

Fears for all Ukraine's nuclear plants after emergency shutdowns



A Russian serviceman guards the Zaporizhzhia nuclear power station earlier this year. Photograph: AP

Russian attacks cut off essential power to the stations last week, forcing all four of them into high-risk mitigation procedures

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There are growing fears that Russia's relentless targeting of Ukraine's electricity grid will threaten the safety of the country's nuclear power plants, in the wake of an unprecedented emergency shutdown on Wednesday.

Petro Kotin, the president of Ukraine's nuclear power company, Energoatom, said that all safety mechanisms had worked as intended on Wednesday, but two generators were damaged in the process, delaying the restart of two reactors. Kotin said repeated shutdowns caused by more Russian missile attacks could cause extensive damage, with a potentially severe impact on Ukraine's power supply and possibly on nuclear safety.

Russia kept up its onslaught on Ukrainian cities on Saturday with an attack on a residential area in the city of Dnipro which injured six people and destroyed seven houses, according to the governor of the Dnipropetrovsk region, Valentyn Reznichenko.

The Ministry of Defence in the UK said Russia had resorted to removing the nuclear warheads from cruise missiles and launching them with just ballast in their nosecones, with the aim of diverting Ukraine's air defences and doing some damage just from the sheer force of their impact on targets. "Whatever Russia's intent, this improvisation highlights the level of depletion in Russia's stock of long-range missiles," the ministry said in one of its daily assessments of the invasion. Ukrainian intelligence believes Russia could carry out another mass missile attack on infrastructure in the middle of this week.

The Zaporizhzhia nuclear plant, Europe's largest, was seized by Russian forces in March and it has been off the grid since September, amid frequent shelling of the area around it.

Ukraine's three other nuclear power plants – Rivne, South Ukraine and Khmelnytskyi – have not been directly targeted in recent Russian missile strikes, but their safety could be threatened by further attacks on the Ukrainian power grid.

Missile attacks last Wednesday on high voltage cables, transformers and substations triggered the first ever simultaneous emergency shutdown, or "scram", of all four plants.

"The complete and simultaneous loss of off-site power for Ukraine's nuclear power plants shows that the situation for nuclear safety and security in the country is becoming increasingly precarious, challenging and potentially dangerous," Rafael Mariano Grossi, the director general of the International Atomic **Energy** Agency (IAEA), said in a statement.

Kotin said: "In all the 40 years of operation of the Ukrainian nuclear industry, nothing like that has ever happened." He emphasised that the plants were designed with multiple levels of protection against the kind of disastrous meltdown and explosion at Chernobyl in 1986.

When the power grid failed under Wednesday's attack, the reactors immediately scrambled to isolate themselves and diesel-powered generators started working to power the water circulation through cooling pools where spent fuel is kept.

However, repeated attacks leading to more emergency shutdowns would impose enormous strain on all the components of the plants, from the core to the steam turbines to the generators, as result of rapid contraction and then expansion again when a plant is restarted.

Kotin likened the process to driving a car at 200 km/h and then coming to an emergency stop. "You have all kinds of consequences, like your valves will warp – and there are a huge amount of valves between the reactor and the turbine," he said. Ultimately, he added, the damage could have an impact on nuclear safety.

Oleh Korikov, Ukraine's chief inspector for nuclear safety, said each time there was an emergency shutdown, the risks multiplied. "Any use of the scram system may cause an accident," Korikov told the *Observer*. "With this shutting-down process, it increases the probability of some malfunction of equipment or some mistake by personnel."

The diesel generators can keep the cooling and other safety systems going, but they do not produce enough power to restart a power plant. After an entire electric power system has shut down, that process is called a "black start" and it gets progressively harder the longer the shutdown lasts.

A complicating factor is that the shutdown of a nuclear reactor produces an isotope of xenon in the fuel rods that absorbs neutrons, slowing down fission and adding to the difficulty in booting it back up.

The stopping and restarting all requires substantial skill on the part of the plants' Ukrainian staff, and the pressure on them is considerable, particularly the workers at the Zaporizhzhia plant, who are operating under armed Russian surveillance.

In early October, Moscow declared the plant was part of Russian territory and therefore was under the supervision of Rosatom, the Russian nuclear power

company. Staff at the plant have been put under pressure to sign documents acknowledging they were working for a Rosatom subsidiary.



Petro Kotin: 'In all the 40 years of operation of the Ukrainian nuclear industry, nothing like that has ever happened.' Photograph: Reuters

“Some people signed it but not many,” Kotin told the *Observer*. “There was a huge push from the beginning but right now it has stopped. The occupiers just stopped all the rhetoric they used before, like ‘this is Russia for ever under Rosatom’.”

Some observers see this change in attitude as a sign that the Russian occupiers of the plant may be intending to withdraw. Kotin added that a second sign they may be making contingency plans to leave was systematic looting. “They are starting to steal everything they can see, and they have packed their bags to get out from there,” he said, while emphasising there was no clarity over the Russians’ intentions.

A former Zaporizhzhia worker who has been in contact with current employees said they had seen no signs of Russian departure. On the contrary, they said, soldiers at the plant were making preparations for a long winter, moving their sleeping quarters to the canteen.

Grossi has been trying for months to negotiate the creation of a “safety and security protection zone” around the nuclear plant where shelling would be prohibited, but Ukraine is insisting that such a zone should be completely demilitarised.



Guardian graphic. Source: the Institute for the Study of War with AEI's Critical Threats Project

“It is illegal for heavy weaponry to be within a civilian nuclear object. They actually use it like a military base for the protection of their heavy weaponry, which they have put in the turbine halls of units [reactors] one and two,” Kotin said. “This is a completely awful situation for fire safety. If there is a fire emergency, then you can’t mitigate it, because you just cannot get access – because all the free space in the turbine halls is packed with all these vehicles.”

He said it was unclear whether there were any explosive materials stored in the turbine halls.

The militarisation of the Zaporizhzhia plant is adding to the constant pressure on the staff, who are faced with the task of keeping two of the reactors in “hot

shutdown” mode – a delicate operation – to provide some power and heating to the plant and the next-door town of Enerhodar, where the workforce lives.

“If you have armed people breathing down your neck in the control room, it’s just an incredibly dangerous situation,” said Mariana Budjeryn, a senior research associate at Harvard University’s project on managing the atom.

“If you have the three other nuclear power plants without any off-site power, and you can’t restart them because the grid is down, it’s like three enormous ticking timebombs,” Budjeryn added. “All of this combined means we’re talking about the most dangerous moment for nuclear security so far.”