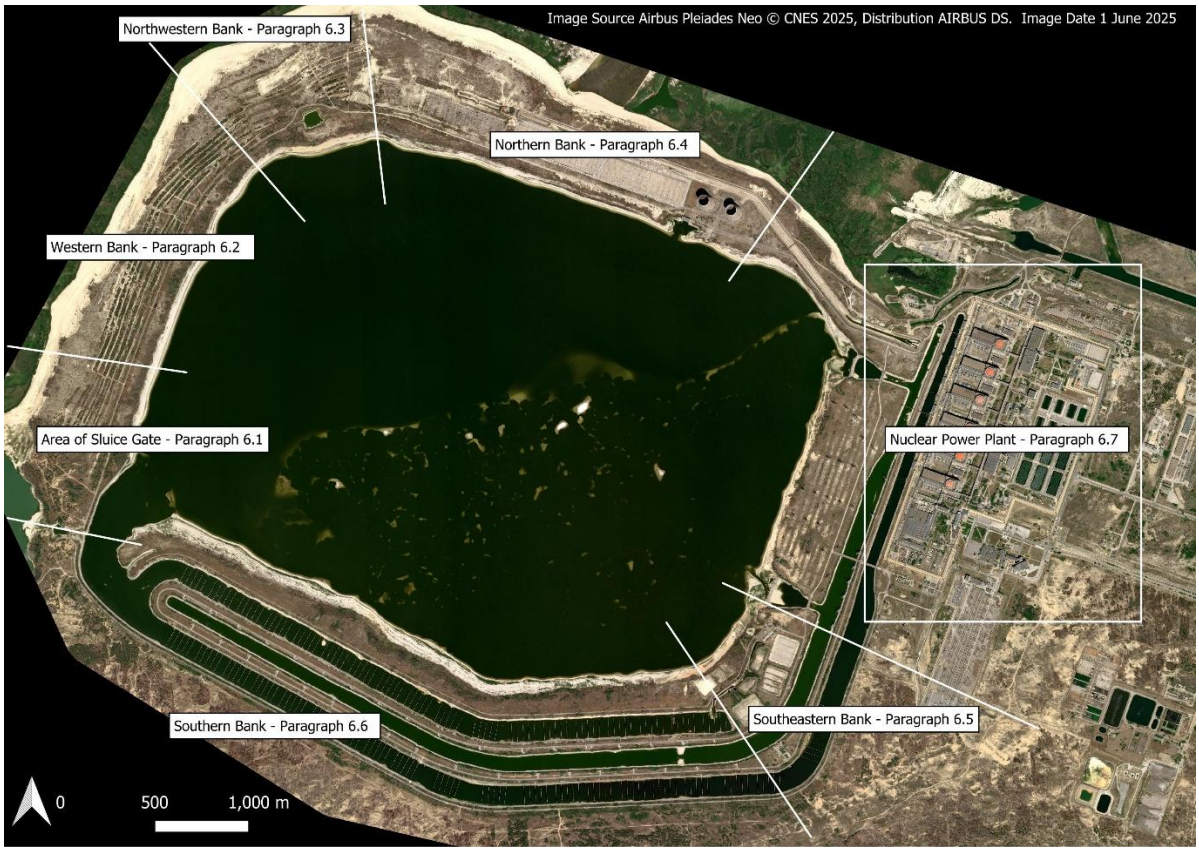

Fig.5 – Reporting Zones for ZNPP

6.1 Area of Sluice Gate

As with other areas around the cooling pond, there has been some clearing of vegetation and new trench construction and other digging (Fig.6). Pre-existing trenches have had some enhancement such as extending the overall extent of the trenches or adding overhead cover or protection. Other enhancements include the adding of a cleared and levelled strip of ground in front of the trench network. It is not clear what purpose this cleared and levelled strip serves; it does not follow any clear military logic or purpose. Vehicle tracks indicating

movement of vehicles was also evident in the area. At the northernmost point of this area, a new construction is underway. It is not clear what this construction is but appears to be dug in with some form of overhead cover, possible an observation post.

At some point between 01 June and 12 August 2025, a substantial fire has occurred, indicated by a large area of burnt vegetation. It cannot be determined what caused the fire or if it was started deliberately (Fig.7).

