

Canada's nuclear regulator overlooked dubious data when renewing Pickering plant's licence, documents show

In 2018, the CNSC extended Ontario Power Generation's licence for its Pickering Nuclear Generating Station for 10 years, and in doing so, lifted key regulatory roadblocks that would have forced OPG to replace aging pressure tubes

<https://www.theglobeandmail.com/canada/article-canadas-nuclear-regulator-overlooked-dubious-data-when-renewing/>

[Matthew McClearn](#)

Published March 23, 2021 Updated March 23, 2021



The Pickering Nuclear Generating Station is shown in January of 2020, a year and a half after the Canadian Nuclear Safety Commission renewed its operating license. - Frank Gunn/The Canadian Press

When it renewed the operating licence for Canada's oldest nuclear power plant, the Canadian Nuclear Safety Commission overlooked perplexing results from inspections of the station's pressure tubes that nobody could explain – a decision critics say is part of a larger pattern of placing the industry's interests over those of the public.

In August, 2018, the CNSC extended Ontario Power Generation's licence for its Pickering Nuclear Generating Station for 10 years – the longest term it had ever received. In doing so, the CNSC lifted key regulatory roadblocks that would have forced OPG to replace aging pressure tubes – six-metre-long rods that contain fuel bundles of uranium – at great expense.

The tubes – often referred to as the heart of CANDUs, the reactor design found in Canada’s nuclear power plants – deteriorate as they age. If one ruptures, coolant could be lost, which could trigger a range of scenarios from a relatively minor incident that’s contained by the plant’s safety systems but results in costly damage, to a catastrophe in which fuel overheats. Each of Pickering’s reactors contains 380 pressure tubes; Pickering Station has six operational reactors.

In a worst-case scenario, a ruptured tube could lead to a series of “cascading failures not unlike what happened at Fukushima,” says Sunil Nijhawan, a nuclear engineer and consultant who once worked for OPG and specializes in accident and safety assessments. He was referring to the 2011 accident at the Fukushima Daiichi Nuclear Power Plant following an earthquake and tsunami, in which the loss of coolant led to three reactor meltdowns, hydrogen explosions and radioactive releases. That scenario is of “low probability,” he added, but “the consequences to the nation would be very high.”



Smoke rises from Unit 3 of Japan's Fukushima Dai-ichi nuclear plant on March 21, 2011, after an earthquake and tsunami caused a disaster. TEPCO via Kyodo News/AP

Documents obtained under the federal Access to Information Act by Ottawa researcher Ken Rubin, and provided to The Globe, show that since 2017, CNSC staffers had grown increasingly concerned about unreliable data arising from OPG’s inspections of pressure tubes.

In December, 2019, Alexandre Viktorov, regulatory program director for CNSC’s Pickering Regulatory Program Division, sent a [letter](#) to OPG detailing numerous concerns about results from those inspections, some of which appeared to defy the laws of physics. A 32-page appendix warned that inspections data were used extensively in predictive models used to determine how

much longer Pickering's tubes should operate before requiring replacement. (These predictions inform what the industry calls "fitness for service" assessments.) The letter described the resulting uncertainty around fitness for service as "potentially one of the biggest issues currently faced by the Industry."

The original design life of Pickering Station's pressure tubes was 30 years, a limit they began passing around 2014. (Its oldest tubes date from 1982). The station was built half a century ago during the nuclear industry's heyday, during which dozens of new reactors entered service worldwide each year. But that era is a distant memory, leaving owners and regulators with difficult decisions about how much longer aging plants should continue operating.

With Pickering Station there's an additional consideration: located just 30 km from downtown Toronto, it's one of very few nuclear plants within a major global city.

In interviews and statements, the CNSC said the inaccurate data – which OPG attributed to improper calibration of measurement equipment by an outside vendor – is being corrected, a process that will be complete by the end of this year.

"There was never an immediate safety concern," a CNSC spokesperson wrote in an e-mail to The Globe. "The CNSC is satisfied with the corrective measures put in place ... no future actions are required."

Critics disagreed on all counts.

Former OPG employee Frank Greening, who worked in the company's pressure tube group for the last decade of his career before retiring in 2000, said the letter shows that OPG was unable to demonstrate to its regulator that the station's pressure tubes were fit for service.

