

MARCH 2018

PUBLIC UTILITIES FORTNIGHTLY

"In the Public Interest"

Jeff Lyash, Michael Britt
Jim Pyke, Dolores Midkiff-Powell
Pat Wood, Kenny Mercado
Jim Steffes, Miles Keogh



NARUC Winter Meeting 2018

Commissioners Emeriti Ed Salmon,
Kim Pizzingrilli, Jim Sullivan
Were There Too

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Cover photography: From left to right, Ed Salmon, NARUC Commissioners Emeritus president for the last sixteen years, former New Jersey Board of Public Utilities president; Kim Pizzingrilli, former Pennsylvania Public Utility Commission commissioner; Jim Sullivan, former NARUC president, former Alabama Public Service Commission president. Photographer: PUF Staff.

Leadership Lyceum Podcast

The Hydro and the Mega Project



Tom Linquist with Jeff Lyash,
President and CEO of Ontario Power Generation



joined Jeff Lyash, president and chief executive officer of Ontario Power Generation, at his office in Toronto for this discussion. Jeff joined OPG and was appointed CEO on August 21, 2015.

OPG is wholly owned by the province of Ontario. OPG was created as part of the restructuring of Ontario's electric system in April 1999. That was when the giant Ontario Hydro company separated into five companies.

One of the largest companies became generation company OPG, and the other became transmission and distribution company Hydro One.

Tom Linquist: Ontario's electricity industry has a rich history, along with a great deal of provincial pride, national pride and politics associated with the electric industry. Please give us a historical perspective.

Jeff Lyash: The origins of these five companies, including OPG and Hydro One, date back to the early twentieth century, with Sir Adam Beck. He was responsible for harnessing Niagara Falls to electrify Canada – Ontario specifically.

Sir Adam Beck traveled in a van across Canada, explaining the power of electricity to people, and the difference it could make in their lives. He told them how that could be done for the benefit of the economy, for the benefit of the citizens of Canada, and the benefit of the environment.

That tradition persists today. Folks around here still call us "The Hydro." The Hydro holds a place in the consciousness of Ontarians and is different than what I've seen in the U.S. It's not an afterthought. It's one of the central things people focus on here.

Back in the late '90s, Ontario Hydro covered the electricity business from generator to meter, set its own rates, and essentially ran the electricity system in Ontario. It began to be viewed as too large. An artifact of the past.

It was viewed as not reflective of the trends of the time, which included a move to a more market-based approach to electricity. As a result, in 1999, the Ontario government decided to break the company into parts.

These parts became OPG as the generator, Hydro One as the transmitter, Ontario Energy Board as the cost regulator, and essentially an independent electric system operator, the IESO. For the last decade, or decade and a half, we have been transitioning out of that long history into this current construct.

Tom Linquist: What are some of the large evolutionary steps in the market's transition?

Jeff Lyash: You have to think in terms of the life of these assets. I can't think of a complex project in the power sector that gets done in less than ten years.

Ten years is a typical project lifetime. Asset lives are forty, sixty, eighty, a hundred years long. You always must think in terms of decades when you're considering what the plan is, and

The Hydro holds a place in the consciousness of Ontarians and is different than what I've seen in the U.S.

what the regulatory and market frameworks are.

One large step is the transition to something that is more market-based. One that includes bilateral contracts for generation, but also includes a competitive marketplace for energy capacity and ancillary services.

The province started down that path, had some issues with those markets, recoiled a bit and as a result has remained in a hybrid location for several years.

The IESO is undertaking a market renewal effort over the next year to eighteen months. It will look at the experience of the last decade, and look forward to the next decade, at what's going to be required in this system to redesign the marketplace as it exists. That's certainly a big step.

A second big step is the creation of the Ontario Energy Board, and the OEB's process of learning how to conduct ratemaking for generating companies like OPG and for wires companies like Hydro One.

There's an effort underway by the province to look at the cost regulator's process and approach to decide whether it is properly set up for the future. This is running in parallel with that market renewal assessment.

Tom Linquist: Is it unusual for a regulator to look at their own processes that way?

Jeff Lyash: I think it is a bit unusual, but we're ten years into this. That is a brief period. Now is a good time for the IESO and the OEB to look to the future and decide what adjustments are needed, and for the industry participants to do the same.

Tom Linquist: There are other notable components of Ontario's electric system that appear to create a long-term competitive advantage in North America.

