Federal Ministry
Republic of Austria
Climate Action, Environment,
Energy, Mobility,
Innovation and Technology

Renewables More Reliable Than Ageing Nuclear Power Plants

As nuclear power plants age, they become increasingly prone to unplanned outages. In contrast, accuracy and range of forecasting for solar and wind power generation keep improving year by year.

In 2018, the seven Belgian nuclear power plants generated less than half of the electricity they were expected to produce based on their nominal net capacity. The reason: On average, the nearly 40-year-old reactors were down for a period of over 180 days. They did not produce anything during that time. Not a single kilowatt-hour.

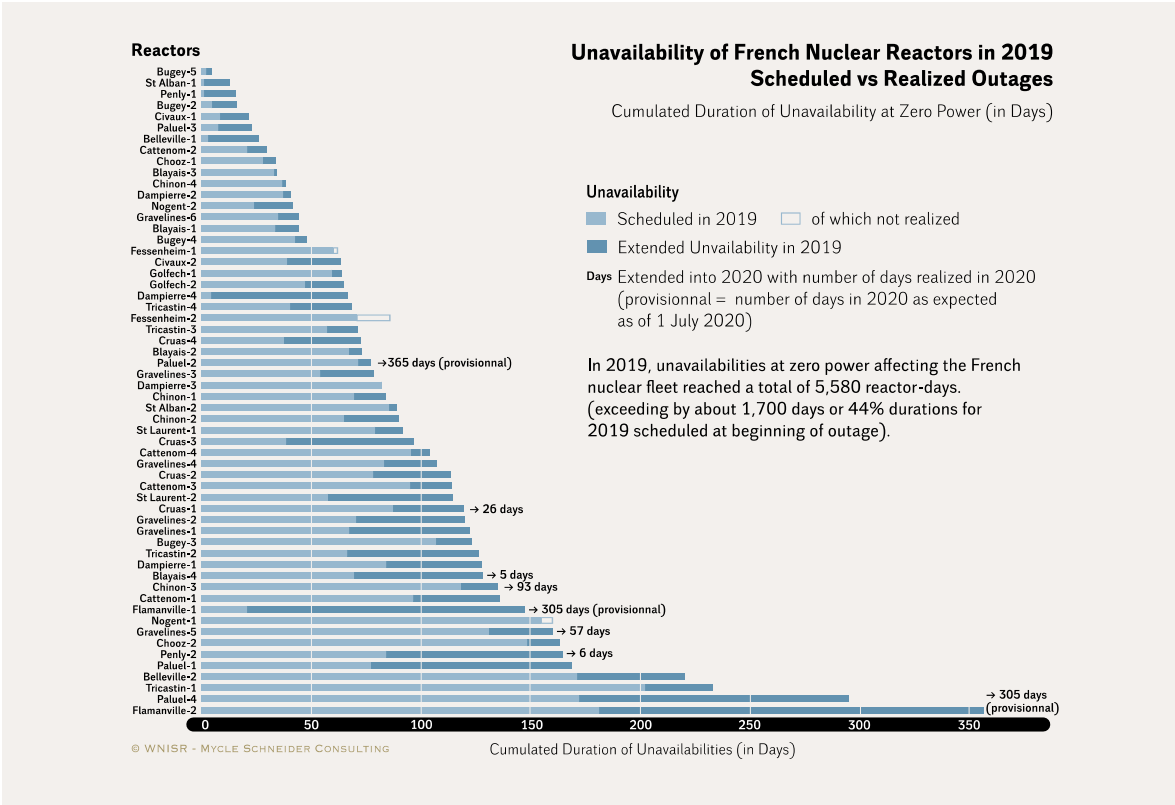
Hywind Scotland, the first floating offshore wind farm does a better job. Since the station was put into operation three years ago, the rotor blades have been operating with an average "load factor" of 54 to 57 percent.[1] Meanwhile, Belgium has become the world's fourth largest offshore wind power plant operator. Offshore turbines generate variable output, but they do so during 95 percent of the hours in a year. Between November 2019 and April 2020, the wind park in the Belgian North Sea *averaged* a load factor of 56 percent; although the output fluctuated, production was close to constant. Better still, the plant supplies electricity primarily during the winter months, thus remarkably balancing out the low output from solar plants at this time of the year.

France operates more than half of the nuclear reactors located in the European Union. In 2019, the 58 French reactors operating at the time—two units in Fessenheim were closed in 2020—generated no electricity at all on a total of 5,580 reactor-days. A dead loss. On

[1] If a 100-megawatt power plant were to produce electricity at full capacity 8,760 hours a year, output would total 876,000 megawatt-hours (MWh) or 876 gigawatt-hours (GWh). The load factor would be 100%. With a load factor of 50%, the amount of electricity produced corresponds to half of the maximum production possible at rated capacity, i.e. 438 GWh in this case. Theoretically, a power plant could run at maximum capacity half the time and produce nothing the rest of the time. In reality, offshore wind power plants nearly always generate some electricity, but at variable levels, whereas nuclear power plants tend to be "all-or-nothing" producers.

average over the year, the entire reactor fleet was unavailable for more than three months, a 10-percent increase on the previous year. A total of 1,700 of these outage days hit the operator unprepared. In other words: the planned duration of standard refuelling and maintenance operations was extended by 44 percent on average.

Figure 1: Planning and reality – Unavailability of French nuclear power reactors in 2019



Source: WNISR2020

The world's largest nuclear power plant operator, the state-controlled utility Électricité de France (EDF), has lost control over its means of production. EDF can no longer reliably predict when which reactors will be operational. The 2019-record makes this very clear:

- All 58 reactors were subject to outages ranging from 5 to 356 days over the year, of which between 1 and 175 days per reactor were unplanned delays.
- At least four reactors were down (at zero capacity) simultaneously at any day of the year.
- Up to 24 reactors were down at the same time.

- On four out of five days of the year, at least 10 reactors simultaneously did not generate any electricity.
- On 94 days—one quarter of a year—20 or more reactors were shut down for at least part of the day.

These figures refer exclusively to the total outage of the reactors and do not take into account unplanned capacity reductions caused by a lack of cooling water as a result of climate change, worker strikes or a lack of electricity demand. Also noteworthy is that these numbers refer to the year prior to the outbreak of the COVID-19 pandemic. In 2020, nuclear power production in France slumped by another 12 percent. A detailed analysis for the first year of the pandemic is not yet available.

Since as early as 2016, India's emerging economy has been producing more electricity with wind turbines than with nuclear power plants. Since 2018, electricity generation by solar photovoltaic systems is also exceeding that of nuclear fission. Projections for solar and wind power have become so accurate that the Indian grid operators apply penalties whenever the output differs by more than 15 percent from forecasts for electricity production levels issued the previous day in 15-minute intervals.

Nuclear power plant operator EDF is no longer able to provide the grid operator any, even remotely, reliable planning data on its production facilities. The reactor Flamanville-2, for example, was originally scheduled to go on a 7-month maintenance outage at the end of December 2018. In reality, it was shut down on 10 January 2019 for what was initially planned to be a 6-month outage but was not reconnected to the grid until 23 months later, on 12 December 2020—after a total of 40 adjustments to this "planned" outage. Even in the last 15 hours prior to restart, the timing of the unit's reconnection to the grid was delayed five times. This cannot be described as reliable planning.

Not to mention the commissioning of the new nuclear plant Flamanville-3, an EPR model, which was initially "planned" for 2009 and was delayed by 14 years, is now expected in 2023 at the earliest. Luckily, France has no penalties for power plant operators who fail to deliver on schedule. They would presumably be unaffordable.