Analyst Comment: Open source reporting (ua-energy.org dated 21 July 2025 https://ua-energy.org/en/posts/21-07-2025) stated that a forest fire occurred nearby to ZNPP but that at no time was there any danger to the plant. **Comment Ends.**

Fig.6 – Enhancement to Trenches in Vicinity of Sluice Gate

Fig.7 – Area of Burnt Ground and Vegetation

6.2 Western Bank

The previously identified trench network, consisting of fighting and communication trenches, in this area of the cooling pond banks has undergone significant development (Fig.8). The fighting trenches have been extended to link the existing trenches together to form a single larger trench. The trench construction follows doctrinal norms in that they follow a zig-zag design; a widely used defensive design for trench warfare. Two cleared and levelled strips have been constructed to the front of the trenches. As with the previous area, the purpose of these strips is unclear. A vehicle track has been cleared to the immediate north of the position. Closer to the cooling pond in this area of the western bank, there are two positions of interest. The first is an unidentified structure, possible with overhead cover or protection or covered by camouflage netting (Cam Net). The second position is also unidentified and displays what could be a 'barrel' like object or some form of ridge under a Cam Net or similar. It is considered highly unlikely that this is a piece of military hardware.

Fig.8 – Enhancement to Trench Network on Western Bank

6.3 Northwestern Bank

The northwestern area of the cooling pond banks displays a considerable militarisation of the ground (Fig.9). Pre-existing trenches constructed since the Russian occupation remain and do not appear to have been increased. However, there are other changes which are significant. A series of small scrapes or berms have been dug in regular succession along the large open area. The appearance of these scrapes suggests they are prepared positions for armoured vehicles to drive into. The previously identified vehicle positioned on the large clearing is displaying signs of debris strewn around it and vehicle hatches removed or open. The dimensions and appearance of this vehicle indicate the destroyed chassis of a BTR variant vehicle.

To the rear of this area, closer to the cooling pond there have been some new positions constructed. A checkpoint consisting of a barrier and adjacent guard post or position is located on the road running parallel to the pond. Nearby there are a number of revetments dug amongst some trees which appear to contain crates or other objects suggesting a storage area, possibly for ammunition. Slightly forward of these revetments two areas of digging or scrapes were also evident amongst the trees.

Fig.9 – Military Positions on the Northwestern Bank

6.4 Northern Bank

The reporting period indicated continued militarisation and development in this area of the cooling pond. Developments were observed during both dates in June and August 2025 as detailed below:

01 June 2025 – The previously reported trench network in this area of the cooling pond had been and continued to be developed (Fig.10). New trenches and scrapes had been excavated and previously dug trenches had been extended. An area of construction was also underway adjacent to the new trenches. Shadow indicated significant depth to the construction and what appeared to be beams had been laid across the pit. The construction had been covered in soil in August suggesting some form of underground construction, by 15 October 2025, the construction had the appearance of a flat and solid structure or overhead cover suggesting a reinforced construction such as a bunker (Fig.11). This is similar in appearance to the structure identified previously near to the sluice gate on the western bank. Fresh digging was observed in other areas of the area. Piles of soil or spoil were being dumped along the rear of the cooling pond bank running parallel to the waterline. Previous MIS reporting on the activity at ZNPP highlighted the possibility of the construction of a pump house on the northern bank (MIS Update to the Analysis of the Russian Occupation in the Vicinity of the ZNPP Cooling Pond dated 5 December 2024 refers). Although there has been no further construction or excavation to suggest such a construction on 2025 imagery, there is nevertheless a concentration of Russian military activity including fortifications in this area of the cooling pond bank.