Jeff Lyash: Ontario has covered a huge swath of ground in

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OPG President & CEO Jeff Lyash launches refurbishment of Darlington Nuclear Generating Station

the last ten years in terms of the makeup of its power system. Canadians think of their electricity system as a point of pride.

They're also very concerned about the environment.

There is real concern about reducing greenhouse gases. A first point of focus has been the decarbonizing of the power system in Ontario.

Over the last ten years, and accelerating over the last five, Ontario has effectively decarbonized the power system. The percentage of economy-wide greenhouse gas in Ontario that's produced by the power system is substantially less than ten percent.

That compares to probably thirty to forty percent in most jurisdictions in the U.S. The carbon intensity of electricity in Ontario on average for the last two years has been forty grams per kilowatt-hour.

California, a state very focused on this, is currently producing about two hundred sixty grams per kilowatt-hour. If we think about Germany, and I bring this up because of their push for high penetration of wind and solar, they're about five hundred sixty grams per kilowatt hour. So, you can see that the Ontario electricity system is one of the least carbon-intensive generating systems in the world.

Now that comes at a price. The other side of that coin is that the price of power in Ontario has gone up substantially. The price of electricity in Ontario is about sixteen cents per kilowatt hour. If I make the same comparisons, California is at about twenty-four and Germany at about forty-five.

Ontario has produced a very low-intensity carbon electricity sector at what globally is a very competitive price.

It started in the seven, eight, nine cent range and increased to sixteen cents as coal was retired, as natural gas came into that stack and as wind and solar penetration increased.

Is this a cost competitive advantage for Ontario? In the long term I would tell you yes.

In the short term, those costs have to be absorbed. Other

jurisdictions that surround Ontario have to begin to put a value on the low carbon intensity of that electricity system.

I think there's a long way to go before it reaches parity. The last point I'd make here, is how you accomplish this is really a regional question because your resources are different, region by region.

Ontario's approach here is to rely heavily on nuclear. About sixty-two percent of our kilowatt hours here in Ontario, on an annual basis, come from nuclear power. About twenty-eight percent comes from hydroelectric generation, and about ten percent comes from all other sources.

It's a good mix, but it requires a region-by-region focus on how to get to the least cost at the lowest carbon level.

Ontario probably came too far, too fast, so this move to low-intensity carbon and this increase in price for the local population is significant.

I think it could have been done over a longer period, and could have been done at a lower cost but could have arrived at the same endpoint. I think policy makers would agree. I think there are lessons for everyone in how Ontario came to have the system that it currently has with all of its advantages and disadvantages.

Tom Linquist: Let's talk about nuclear. You are leading what you refer to as a mega-project in the Darlington Nuclear Generating Station refurbishment. At a \$12.8 billion project cost.

Ontario has produced a very low-intensity carbon electricity sector at what globally is a very competitive price.

Darlington's four units produce about twenty percent of the province's power. You have had a very different experience with Darlington than your U.S. counterparts have had with their nuclear expansions. What is unique about your approach?

Jeff Lyash: That's right. When I think about Darlington, I don't think about it as a nuclear project. I do think of it as a mega-project.

Mega-projects, whether it's Darlington, or Vogtle and V.C. Summer in the U.S., Muskrat Falls in Canada, the Big Dig in Boston, these things are a different animal and I think they require a more disciplined approach than smaller projects.

They're more complicated. There is more uncertainty. There is more risk. They live over a longer period, through election cycles and economic cycles. Therefore, the approach to them has to be very deliberate.

As we framed out the Darlington refurbishment, we looked at the experience of new nuclear construction in the U.S., but we also looked more broadly at mega-project experience. I'd like to share eight points that are very critical for these projects. Each will sound simple, but the discipline around them is not so simple.



Darlington Nuclear Generating Station
located on Lake Ontario, east of Toronto

1. Scope: You must be clear at the front end what the scope is and have confidence that you've got the full scope identified. That may mean taking longer to make the decision on whether to proceed than you might otherwise want to take.

2. Cost estimate and schedule: It takes the development of a cost estimate and a schedule that is detailed enough and clear enough to be used to maintain accountability through the project. Undertaking one of these projects with a class five or four or even class three estimate as opposed to an estimate that's at the class two or three level, very high confidence, is the difference.

3. Engineering: Engineering needs to be complete before you're physically in the field, working the project, which is a very tall order. You not only have to complete the detailed engineering, you have to work it through your supply chain and adjust the engineering to reflect what you can actually buy instead of what you'd like to buy in the marketplace.

