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**January 25, 2024**  
**GridTalk #409**

**SANDRA DYKXHOORN INTERVIEW**

Hi, and welcome to GridTalk. Today we're very pleased to go north of the border to talk to Sandra Dykxhoorn who's the vice president of New Nuclear Growth at Ontario Power Generation and I believe she's based in Toronto, is that true?

A: That's right.

Q: Welcome. So, the reason we're knocking on your door today is I'm very interested in small modular reactors. They've had quite a setback in the United States. There was a major project by NuScale and NuScale has backed off and they were the lead, the only technology that the Nuclear Regulatory Commission in the United States has endorsed so I'm very interested to learn more about Ontario Power and your plans to start building one pretty soon with a target date of completion by 2028 but before we get into that, talk a little bit about nuclear power in Ontario which I understand provides half of the provinces' energy so it's a well-proven and accepted technology in your part of the world and

give a flavor of the regulatory environment in Ontario and Canada for nuclear power.

A: Sure, happy to do it. So, Ontario has the largest amount of nuclear power in Canada. There's about 18 nuclear power reactors in Canada, the vast majority in Ontario, one operating nuclear power plant in New Brunswick. There was nuclear power operating in Québec but that reactor was put in safe store in 2012. In Ontario, we've had... OPG owns and operates two power plants; one is Pickering just east of the, of Toronto actually really part the GTA, the Greater Toronto Area and then Darlington Nuclear Station which is just a tad further to the east there, and then there's...

Q: So, these two projects are fairly large by U.S. standards. If I read correctly, they have 4,850 megawatts is that correct combined?

A: The existing stations?

Q: Yes.

A: So, Pickering is the first nuclear station that was built in Ontario and they're each roughly about 585 megawatts so total power output from Pickering is roughly approximately 3,000 megawatts. Darlington is...I probably got the number wrong but it's roughly on that, the Darlington Nuclear Station is 1,000 megawatts roughly per unit so total of 4,000 megawatts output so

that's the largest CANDU plant and Bruce Power is slightly different size; they're all just slightly different generations of the CANDU reactor technology, and together, Bruce between Bruce Power and OPG, that's 60% of Ontario's output. And Darlington alone provides 20% of Ontario's electricity on a daily basis.

Q: So, you have two that OPG operates and two that you lease to Bruce, is that right?

A: Yes, that's correct.

Q: Okay.

A: So, originally it was all under Ontario Hydro and then there was a bit of a breakup if you will in the 90s and Ontario Power Generation was born in 1999 and at the same time, Bruce Power was formed as part of a consortium and so they lease and operate the lands in Bruce County and we still own the land and still a very much part of that community.

Q: So, let's look at the big picture just really briefly. The United States is roughly 10 times Canada in population. We have 90+ nuclear reactors to your 18. It seems like nuclear power is more accepted in Canada. Would you say that's true and what would you attribute it to?

A: Well, I started at Ontario Power Generation in 2016 and the mood publicly I would say has shifted a lot and even in the past

eight years and part of that has been driven by climate change and a desire to be building out clean, emissions-free generation options and there's not really a ton of alternatives when you actually start thinking through the other clean options, all of which are good and needed but only nuclear can provide baseload electricity 24 hours a day and I'll give a brief story. Alberta which is not next to Ontario but to the west in Canada has a much greater reliance on coal and gas in particular. It's the dirtiest of the grids in Canada and they reached a peak demand a week and a bit ago and almost had rolling blackouts. And they had coal and gas operating at maximum as they could and there was no wind and solar able to kind of step in and help meet the demand on those really cold days and that typically you have in the north is where you see the greatest demand for electricity is on these extreme weather conditions and I know you've had experience with things like that in Texas, has had some issues in the United States but you need to build an electricity system that can operate for those extreme fluctuations and so, we've had experiences like that that help drive us to like, there's really no option to meet net zero without nuclear as part of that solution and renewables are great but they're intermittent. And what do you do if the sun's not shining and the wind's isn't blowing? And batteries are going to become very much part of the

grid as well but they're not yet available at scale, and at OPG and in Ontario have had great experience in the past, almost six decades, operating nuclear power safely, reliably, and producing a great amount of electricity. We've gotten rid of all of our coal; the last coal station was closed in 2014 and we no longer have smog days in Toronto. This used to be something that everybody grew up in, thought was normal. It doesn't happen anymore cause it's not a condition.

