

INFORMATION NOTE

Arrangements in the event of a total loss of external power supplies of the Zaporizhzhya power plant in Ukraine

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The six reactors of the Zaporizhzhya nuclear power plant are VVER 1000 Russian-designed reactors. Based on information available from the IAEA, the status of the reactors is as follows:

- Reactors 2 and 4 are operating;
- Reactor 1 has been shut down for maintenance since February 27, 2022;
- Reactor 3 has been in cold shutdown¹ since March 4, 2022;
- Reactors 5 and 6 have been in cold shutdown since February 25, 2022.

The cores of the reactors in cold shutdown have not been discharged.

The plant is currently connected to the Ukrainian electricity grid by two of the four 750 kV lines available. Two lines are currently unavailable due to the fighting; a third one was temporarily unavailable but was repaired on the evening of March 18, 2022. The power plant is also connected to the Ukrainian 330 kV grid, to which the Zaporizhzhya thermal power plant and the Dnipro and Kakhovka hydroelectric power plants are connected nearby. This 330 kV line is currently available.

The Zaporizhzhya NPP provides electricity to the Ukrainian power grid but when its reactors are shut down, the Ukrainian power grid provides power for its monitoring and backup systems. The availability of these external power supplies is therefore an important issue for ensuring the safety of the reactors.

Means of managing a total loss of external power supplies

In the event of a total loss of the external electrical network (750 kV and 330 kV), the reactors in operation could continue to produce electricity for the six reactors of the Zaporizhzhya plant, provided that at least one reactor successfully completes an "islanding transient"².

In the event of a failed islanding of all the reactors on the site, each reactor has three emergency generators (6.6 kV). Each reactor has three independent trains of backup systems, a single train being sufficient to stabilize the

¹ Reactors 3, 5 and 6 could be restarted if the Ukrainian power grid needed more power. Electricity consumption in Ukraine is currently reduced due to the ongoing conflict.

² After the islanding transient, the power supply of a reactor is ensured directly by its main alternator and no longer by the external electrical network.

reactor. Thus, a single generator set is sufficient to maintain the reactor in a safe state. The redundancy of the generator sets provides a certain guarantee on the stabilization of the reactors. In addition, two generators, protected against aggression and malicious acts (bunkerized), are also present on site.

Each emergency generator has a fuel tank giving it an autonomy estimated at one week by the site operator. Beyond that, the fuel tanks will have to be refilled.

This favourable situation should not hide the risks of intrinsic failure of certain generators, whose long-term operation would likely exceed the scope of their periodic tests (probably a few hours) and could generate problems unknown to the operator.

The failure of several emergency generators could therefore not be excluded before fuel reserves are exhausted. To avoid this situation, the restoration of an external power supply (330 kV or 750 kV) would be actively sought by the site teams.

Following the European stress tests carried out after the accident at the Fukushima Daiichi plant, each reactor also has mobile equipment to manage the total failure of internal and external power supplies, including:

- an autonomous mobile thermal pump (truck) providing water supply to the steam generators that are capable of cooling the reactor core, using multiple water supplies.
- an autonomous mobile thermal pump (truck) providing water injection to the fuel assembly storage pool to compensate for water loss by boiling, using multiple water reserves.
- a mobile generator (truck) to supply power to certain equipment: instrumentation and control, pumps for injecting high-pressure borated water into the primary circuit, pumps for the cooling system of the fuel deactivation pool, compressed air system, thermal conditioning of the control room, pressure control devices for the primary and secondary circuits.

These equipment has a fuel autonomy of three days. This autonomy is in addition to the seven-day autonomy provided by the fixed equipment. The site teams have been trained to these mobile means.

Conclusion

On the basis of the information available to IRSN, the resources planned for the Zaporizhzhya power plant would enable the site teams, in the event of failure of the islanding transient, to cope with a situation of total loss of external power supplies for a period of at least 10 days. This conclusion is subject to the reliability of the equipment implemented, their initial fuel supply, the availability of crews and the absence of other factors that could aggravate the situation.