Analyst Comment: The reason for the construction of these 'bunkers' is unclear from imagery alone but it is of note that they have been placed at key locations around the cooling pond; by the sluice gate, on the western bank and on the northern bank. It is likely that they may represent a local command and control node over troops in that specific area. It does indicate the further militarisation of the area around the cooling pond. **Comment Ends.**

Fig. 10 – New Trenches and Construction in June 2025

Fig. 11 – Possible Reinforced Structures

12 August 2025 – Work in this area of the cooling pond continued into August 2025 (Fig.12). New trenches had been dug and there was more work to extend existing trenches. The construction observed in June had now been covered over with soil and does not appear to be part of a trench system. The exact purpose of this construction remains unclear but is likely to have an underground element. A small footpath had developed leading to the water's edge of the cooling pond. This footpath appears to have become evident through repeated use rather than being constructed and may indicate a regular and frequent collection of water or disposal of waste. There continued to be small scale digging of scrapes in the vicinity of existing trenches and scrapes. To the east of this area there was evidence of a small fire with burnt ground observed close to the venturi cooling towers. A small pool of water was also evident in the adjacent channel while the remainder of the channel remains dry, potentially as a result of firefighting activities after the fire in the immediate vicinity.

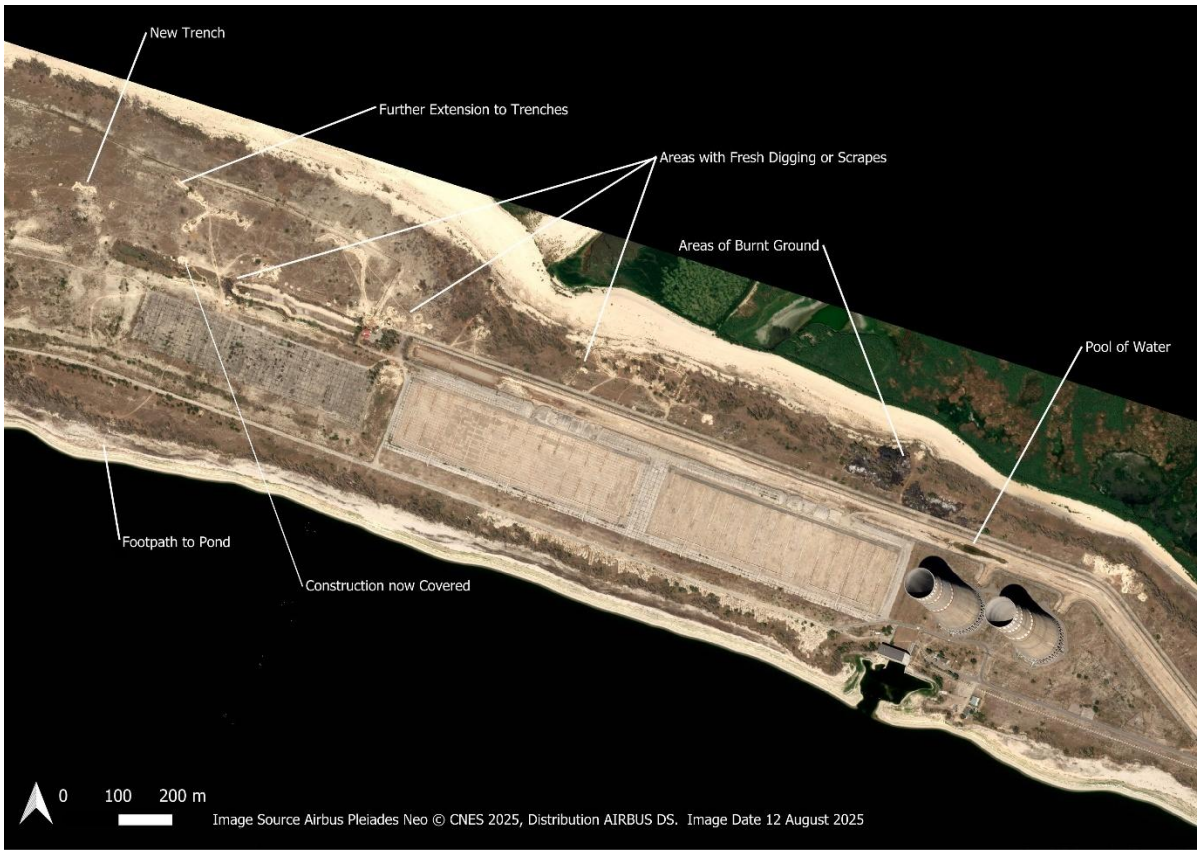

Fig. 12 – Area of the Northern Bank - August 2025

6.5 Southeastern Bank

A previously identified military checkpoint remained at the southeast area of the cooling pond and adjacent to the ZNPP associated transformer yard (Fig.13). The checkpoint consisted of a man-made chicane and was occupied by a BTR variant armoured personnel carrier and a utility truck. Two large graded or levelled areas of earth had been cleared in the immediate vicinity of the checkpoint. Also, two small revetments had been positioned either side of the road immediately to the north of the checkpoint. Further back and towards the transformer yard, an area of felled trees was evident. The checkpoint provides control of access to the area immediately south of the cooling pond.

Fig. 13 – Checkpoint to the Southeast Area of Cooling Pond

6.6 Southern Bank

There was limited activity observed along the southern bank of the cooling ponds and the southern side of the cooling water channels (Fig.14). Despite some vehicle tracks evident on the southern bank, there was no obvious military activity observed. There was evidence of tree felling in some areas of the bank although there was no obvious explanation for the tree felling. There were also large areas where the vegetation appeared to be dead. Given the time of year, it would be expected that the trees and vegetation should be in leaf and displaying dense foliage. However much of the vegetation was displaying a brown colour with very sparse foliage.