Q: Sandra, you've done an excellent job painting the background, which is what I hoped you'd do but now let's get to the topic at hand. SMR technology has not really taken off in the world yet even though the technology's fairly understood. According to my checking as of the end of 2022, just China, Russia, and India had a plant each. Why is it that the western world has not done this yet and why is Ontario brave enough to be among the first in the western world to really pursue this with both hands?

A: Yeah, I think the reason why small modular reactors exist at all and why people are investing in this technology is because we know there is a need for smaller, clean baseload power options that can replace gas and coal, and the war in Ukraine is also really driving the demand for that in Europe and there's a real desire to get off Russian oil. There's also other geopolitics

that factor into not wanting to partner with the sort of the non-western countries, and I think China and Russia were able to invest; they obviously have significant background in nuclear technology as well and probably don't need to tell you or your listeners that. And there have been poor experiences with large nuclear buildouts globally having cost overruns and just challenges with the project. I mean, you guys have a recent example at Vogtle in Georgia just coming online; that's very exciting but that took, it was 10 years delayed. And part of the solution with the small modular reactor is that it's smaller so that should be quicker to build; doesn't take as long. Additionally, it's more modular and more standardized so that traditionally in large nuclear reactor, you do everything onsite, you do all the construction and everything and what we try to do is introduce factory buildout components so that there...it's a little bit like the oil and gas industry where you can ship modules and not everything is being constructed onsite and if something goes wrong, it doesn't pause the whole project, so we're trying to fix some of that and the more standardized we can make it the better it is and the more we'll see deployed and the reason OPG has the confidence to take first mover position is the experience we've had in managing our giant and refurbishment project, which is as \$12.8 billion dollar project. We're on-time

and on-budget. In fact, we're early and we expect to bring our last unit on in 2026 and that's essentially taking out all the guts of our CANDU reactor and rebuilding it so we can get another 30 years of life and the amount of project management and construction and the logistics that had to go into planning for that project and the ability that we've shown to deliver has given us the confidence to transfer those skills and now that we have the humans and the talent and the supply chain needed to move forward with small modular reactor buildout as well.

Q: Is there anything unique; let me just bring back something you mentioned a minute ago about we're waiting for batteries to backup intermittent renewable resources. Is there anything unique about that need and the current makeup of the grid that points to smaller nuclear reactors as being more advantageous at this time as opposed to large baseload?

A: Yeah, I think one of the major differences that typically, whether it's wind/solar batteries you're looking a 20-year life and for nuclear, it's a minimum 60 to 70 years that you're going to get out of these plants and in the case of our Pickering station, we're just awaiting approval from our shareholder, the Government of Ontario, to proceed with our refurbishment there, that will bring that station to 90 years of life so yes, it's a higher capital investment at the beginning but for future

generations, like it's one of those things like, we have Niagara Falls and I'm sure all your listeners are familiar with Niagara Falls. In 1960 or whenever it was built, it was expensive but it's basically free and it's more than paid for itself and it's an asset that lives forever and it's properly maintained and that's, there's a similar value proposition that new...

Q: So, just to be clear the Falls weren't built but you're talking about the hydroelectric station facilities?

A: The hydro station; apologies, yeah.

Q: For Americans that are far from that area let's be clear, but my question was is there anything about small modular reactor technology that makes more sense now than ever before of going small, building smaller units, easier to manage, easier to maintain. Are they more inherently safe?

