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February 27, 2014

The Honorable Allison Macfarlane
Chairman
Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, MD 20852

RE: Troubling Press Report Regarding Deterioration of Steam Generator Tubes at St. Lucie Nuclear Power Plant

Dear Chairman Macfarlane:

Attached to this correspondence is a troubling press report regarding deterioration of steam generator tubes at the St. Lucie Nuclear Power Plant, Unit 2 ("St. Lucie") in Jensen Beach, Florida. I respectfully request that the Nuclear Regulatory Commission ("NRC") review the report and situation and provide me with NRC's analysis of the matter.

It appears that there may be significant deterioration in an abnormally high number of tubes that carry hot radioactive water at the St. Lucie plant. The wear indications may have been exacerbated after power production was increased in 2012. According to the NRC website, "there is potential that if a tube bursts while a plant is operating, radioactivity from the primary coolant system...could escape directly to the atmosphere in the form of steam."

I look forward to your review and response. In the meantime, if you have any questions, please do not hesitate to contact me or my Legislative Assistant, Javier Gamboa at 202-225-3376 or javier.gamboa@mail.house.gov.

Sincerely,

A handwritten signature in cursive script that reads "Kathy Castor".

Kathy Castor
U.S. Representative
Florida- District 14

COOLING TUBES AT FPL ST. LUCIE NUKE PLANT SHOW SIGNIFICANT WEAR

Ivan Penn, Times Staff Writer

Saturday, February 22, 2014 12:00pm

Yet another Florida nuclear plant may be in trouble.

More than 3,700 tubes that help cool a nuclear reactor at Florida Power & Light's St. Lucie facility exhibit wear. Most other similar plants have between zero and a few hundred.

Worst case: A tube bursts and spews radioactive fluid. That's what happened at the San Onofre plant in California two years ago. The plant shut down forever because it would have cost too much to fix.

FPL says its plant is safe, the rate of wear is slowing and its customers' multibillion-dollar investment in the plant is not in jeopardy.

"The bottom line is, these components are functioning within their requirements, and if they weren't they would be removed from service," said Michael Waldron, an FPL spokesman.

FPL is so confident in St. Lucie's condition that it boosted the plant's power. The utility acknowledged that will aggravate wear on the tubes, located inside steam generators.

Critics say that's like pressing hard on the accelerator, even when you know the car has worn brakes.

"The damn thing is grinding down," said Daniel Hirsch, a University of California at Santa Cruz nuclear policy lecturer. "They must be terrified internally. They've got steam generators that are now just falling apart."

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Nuclear power plants are like very expensive tea kettles. The reactor heats water. The steam generator turns hot water to steam, which powers a turbine, which makes electricity.

The steam generator also uses its thousands of alloy tubes to cool water, which is pumped back to cool the reactor. In that sense, the steam generators are a safety device.

"The tubes need to be very thin to transfer heat, and they need to be very strong to prevent a meltdown," said Hirsch, who reviewed the tube problems at San Onofre and St. Lucie. "Steam generators are really critical to safety. It's not a feature you want to play with."

FPL, the state's largest electric utility, brought the St. Lucie 2 plant online in 1983, about 50 miles north of West Palm Beach.

In 2007, FPL installed two new steam generators for \$140 million, intending them to last until the plant's license expires in 2043. Each generator contained about 9,000 tubes, which are 50 to 70 feet long.

In 2009, FPL shut down the reactor for routine refueling. An inspection found that the tubes were banging against the stainless steel antivibration bars, leaving dents and wear spots.

More than 2,000 tubes showed some wear in 5,855 separate places. (A tube can be worn in multiple spots.)

At that time — this was three years before San Onofre — it was by far the most wear found at the 20 or so similar plants with new generators, according to filings with the federal Nuclear Regulatory Commission. The Salem 2 plant in New Jersey had 1,567 wear indications when first inspected, but no other plant had more than a few hundred. The typical plant had fewer than 20.