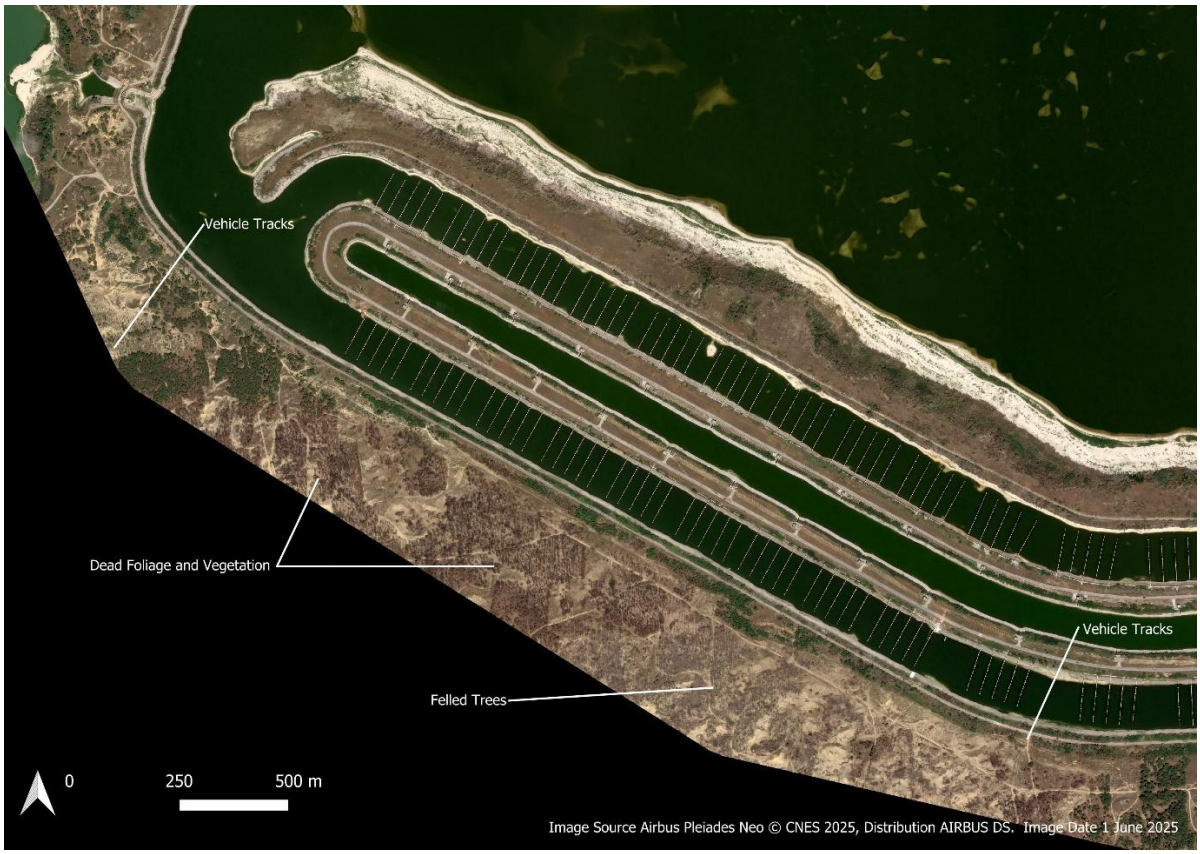

Fig. 14 – Dead Foliage and Felled Trees on Southern Bank

6.7 Nuclear Power Plant

Analysis of the Nuclear Power Plant confirmed continued garrisoning of the installation. Some significant enhancements of the garrison included the construction of sangars at several points around the perimeter (Fig.15). The sangars appear to have a steel cage placed over or around them suggesting drone or projectile protection. A similar sangar was also observed on the roof of one of the buildings in the plant. The roof of the reactor buildings also had structures built on them, potentially sangars or observation posts. These structures did not appear to have the steel cages to protect them. The imagery also confirmed the continued practice of parking vehicles, including military vehicles under the raised gantries around the plant. Only minimal parts of the vehicles were evident, preventing a positive identification of vehicle types.

Fig. 15 – Further Militarisation of the Nuclear Power Plant

At the rear of the reactor and turbine halls, there appeared to be some undetermined construction work ongoing. A new hardstanding had been built and there were some piles of sand or aggregate observed (Fig.16). The spent fuel storage area had undergone some changes (Fig.17). A wire mesh has been constructed over the dry cask containers of spent fuel, claimed by ROSATOM as protection against UAV. In addition, an internal wall or barrier had been constructed within the spent fuel compound.

Analyst Assessment: The construction of the wire mesh, building of sangars and other 'security' related constructions are likely to be part of the disinformation campaign designed to portray ZNPP as under threat from attack whereas it is almost certain that Ukraine will not conduct any operations against Russian Forces or the infrastructure at ZNPP which may compromise nuclear safety. **Assessment Ends**.