A: Well, the whole business case was really around building something that could replace coal and gas and so, batteries aren't that size. Like you have to have pretty big battery to replace a coal and gas plant and then you also need to charge it so that you're either charging it through...maybe you're pairing it with wind and solar. Again, sometimes these batteries have four, six, eight hours; depends on the battery but you're not getting 100% output from that battery and you would with SMR and the innovation is now there. Lots of money has been spent and we're



confident at OPG that from a cost perspective, there is a business case that is cost competitive with batteries and renewables that makes a ton of sense for us to move forward with this project.

Q: So, where is the plant that's going to build first? Can you tell us a little bit about it? How close is it...

A: That's actually right next to our existing CANDU plant at Darlington which is in Bowmanville, roughly; oh, I should know this, but 30 kilometers roughly on the outskirts of the GTA so really ideally located where a major need of electricity is, which is the Toronto area and it's nice that it's also situated on land that's already an existing nuclear site.

Q: What is GTA?

A: The Greater Toronto Area. Sorry, that's my native lingo

Q: Got it, thanks. Okay. So, you have the security built in at the site and they're used to nuclear assets. Is that the advantage?

A: Yeah, and I mean we actually started down a path in Ontario in 2008 towards building out a large nuclear station next to that site and ultimately paused because there wasn't a need for electricity at that time so it was paused in 2013. Things have obviously evolved and changed as we're moving forward with major

decarbonize efforts in both sides of the border, and the need for electricity is very high.

Q: I assume by putting it there it mitigates the need for transmission for you have transmission to the area?

A: There is existing transmission so that certainly helps as well and we went through the process of getting an environmental assessment to get ready to build new nuclear so that is helpful as well and we have the community license and social support and we're working very closely with the indigenous communities as well as we're moving forward through our licensing process and our hope is that we'll get through that and begin construction of the actual reactor in early 2025.

Q: And when will it be complete, Sandra?

A: In 2028; operational in 2029.

Q: That's pretty ambitious.

A: Yeah, that's also the advantage of small, you shorten the construction time.

Q: Okay.

A: And so that will be the first reactor and we're planning to build four at the site, so...

Q: At the same site?

A: Same site and so the same size of reactor as well so starting with the first one following a similar model to what we

did with the refurbishment which is make all your mistakes on the first one and then get it continually better over each subsequent unit and the economy to scale you get from building out four there make a ton of sense for OPG and there's the need for electricity so that's why we're moving forward with that.

Q: So, what's the estimated cost of all four?

A: So not released yet. We're still in the midst of finalizing the engineering design. This is a first-of-a-kind deployment. We also have to complete construction and so a lot of work is going into finalizing that cost estimate and we expect to release that at the end of this year and move forward into construction.

Q: Do you have any sense of what the cost; this is a technical question so if you're not prepared to answer it, I understand but the NuScale project that they were pursuing developing in the United States; originally, they thought that the power off of it would cost, well actually, ultimately, they canceled it because it went up 50% to \$58 per megawatt hour. Do you have any sense whether your projects will be anywhere near that or below that?

A: I'm not going to comment on the specifics of the NuScale project. I mean, ultimately for them, the challenge was like where that was situated and the need for electricity in that region and then the customer base like we have, we'll be selling our electricity into the power grid and there's a definite need

for that amount of electricity and there's a different way in which the cost recovery happens I think in both cases. We're confident with our choice with General Electric, GE's Hitachi, it's called the BWRX-300 and we've done our homework. NuScale was a part of our process and ultimately wasn't in the final three and ultimately, we chose to move forward with the GE Hitachi design because we felt it was going to be ready technologically first to deploy and we assessed every part of this including technology, readiness, cost, economics and the whole nine yards and we still remain confident that's the right choice.

Q: Can you talk a little bit about the safety mechanism and how any public concerns about the safety of nuclear power will be addressed and also about the nuclear waste question? How will you plan to handle the waste off of these four units?

A: Yeah, so for us, we're planning to manage it in a very similar way the that we already do and we actually don't even call it nuclear waste any more. We call it nuclear byproducts and that's because there's bit a misnomer by probably the nuclear industry has done to ourselves and calling it waste because actually still almost 90%-95% of energy still remains in those nuclear fuel bundles and...