"At the time they were approving this licence, they knew about this problem," Mr. Greening said. "So I can't help but use the word 'cover up' at that point. The CNSC had the audacity to go public and say, 'Everything's fine. There's your licence.' "

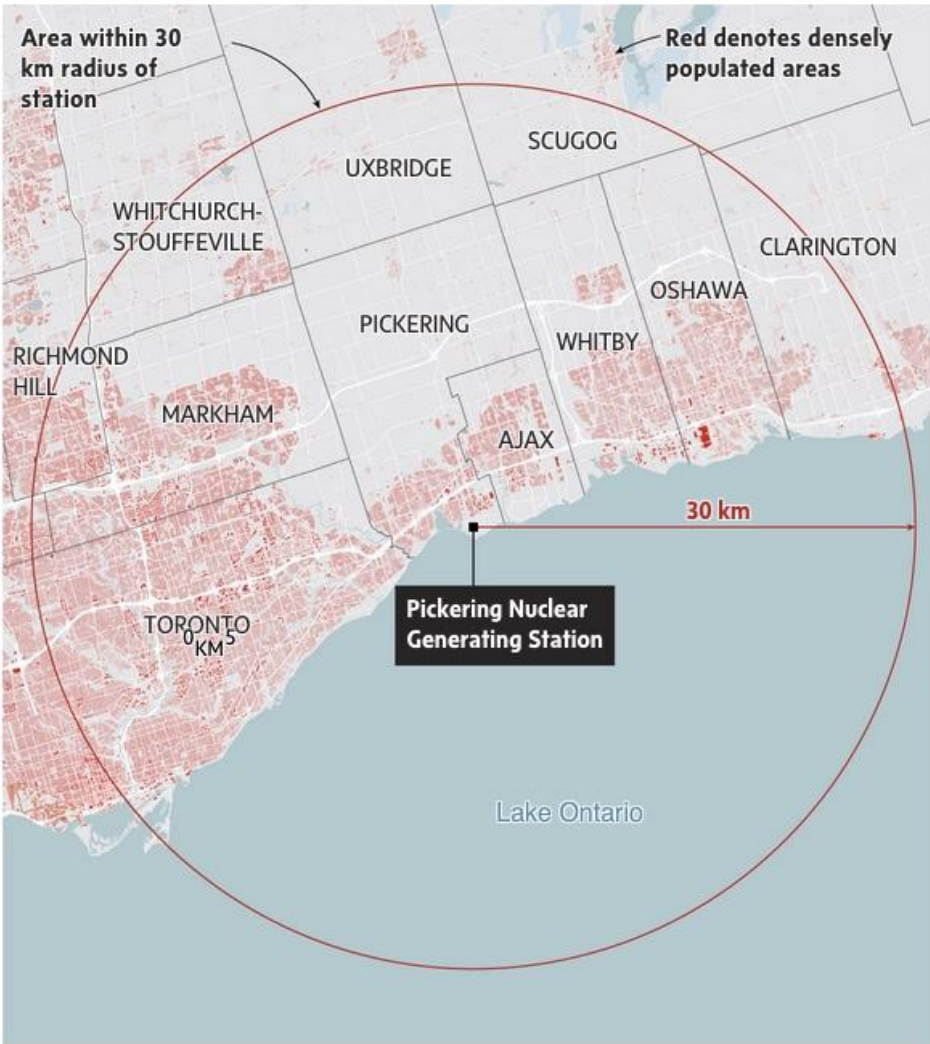
Gordon Edwards, president of the Canadian Coalition for Nuclear Responsibility, is a long-time anti-nuclear activist and consultant. He said the inability to resolve the data problems until late 2021 shows that the industry is currently running blind.

"Whether they admit it or not, they know they are taking a risk," he said.

"We're running these reactors without any real confidence that we're doing the right thing."

Pickering Nuclear Generating Station is located in a densely populated area

The Ontario Clean Air Alliance, which has called for the plant's prompt dismantling, says more people live within a 30 km radius of it than any other nuclear power plant in North America



MURAT YÜKSELİR / THE GLOBE AND MAIL, SOURCE: TILEZEN; OPENSTREETMAP CONTRIBUTORS; MICROSOFT; STATISTICS CANADA

Heart of the Reactor

Pressure tubes, the major life-limiting component of CANDUs, inhabit a hostile environment. They're bombarded with neutrons as nuclear fission takes place within. While most of these neutrons travel through the material, some are absorbed: pressure tubes gradually pick 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. Meanwhile their walls thin and the metal embrittles, and tubes begin to sag.

