

Reactors at Bruce nuclear station violated terms of operating licence

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Two reactors at the Bruce Nuclear Generating Station have violated the terms of its operating licence, its operator and the federal regulator have revealed.

Bruce Power, which operates the plant in Kincardine, Ont., announced in a July 13 statement that pressure tubes in Unit 3 and Unit 6 were found to have “higher-than-anticipated readings.” The following day, the Canadian Nuclear Safety Commission (CNSC) issued its own statement saying hydrogen equivalent concentration (Heq) levels in some of the station’s pressure tubes exceeded the allowable limit of 120 parts per million.

Pressure tubes are six-metre-long rods that contain bundles of uranium fuel. A CANDU reactor contains several hundred of them – and they are considered the principal life-limiting component

of Canada's reactor fleet. Pressure tubes with high Heq levels are at risk of developing blisters and cracks that could cause them to fracture.

Citing an ongoing "regulatory process" that "will continue to evolve," Bruce Power did not answer questions from The Globe and Mail regarding how many tubes were affected or how much they exceeded the allowable limit. In a statement, spokesperson John Peevers wrote: "All six units that are currently operating have recently undergone similar inspections and demonstrated fitness for service."

The CNSC, which regulates the industry, said in a written response to questions Friday that two tubes at the Bruce facility exceeded licensing limits. In the tube in Unit 6, the Heq level was measured at 212 ppm, almost double the allowable limit. It's unclear what could have caused such an off-the-charts reading.

"Although a licence non-compliance is serious, it does not mean that safety of the operating units is compromised," the CNSC said. It added that both reactors were already shut down when the exceedances were discovered. (All the tubes in Unit 6 are in the process of being replaced.)

At issue is the industry's ability to accurately predict how long Canada's aging nuclear reactors, many of which have already exceeded their 30-year design life, can continue to operate safely.

In 2018, Bruce Power said it expected tubes in units 5, 7 and 8 would exceed the hydrogen concentration limit before being shut down for refurbishment.

In response to Bruce Power's contraventions, on July 13 the CNSC ordered the company, along with fellow CANDU operators Ontario Power Generation (OPG) and New Brunswick Power, to review the fitness for service of their pressure tubes and report back no later than the end of July.

Frank Greening, a retired OPG employee who worked for more than a decade with pressure tubes, said the Unit 6 tube reading is unprecedented and puts the regulator in a difficult position.

[Canada's nuclear regulator overlooked dubious data when renewing Pickering plant's licence, documents show](#)

"If they take that hard line, they would have to tell just about the whole Canadian nuclear industry to shut down these units until they can sort this out," Dr. Greening said. "And that's borderline catastrophic ... I think we'd have brownouts, or rolling blackouts, because I don't think they can make up the deficit." (According to the Canada Energy Regulator, Ontario generates about 60 per cent of its electricity with nuclear power; in New Brunswick, the figure is almost 40 per cent.)

Another option would be to raise the allowable limit for hydrogen concentration, which the CNSC has done before. Pressure tubes were originally expected to remain in service for 30 years, and the CNSC has raised regulatory limits several times as reactors approached them. For example, the maximum allowable hydrogen concentration was originally 100 ppm but was increased to 120 ppm a few years ago.

Pressure tubes deteriorate as they age, picking up deuterium (an isotope of hydrogen) through a corrosion process known as deuterium ingress. In combination with other aging processes, deuterium ingress causes tubes to grow in length and diameter, known as creep, which allows more coolant to bypass the fuel bundles, lowering the margin of safety. Over time, tube walls become thinner and more brittle, which can cause them to crack and eventually fracture.

In January, 2019, the CNSC renewed Bruce Power's licence to operate the Bruce station for 10 years, to 2028. However, the regulator insisted that before Heq levels exceeded 120 ppm, Bruce Power would have to prove that its pressure tubes could continue to operate safely above that level. If any pressure tube reached the limit, it declared, the operator would have to shut down the reactor.

At the time, Bruce Power promised to "extend the validity limits of the existing fracture toughness model to 140 ppm of [Heq] in pressure tubes by the end of 2018 and to 160 ppm of [Heq] by the end of 2019."

But the CNSC said it received a new fracture toughness model for review this May. "No decisions regarding acceptance of the model have been made at this time," it said.

The regulatory violations at the Bruce station are the latest indication that the industry's approach to managing the aging of pressure tubes, and predicting deuterium ingress, may be breaking down.

"It shows their predictions aren't worth beans," Dr. Greening said. "Their predictions are failing. And this is not the first time."

In March, The Globe reported that, since 2017, CNSC staffers had expressed concerns about unreliable data from pressure tube inspections by OPG at its Pickering plant, east of Toronto. CNSC staffers warned that measuring and predicting deuterium ingress is "potentially one of the biggest issues currently faced by the Industry."

In a video statement released shortly after the story was published, CNSC president Rumina Velshi said: "We've heard from some who engage in sensationalism and who prefer to either misrepresent or ignore the facts." She insisted the regulator considered safety to be a paramount concern.

After the revelations by Bruce Power this month, the CNSC acknowledged that the industry's predictive models appear to "underpredict the maximum hydrogen equivalent concentration in pressure tubes of CANDU reactors."