Aging steam generators near the end of their useful lives can develop significant tube wear, but to sustain thousands of wear indications just a couple of years after installation is unusual.

"St. Lucie is the outlier of all the active plants," said Arnie Gundersen, a nuclear engineer and frequent critic of the nuclear industry.

FPL turned the plant back on, telling the NRC in a subsequent report that the tube wear was within allowable levels. Federal regulators agreed that the plant was safe to operate, though they noted that the number of wear indications was "much greater" than in other steam generators of similar age.

In 2011, FPL again shut down the reactor and inspected the tubes. The wear had spread.

Affected tubes: 2,978, up 46 percent from 2009.

Worn spots: 8,825, up 51 percent.

...

On Jan. 31, 2012, a "high radiation alarm" went off at the San Onofre 3 plant south of Los Angeles.

A tube inside a steam generator had burst, belching irradiated fluid into the containment building. No one was hurt.

The plant went into "rapid power reduction" and shut down, according to NRC documents.

San Onofre 3 had received two new steam generators less than a year earlier. After the leak, inspectors found 1,806 tubes worn in 10,284 places. They also found an unusually high number of worn tubes at the nearby San Onofre 2 plant.

The burst tube had rubbed against another tube, which may explain why it wore out so fast. But, as at St. Lucie, much of the wear to the tubes appeared at the antivibration bars.

Plant owner Southern California Edison concluded that a design change in the Mitsubishi-made steam generators contributed to the wear.

They lacked what are called stay cylinders. The space taken up by stay cylinders was replaced with more tubes, which helped increase the plant's power.

St. Lucie 2's new steam generators also lack a stay cylinder, though they were made by AREVA, a French company.

To deal with the wear problem, Southern California Edison considered reducing power by up to 40 percent or replacing the almost new steam generators, at a cost of \$1 billion or more.

Ultimately, the utility decided closing the plants was the best alternative.

A few months after the San Onofre leak, FPL inspected the St. Lucie plant. Again, the problem had spread. More than 3,745 tubes showed wear in 11,518 places, almost 1,250 more than at San Onofre 3.

In answers to questions from the *Tampa Bay Times*, the NRC said the plant has no safety issues and operates within established guidelines. That includes holding up under "postulated accident conditions."

FPL insisted St. Lucie should not be linked to San Onofre from either a safety or financial standpoint.

"From an engineering perspective," said Waldron, the FPL spokesman, "you can neither make a comparison, nor can you assume an outcome because the two systems are so different."

Southern California Edison, however, found plenty of similarities.

In its analysis of what happened at San Onofre, the company called St. Lucie "the next closest plant with a high number of wear indications."

"Although a different (steam generator) design, the (antivibration bars) serve the same design function," Edison wrote in its April 2, 2012, analysis. "So St. Lucie was used to determine similarities and potential actions."

During hearings, Edison repeatedly pointed to St. Lucie as having the same problem, said Hirsch and Gundersen.

"I think the comparison is dead on," Gundersen said. "All of the failure modes except for (tubes hitting each other) are identical. When the same problem popped at the two San Onofre plants, it suddenly became a cluster."

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Ultimately it's not the number of instances of wear but the depth of wear that matters most.

Think of it this way: If hundreds of roof shingles all show minor wear, the home remains dry. But if a hole wears right through to the attic, water leaks into the living room every time it rains.

Inspectors measure the depth in percentages. One percent is very shallow; 100 percent equals a burst tube. The tube walls are 0.043 inches thick, about as thick as a compact disc.

Speaking generally, Michel J. Pettigrew, principal research engineer for Atomic Energy of Canada Ltd., said most tube wear stays shallow and doesn't develop into anything significant.

"It is the wear indications greater than 20 percent of tube wall that are significant," he said. "These should be monitored closely."

When it closed, San Onofre 3 had 2,519 wear spots at least 20 percent deep into a tube wall. When last inspected in 2012, the St. Lucie plant had 1,920, the *Times* analysis found.