Eventually tubes can become so brittle that they can fracture. Several CANDU tubes failed in the 1970s and 1980s, but these incidents were of low severity and plant safety systems were able to cope: there has been no reported tube ruptures since 1986.

The original design life for pressure tubes was approximately 30 years – or 210,000 effective full power hours (EFPH). When the tubes in Hydro Quebec’s CANDU station east of Trois Rivières reached that limit, it closed the plant, called Gentilly-2. Thierry Vandal, chief executive at the time, testified before Quebec’s national assembly that he considered 210,000 EFPH “the extreme limit” beyond which his management team dared not go.

“I would no more operate Gentilly-2 beyond 210,000 hours than I would climb onto an airplane that does not have its permits and that does not meet the standards,” he said, according to a translated transcript.

The decision to operate Pickering’s tubes longer was informed, in part, by data from inspections and predictive models showing tubes could remain fit for service well beyond original expectations. In 2014, as Pickering’s oldest pressure tubes neared 210,000 EFPH, OPG officials told the CNSC that limit had been arbitrary.

“It wasn’t based on technical knowledge or experience of the day,” testified Bryce Phillips, senior vice-president of the Pickering Station, at a hearing. “No one had run a CANDU reactor for any significant period of time back then. We know a lot more now than we did then.”

The CNSC raised the limit to 247,000 EFPH (in 2014) and then to 295,000 EFPH (in 2018). It deems the new limit to be safe. During a meeting in January, CNSC technical specialist Blair Carroll told commissioners that licensees had shown that tubes deteriorated less than expected, so “additional operating margins were available.”

Even as it eased the age limits, however, the CNSC beefed up inspection requirements.

OPG shuts down reactors for inspections every two or three years, during planned outages. It can take between five and 10 days to get the reactor powered down and depressurized. OPG uses a cutting tool to scrape off tiny metal samples (about a millimetre thick) from select tubes and drops them into flasks. They’re called scrape measurements, and they’re typically conducted on 10 or more tubes. The highly radioactive samples are sent to a lab for analysis, to measure how much deuterium they’ve picked up.

All this is expensive. Each day a reactor is out of service costs up to \$1-million. Whereas in years past planned outages lasted about 60 days, now they’re taking up to twice as long. OPG figured that the incremental costs for additional inspections would be as much as \$236-million for the four years leading up to 2020.

OPG can’t inspect all 380 tubes in each reactor – there’s simply too many. Instead, it feeds data from the small number of inspected tubes into mathematical models used to predict how long the rest can safely remain in service. (More than two-thirds of tubes will never be inspected.) One model predicts how quickly tubes will accumulate deuterium. Others estimate how much they

will weaken as they accumulate deuterium, and are known as material fracture toughness models.

But internal CNSC documents make it abundantly clear that modelling is not an exact science. Models are frequently revised because they don't square with data obtained during inspections.

Dr. Greening, the retired expert, said deuterium ingress is bafflingly complex. Generally, it occurs more rapidly in parts of the tube subjected to higher water temperatures; concentrations tend to be higher at the tube's outlet end where coolant water exits at about 300 C. They're also higher at a part of the tube known as the rolled joint. For reasons that aren't fully understood, tubes near one another in the reactor sometimes pick up deuterium at different rates.

"Deuterium pickup does not follow a nice simple law," he said. "So to predict it is a nightmare."

Making accurate predictions isn't the only challenge: scraping inspections have been known to produce unreliable data since the 1990s. The latest problems surfaced in 2017 when data from one of Pickering Station's reactors showed a "relatively large" reduction in deuterium levels. It wasn't an isolated incident: In August, 2018, OPG submitted 20 scrapes from tubes in another reactor. After analysis, 12 of them showed decreased or unchanged deuterium levels.

These readings distressed CNSC staff for one simple reason: There is no known way that deuterium can diffuse out of pressure tubes. It always accumulates over time, so falling levels suggested the data was corrupt. The whole method by which operators assessed fitness for service of pressure tubes had been called into question.

"The continuous challenges and the overall lack of understanding is very worrisome," CNSC staff wrote.

And there was yet another problem.

In addition to inspecting in-service tubes, OPG periodically removes one from each reactor and sends it to a lab for destructive testing. A crack is introduced into a section of the tube, and then it's pressurized until it bursts. The results help the nuclear industry gauge how long tubes can remain in service before they become dangerously brittle.

During a burst test in 2017 known as BT-29, a segment of tube burst at a pressure below what the mathematical models predicted. OPG told the Commission that the testing conditions "were more severe than conditions expected for pressure tubes in

Units" and that the facility's tubes remained fit for service.