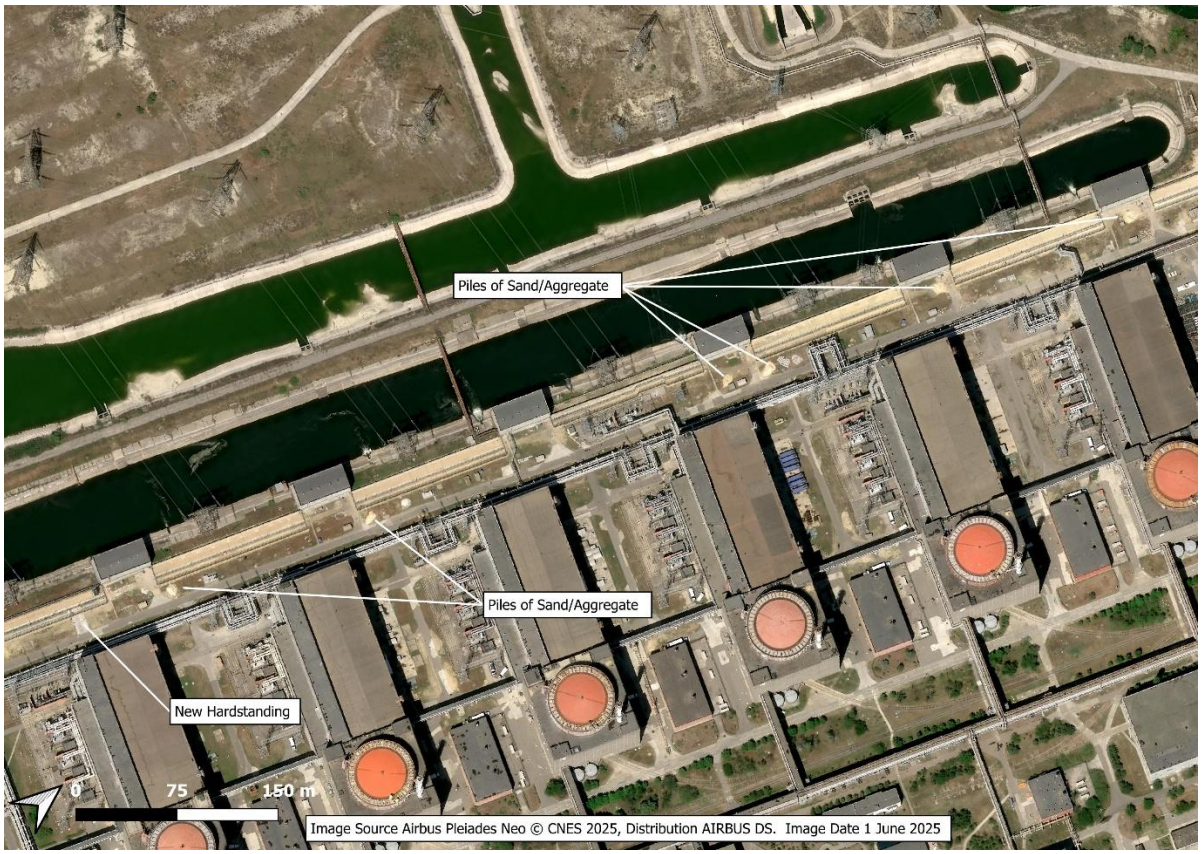

Fig. 16 – Evidence of Construction Work at Nuclear Power Plant

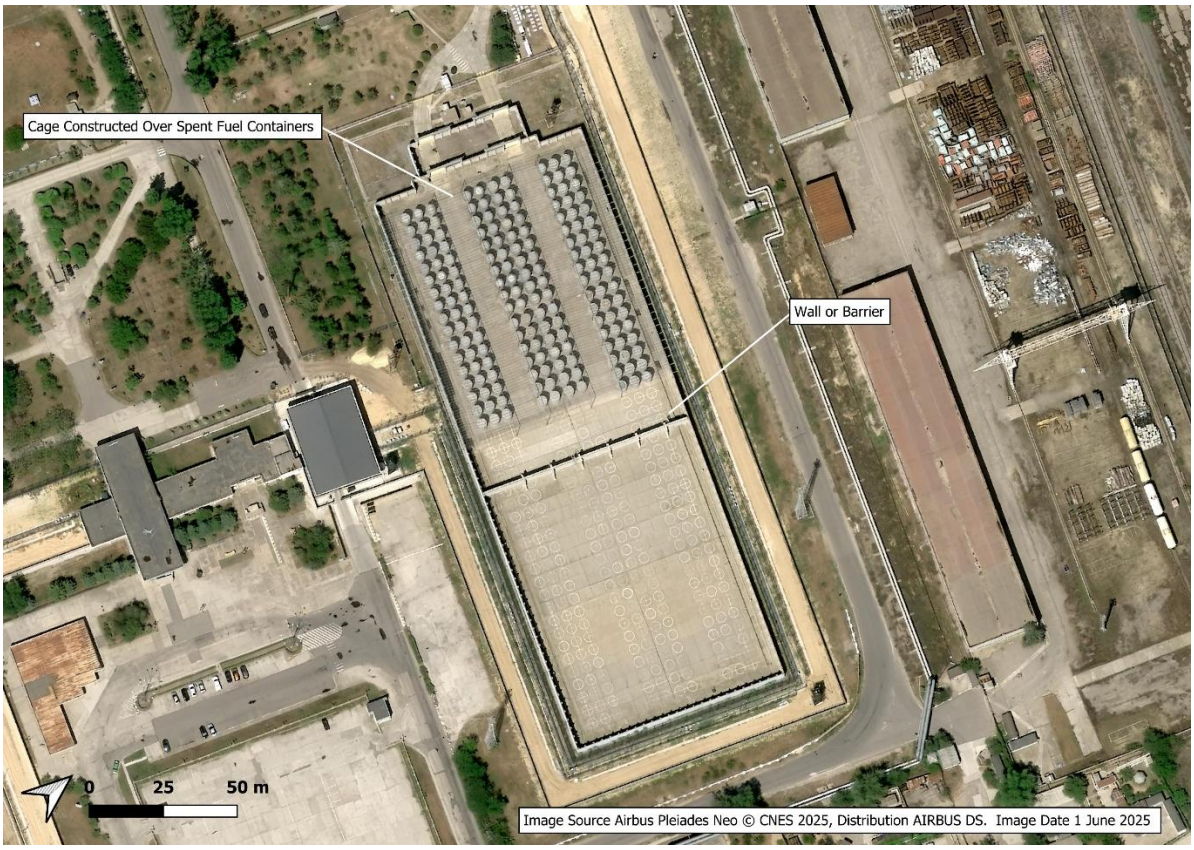

Fig. 17 – Spent Fuel Storage Area

7 Conclusions

Analysis of the imagery of ZNPP from 01 June and 15 October 2025 confirms the continued militarisation of the plant and associated infrastructure. This includes the introduction of sangars around the perimeter of the nuclear power plant at key points, change of direction of the perimeter and at intervals along the long walls. There has also been continued military associated activity around the cooling pond with the enhancement of existing trenches and the digging of more trench networks and revetments and the construction of more permanent, possibly hardened positions.

The introduction of the sangars around the nuclear power plant perimeter is a significant enhancement to the military posture at the installation. The sangars have an element of elevation and are protected by a steel mesh cage, usually associated with the protection against drone and projected warhead attack. These constructions are an aggressive measure commonly placed by military forces around their positions such as patrol bases and forward operating bases, particularly in environments with a high tempo of enemy activity. They are not a physical security barrier such as a fence or wall but are designed to position troops to observe the area external to the location and to have interlocking arcs of fire. In this instance, it is highly likely that the addition of these aggressive security structures is feeding the Russian narrative that ZNPP is under threat whereas in reality, no