Q: And there are startups looking at ways of extracting that energy.

A: Yeah.

Q: So...

A: We're seeing hints of most of that as well and there's potential especially for CANDU fuel to reuse and repost aside and put it back on the grid so the way; nuclear power is the only source of electricity where every single part of the lifecycle from inception to decommissioning, safe-store and how we manage the nuclear byproducts which is we know where everything is, everything's tracked, and nothing's getting exuded into the environment. Unfortunately solar, while wonderful and a great technology, doesn't necessarily have the same story. There's a bunch of chemicals that have to get extracted from the ground. There's a lot of these are being manufactured in China and they don't have the same kind of environmental regulations that we do here in North America and you get shipped over here on a barge and we put them on our roofs and we feel really good about ourselves from an environmental perspective but we're not thinking about the full lifecycle costs and ultimately, they all have to go into a landfill. There's no full decommissioning posts and this is something Alberta's actually thinking about right now even with orphaned wells that used to be used for oil extraction and they're...the company's need to be required in some kind of manner to manage things when they're no longer in use. And so,

nuclear has a great story to tell; actually, we're proud of it and have rebranded our nuclear byproduct facility to be called Nuclear Sustainability Services and we're very actively talking about how we do that with the public and we're not afraid to say that story and I think that's something the nuclear industry probably hasn't done a great job of.

Q: Okay and what about the safety question then? Is this the next generation safety design and take a minute and explain the unique characteristics of the GE product.

A: Yeah, so essentially what they're trying to do is remove the humans that need to be involved in managing a nuclear reactor in the event that there's an emergency or something happens and so ultimately, there's something called passive safety. There's also wording; NRC uses slightly different wording than the Canadian Nuclear Safety Commission but NRC is the Nuclear Regulatory Commission in the United States, so there's inherent safety and passive safety but either way, same kind of concept in which you can kind of have walk-away safety and a human doesn't have to necessarily push a button or do anything for seven days. That's the idea and greatly simplifies the management structure, not a people-required, lowers the overall cost of managing the system and that's essentially the biggest cost when it comes to nuclear is the amount of humans involved in operating the plants.

Q: So as vice president of New Nuclear Growth for OPG, OPG does have some operations in the United States does it not?

A: Yep, all hydro. We have a subsidiary called Eagle Creek Renewables and we purchased that in 2018 along with a company called Cube Hydro and they merged, and I think there's roughly and I know the number keeps changing but I think it's 86 hydro stations mostly in the eastern United States, largely in through the Washington/Virginia/Charlotte, like that North Carolina states, and elsewhere as well.

Q: So, what I was going to ask you is as a Nuclear Growth official, can we expect OPG to possibly to take this new technology into the United States and is this design getting reviewed by the NRC for possible use in the United States?

A: It is and actually we're partnered with a company called Tennessee Valley Authority which is based in well, Tennessee and they have decided to move forward with the same technology as us. They plan to be a fast follower. They are a sophisticated nuclear operating company already and what we're doing is cooperating on the technical stuff and we're also partnering with them with Synthos Green Energy which based in Poland and together what we doing is we're working to lower the overall costs for everyone to deploy this technology in our respective jurisdictions and so OPG is actively working with partners in other parts of Canada. We

are actively working with TVA. Never say never; there could be all kinds of partnerships that we're willing to explore in the United States but right now, the nature of our collaboration is mainly with TVA and then GE Hitachi is based in Wilmington, North Carolina and we have lots of interface with them as a company as well.

Q: So, what's the most exciting aspect of this work? I mean, you're bringing something to market like I said is not really known and used in the free world yet. Do you think this is going to be a real revolutionary development for the power industry in the world and United States?