As for the deepest wear, FPL can correctly argue that San Onofre was in far worse shape. More than 280 wear spots showed at least 50 percent wear. At St. Lucie there were none.

When a wear spot reaches 40 percent deep, federal regulations require a utility to plug the tube. Plugging eliminates the possibility of a tube bursting but also renders the tube useless. Plug too many and the plant can't produce as much power.

FPL had plugged only about 155 tubes as of the last inspection, far less than the 807 at San Onofre 3.

But St. Lucie's tubes are still in use, and some are still wearing down. The last inspection found 480 wear spots at least 30 percent deep, and 139 of those were at least 35 percent deep.

While not as severe as San Onofre, the depth of wear at St. Lucie exceeds other plants with replaced steam generators.

For instance, neither of the two plants at the Joseph M. Farley complex in Alabama had plugged any tubes as of their 2011 and 2012 reports. Same for Diablo Canyon 1 in California. Beaver Valley 1 in Pennsylvania and Comanche Peak 1 in Texas had plugged just one tube since the new steam generators began operating.

The last inspection of units 1 and 2 at the South Texas Project didn't find a single wear spot due to antivibration bars, even though the steam generators are several years older than the ones at St. Lucie.

"We have not had any issues at all," said Buddy Eller, a spokesman for South Texas.

In its response to the *Times*, FPL pointed to the big difference in the number of tubes with deep wear as a reason why its nuclear plant will be fine in the long run. The tubes at San Onofre 3 wore out in less than a year, while St. Lucie's replacement steam generators have been running for seven years and the wear still is not as advanced, the company said.

FPL also emphasized that the wear at the St. Lucie plant is mostly contained to areas around the antivibration bars. There is none of the rapid tube-to-tube wear like at San Onofre.

Waldron, the FPL spokesman, said these numbers are not alarming.

"We have very detailed, sophisticated engineering analysis that allow us to predict the rate of wear, and we are actually seeing the rate of wear slow significantly," he said.

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For the last 16 months, however, St. Lucie's tubes have been under more stress.

Near the end of 2012, FPL completed a \$1.2 billion project to boost the power from both St. Lucie reactors by almost 12 percent. The more power the plant puts out, the harder the tubes work to do the dual job of creating steam and cooling the reactor.

FPL estimated the additional power could increase the rate of tube wear by up to 24 percent, according to an NRC review dated Jan. 27.

Joey Ledford, an NRC spokesman, said regulators reviewed the impact of the increased power at St. Lucie. They determined that FPL would only be allowed to "operate their steam generators if they could maintain tube integrity for the period of time between inspections."

"The reference to 24 percent is more representative of an upper limit for potential wear during post-uprate operation and is not a prediction of the actual wear rate," Ledford said.

But Dave Lochbaum, a nuclear engineer with the Union of Concerned Scientists, compared the power uprate to playing roulette.

"That would seem to be a gamble," he said. "I don't want (a leak) to be the indication I have a problem."

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So what happens next?

In March, FPL will shut down the reactor and inspect the plant's steam generator tubes for the first time since November 2012.

The plant likely will have more tube wear. How much more will determine the next step.

If the additional tube wear is minor, FPL might simply fire up the reactor and take another look in about 18 months.

If the damage is substantially worse, FPL might have to plug a lot more tubes. Individual tubes could be fixed in some cases, though that is time consuming, can keep the plant offline longer and doesn't always stop the problem.

At some point, the company might feel compelled to lower the plant's power output to ease the pressure on the remaining tubes or consider the drastic step of replacing the generators again.

All of those options cost money.

A prolonged outage or lowering the power output would raise concerns over spending \$1.2 billion of customers' money on the power uprate in the first place.

It would also add to the state's grim track record recently with nuclear plants. Last year, Duke Energy permanently closed the Crystal River nuclear plant long crippled after a botched repair job. Duke also announced it would not move forward with the planned Levy County nuclear complex. Duke's customers are on the hook for about \$3 billion related to the two failed projects.

FPL rejects any suggestion that its plant should be part of that conversation.