Nevertheless, the CNSC imposed restrictions on use of that model; according to the CNSC, industry subsequently conducted nine more burst tests, none of which exhibited the same weakness.

‘Numerically corrected’

The CNSC said the BT-29 test had no impact on its assessment of the safe operation of pressure tubes, and it has also moved on from the concerns expressed in the Dec. 2019 letter.

In e-mailed responses to questions, a Commission spokesperson explained that subsequently, an investigation determined that a contractor hired by OPG to measure deuterium concentrations in scrape samples had miscalibrated a measuring tool known as a Thermal Desorption Mass Spectrometer. The data is now being “numerically corrected to account for the calibration error.”

In an interview, Dr. Viktorov acknowledged that some of the concerns identified in his Dec. 2019 letter remain unresolved. But he said that they relate to the predictive models, not the condition of tubes. “What the present condition is right now, we know this through inspections.” OPG complied with its licensing requirements at all times, he added.

Dr. Greening found the Commission’s explanation unsatisfactory.

“That opens a huge can of worms in my mind,” he said. “Well, why was [the equipment] not calibrated? Don’t you guys do these measurements all the time? Don’t you have protocols and procedures? How could you miss that?”

“They are in violation of their own standard,” he added. “Their license requirement is they do these tests, get this data and show that everything’s fine. And right now they’re not in a position to do that.”

Responding to questions from The Globe, CNSC president Rumina Velshi said it would be inappropriate to comment on the Commission’s decisions beyond what the CNSC had already published.

“Pickering Nuclear Generating Station pressure tube fitness for service was confirmed through various evaluation methods and continues to be evaluated regularly by Ontario Power Generation and reviewed by our staff,” a CNSC spokesperson wrote.

The CNSC reports to Parliament through the Minister of Natural Resources, Seamus O’Regan.

His press secretary, Ian Cameron, wrote in a statement: “The health and safety of Canadians is always our top priority. All Canadian nuclear power facilities are licensed and monitored by Canada’s independent regulator – the Canadian Nuclear Safety Commission (CNSC) – which makes science-based, objective decisions, and regularly undergoes peer-reviews from world-renowned organizations.”

Critics often accuse the CNSC of serving the industry’s interests. The documents obtained through the Access to Information Act appear to tell a more complicated story. Read in one light, Dr. Viktorov emerges as a diligent, thorough regulator, a man not easily satisfied by what he regarded as unsatisfactory responses from regulated companies. (The CNSC rejected OPG’s

early explanations for the wonky data, and subsequent developments suggest that skepticism was warranted.)

Yet neither Dr. Viktorov nor anybody else from the CNSC raised concerns about erroneous inspections data at the 2018 hearings. (Rather, he assured the Commission that OPG's continuing work "will continue demonstrating that the fuel channels are fit for service" beyond 40 years of age.) The Commission extended the license for 10 years.

"This issue was not raised during the Pickering relicensing hearing because the questionable data was never used," the CNSC said in a statement. "Relicensing decisions were only based on valid data." In contrast, the Dec. 2019 letter repeatedly emphasized how bad inspections data could compromise predictive models.

Dr. Nijhawan said what troubled him most about the letter was how quickly the CNSC declared that the industry had resolved problems identified by staff.

"In most cases they turn obvious mistakes and violations into non-issues, and where they cannot they accept garbage science," he wrote.

At the time of the licence renewal, OPG's stated intent was that commercial operations would cease at the end of 2024. Since then, however, OPG has said it wants to run the reactors for an additional year. A hearing date before the CNSC hasn't been set.

Dr. Nijhawan said pressure tubes are but one of many CANDU reactor components that have aged to the point where they present a hazard to public safety.

"Pickering has 100 other issues with it," he said. "You cannot run these reactors to that age."

Dr. Greening said that the CANDU design is clever, and Canadians should be proud of it. But he says the industry cannot accept that its reactors have aged past the point of obsolescence.

"They don't want to give up and they want to keep pushing this CANDU to the absolute limit," he said. "And my concern is that one of these days, they'll exceed that limit, and we will have a potentially very nasty accident at one of these stations.

"I think they're playing Russian Roulette with the Canadian public."

Editor's note: The Canadian Nuclear Safety Commission reports to Parliament through the Minister of Natural Resources. Incorrect information appeared in a previous version of this story.

© Copyright 2021 The Globe and Mail Inc. All rights reserved.