threat exists. Ukraine is almost certainly not going to conduct any operations that will compromise nuclear safety at ZNPP. Although it cannot be determined from imagery, it is highly likely that these positions will be manned by troops equipped with small arms and likely up to larger heavy machine guns.

The continued construction and enhancement or development of the trench networks around the cooling pond is further evidence of the garrisoning of the wider area and associated infrastructure of the entire installation. Evidence of grading or levelling of earth, building of revetments and storage of undetermined crates suggests the consolidation of the positions and preparations for positioning of vehicles alongside troop positions, highly likely the armoured vehicles known to be present at the installation, such as the BTR variant armoured vehicles. This is an enhancement to the military posture displayed at the plant and is disproportionate to any threat to the installation, perceived or real. It is highly likely that there will be continued development to the military garrison around the cooling pond.

The garrisoning of the cooling pond area has also likely led to second order issues beyond the digging in and construction of revetments. The large fire which took place on the western bank and in a small area of the northern bank suggests an incident occurred during the reporting period. There does not appear to be any reason to burn the vegetation in the area, although there has been a programme of tree felling in other areas. Possible scenarios include a deliberate fire that got out of control or an unintentional fire caused by reckless activity or accident.

The installing of a wire mesh cage over the dry cask spent fuel storage compound is likely a measure to protect against drone strikes. Russia has previously claimed that the plant has been subjected to drone attack, providing evidence of small airframes and minor damage to plant infrastructure. Previous MIS reporting (Analysis of alleged unmanned aerial vehicle attacks against ZNPP dated 12 April 2024) challenged the Russian narrative in this respect, highlighting the lack of any benefit to the Ukrainians in attacking the plant. It was assessed that the likely scenario was a false flag operation on behalf of the Russians to discredit

Ukraine's approach to nuclear safety. The placing of the cage over the spent fuel is possibly an extension of that intention.

While it is clear that there is some small-scale construction work ongoing at the plant, it could not be determined from imagery what the construction work entailed or its purpose.

Water levels within the cooling pond and associated channels have continued to drop since previous analysis conducted by MIS (Analysis of the Russian Occupation in the Vicinity of the ZNPP Cooling Pond dated July 2024). The construction of a dam within the southern area intake channel in effect has created a smaller cooling pond cut off from the larger pond. It is likely that water levels in this smaller pond can be managed more effectively and kept to a sufficient level by pumping water from the larger pond to manage cooling of the reactors. The discharge channel is displaying very low water levels; pooling of water and exposed channel floor is evident at the northern end of this channel.