"Two things are for certain," Waldron said. "The investment we have made in (upgrading St. Lucie) will benefit FPL customers for decades, and the plant continues to operate to the highest safety standards. To suggest otherwise is patently untrue."

Nonetheless, there are those who suggest otherwise.

"I'd have to agree that every steam generator has dents," Gundersen said. "But the magnitude of what is going on at St. Lucie is off the charts. These guys are a hundred times worse than the industry average."

Ivan Penn can be reached at ipenn@tampabay.com or (727) 892-2332.

**Abnormal wear
at nuclear plants**

In 2012, a tube inside a steam generator at the San Onofre 3 nuclear plant burst, releasing radioactive steam. An inspection showed that hundreds of the tubes inside the generator had developed thousands of dents, or what the industry calls "wear indications." Last year, the San Onofre plant closed forever. A *Tampa Bay Times* analysis has found that the St. Lucie 2 nuclear plant also has significant tube wear. By some measures, St. Lucie 2 was already showing more wear during the last inspection in November 2012 than San Onofre 3 was when it closed.

| | ST. LUCIE | SAN ONOFRE |
|-------------|-----------|------------|
| TUBES | | |
| | 3,745 | 1,806 |
| AFFECTED* | | |
| WEAR | | |
| | 11,518 | 10,284 |
| INDICATIONS | | |

The deeper the wear, the greater potential for problems. Which plant had deeper wear? So far, San Onofre 3.

| | WEAR INDICATIONS AT LEAST 20% DEEP | AT LEAST 35% | AT LEAST 50% |
|------------|------------------------------------|--------------|--------------|
| SAN ONOFRE | 2,519 | 955 | 282 |
| ST. LUCIE | 1,920 | 139 | 0 |

But San Onofre is closed. It can't get any worse.

St. Lucie's wear keeps getting deeper with each inspection.

| | MARCH 2009 | APRIL 2011 | NOV. 2012 |
|-------------------|------------|------------|-----------|
| WEAR INDICATIONS | | | |
| | 75 | 1,228 | 1,920 |
| AT LEAST 20% DEEP | | | |

WEAR INDICATIONS

2

180

480

AT LEAST 30% DEEP

That much wear is not normal. Most similar plants with new steam generators have between zero and a few hundred wear indications. Some examples:

| PLANT (YEAR OF REPORT) | NUMBER OF WEAR INDICATIONS |
|---------------------------------|----------------------------|
| JOSEPH M. FARLEY 2, ALA. (2011) | 0 |
| COMANCHE PEAK 1, TEXAS (2013) | 1 |
| DIABLO CANYON 1, CALIF. (2011) | 1 |
| JOSEPH M. FARLEY 1, ALA. (2011) | 6 |
| PRAIRIE ISLAND 1, MINN. (2012) | 353 |
| CALLAWAY 1, MO. (2011) | 623 |
| SALEM 2, N.J. (2012) | 1,927 |
| ST. LUCIE, FLA. (2012) | 11,518 |

* Both St. Lucie 2 and San Onofre 3 installed two new steam generators with about 9,000 tubes per generator. The generators were made by two different companies but they operate in much the same manner. Some tubes are worn in more than one place, which explains why the number of wear indications is much higher than the number of affected tubes.

Sources: FPL and Nuclear Regulatory Commission

Growing problem: The story of one tube

The tube in row 80, column 103 of one of the steam generators at St. Lucie shows how the wear is getting worse.

In March 2009, the tube showed wear at five locations. The depths were:

1. 6 percent through the tube
2. 6 percent
3. 8 percent
4. 15 percent
5. 17 percent

In April 2011, the number of wear indications on the tube had grown from five to six and they were all deeper.

1. 15 percent
2. 16 percent
3. 16 percent
4. 29 percent
5. 24 percent
6. 11 percent

By November 2012, the six wear indications were again all deeper.

1. 20 percent
2. 20 percent
3. 21 percent
4. 33 percent
5. 26 percent
6. 17 percent

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