A: Oh yeah, I think it's a game-changer. I fully, obviously believe in the technology. I think the biggest piece is ensuring it's the right policy supports with the government to get these first-of-the-kind projects up and running and once you get to "nth-of-a-kind" you kind of need like the first two, three, four, five up and then you can get to an "nth-of-a-kind" and really maximize economies of scale. And once you have that you have a really exciting industry that can look something similar to gas with a really standardized design and approach that can be deployed all over the world and so, we are really at the front of the pack here and I think OPG is recognized now globally as a world leader in its small modular deployment and we're being



asked how we can help enable deployment in other jurisdictions and we are figuring that out. We are certainly actively talking to folks in different jurisdictions particularly in Europe about whether or not we would consider being an operator and owner in those jurisdictions but primarily we focused on getting this first one done right here and building out a fleet here in Canada and definitely believe we're part of something big.

Q: So, I'm going to be talking to Todd Smith, the Minister of Energy for Ontario. I'm going to ask him about this and what should I ask him about Ontario's unique embrace of SMR technology?

A: Well, he's a massive supporter of nuclear energy and a real big champion and actually you can ask him what Ontario is planning to do in the future as it relates to not only the Darlington nuclear project but what are they planning to do beyond that project because we have a need for doubling the size of the grid and how nuclear features into that is huge and what kind of policy supports, and particularly financing and work with federal government, the provincial government can continue to do is critically important for our success both at Darlington but also beyond. I think you'll have a great conversation with him.

Q: Okay. One last question is just to clear up some ideas and make sure everything's clear. Is OPG a publicly owned company? Is

it a private company? You mentioned TVA. TVA is technically not a company; it's like Bonneville, it's a public power agency. Tell me what kind of animal is OPG and do you have stockholders?

A: Yes, so we are setup as a private company. We were actually setup originally to be sold; that was the original intent of the government in 1999 and ultimately was stopped for various reasons which we probably don't have time to get into here, but we have a very sophisticated independent board of directors with significant nuclear expertise. There's \$66 billion dollars' worth of assets here in Ontario. We're rated by S&P, Moody's. I missing one, DBI I believe, and we raise all of our debt in the private markets, well, much of it and that's something that's happened over the last 5-10 years, and we're actively building now a lot of the energy infrastructure here in Ontario. We are owned 100% by the Province of Ontario so Mr. Smith, whom you'll be speaking with is our shareholder and we have obviously, a close working relationship with the minister in the province and they also hold a couple of hats; they are the regulator and energy policy center as well but that's the nature of OPG.

Q: Do you think that's the secret sauce here and this will be my last question because the United States, there's always been a tug of war with the NRC and state regulators and utilities and people are complaining that the NRC processes were too

complicated and they had to be simplified and streamlined. Do you think, I mean if countries like China and Russia; they don't have that. It seems like your situation's fairly unique to compared to a lot of investor-owned utilities in the United States. Do you think your situation is kind of like a unicorn; unique situation, or do you think that this technology's going to rapidly spread to lots of diverse entities like investor-owned utilities?

A: Oh, I think it's going to spread. I think like...sure, we have a unique situation but I don't think it's just based on the politics or the governance. I think it's based on the talent and skill that we've shown building out a Darlington Refurbishment Project so if we didn't do that successfully, we wouldn't be building SMRs, right?

Q: Um hum.

A: So, that credibility is something we've built and whether you're public or private, I don't think it matters. If you have the right team in place to do this right, and we are partnering with both public sector and private sector. In Saskatchewan, we are working with the public utility, Saskatchewan Power to deploy SMRs out there and we announced last week, Monday, that we're working with Capital Power, which is a publicly traded on a TSX, \$4.5 billion dollar CAPEX company. They're very motivated to get into the small modular reactors space and they have numerous

assets in the United States so I think this is going to rapidly be spread and we have the first mover advantage and we have the support from the government to move forward and the credibility to make it happen and we will get it done.

Q: Thank you, Sandra. It's a pleasure talking to you.

A: Thank you, Marty.

We've been talking to Sandra Dykxhoorn who's the vice president of New Nuclear Growth at Ontario Power Generation.

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