4. Up front extensive planning and preparation: Up front extensive planning and preparation using those first three: scope, cost and schedule, and engineering is critical. At Darlington, we actually spent a third of the total project cost before removing the first unit from service to go to work.

5. Embedded risks. One of the additional things that I try to keep in mind constantly, every day.

We have eyes wide open around risk. What are the embedded risks and what are we doing to mitigate or eliminate them? We looked hard at risk up front and monetized those risks into the price.

Tom Linquist: What does it mean to monetize risks?

Jeff Lyash: Calculate them in dollars through contingency,

Our objective at Darlington is to finish this \$12.8 billion dollar project on schedule and on budget.

risk-specific contingency, and into days in terms of scheduling.

Few people look at those risks at a detailed enough level. My focus every day is less on exactly what's being executed and more on where are we in terms of discovery, realization, and mitigation of the risks that we outlined at the front end of the project.

6. Lessons learned: They are incredibly important. Understanding all the lessons learned from other mega-projects at the outset and then throughout every series of work, extracting the lessons learned and applying them forward.

7: Oversight: It is critical. Having a layered, efficient but very aggressive oversight program so that we are aware as things go off track, which they do, daily. But they're recognized early and acted upon early.

8. Building a highly effective, motivated and aligned leadership team. Not just the owner but the owner's leadership team should be integrated and aligned with all the principal contractors. Being willing to hold that team to a very high standard and to adjust that team when it's not working, in real-time, is vital.

Our objective at Darlington is to finish this \$12.8 billion-dollar project on schedule and on budget. We're about sixty percent through the first unit and are currently ahead of schedule and slightly under budget.



Life-sized reactor mock-up used to train and practice for Darlington Refurbishment

That's the way we intend to keep the rest of the project. My experience is if you stay focused on these eight things I mentioned, it'll get you most of the way there.

Tom Linquist: Your training facility features a full-scale reactor mock-up inside the Darlington Energy Complex. You invested a significant amount of money to build the mock reactor. Please describe it for us.

Jeff Lyash: Managing these refurbishments, means basically replacing the reactor, taking it in pieces and rebuilding it inside the containment. That's a daunting task. Since we are in Canada, I'll use a Canadian hockey analogy.

It's a very complicated thing to do. It requires robotic tooling and because we are working in a highly radioactive area, most of it is done remotely.

If you were a hockey team and you only had the ability to talk about how you're going to play the game on paper, that would produce one level of performance. If you only had half a sheet of ice to practice on to do your skating drills and shooting drills, that would be better, but it still doesn't simulate the real game.

However, if you have the ice for as long as you need it with your entire team and you can play out the whole game over and over again, tweaking it and tuning it, you're much more likely to win.

In the past, projects were planned on paper or at best they were done with task-specific simulations. We decided that wasn't enough. We needed the full sheet of ice for as long as we had to have it.

We built a full-scale reactor – Calandria. Calandria has the same materials accurate to a thirty-second of an inch or better. Every tool, every process was designed, tested, time trialed on the reactor and that was all done before we ever started physical work in the field.

Every worker qualifies on every task and then qualifies on how all those tasks integrate into a series on that reactor before they ever walk into the plant.

Back to my point on having a good cost estimate and schedule, our estimate for the durations isn't built on how long it's going to theoretically take to pull an end fitting or to cut a bellows or to pull a pressure tube.

It's based on time trials over and over and over again to establish how long these tasks actually take. We built that cost and schedule estimate off those numbers, not off a guess.

I don't have to wait three months to decide whether we're hitting the schedule in the estimate. I know shift by shift. That's thanks to the work we put in on that mockup.

Tom Linquist: I was impressed by the tour of the mockup you treated me to back in November. But it was not just the facility, it was what was going on that very day.

You outlined the critical management points for a mega-project. You concluded the outline with the oversight program and with building highly effective and aligned leadership teams.

I observed those two areas in practice during my visit in November. Your leadership team did not like some of the things they were seeing at the project and had the authority to halt work. Please share what happened that day.

Jeff Lyash: Our philosophy is that performance is results times behaviors, and the harder you drive results, for example, the number of pressure tubes changed per shift, the harder you have to drive behaviors.

Good results produced with bad behaviors is bad performance. Good behaviors with no results is also bad performance. The harder you drive results, the harder you must drive behaviors.



Sir Adam Beck I Generating Station has provided clean, renewable electricity for nearly 100 years.

Therefore, a lot of our oversight focuses on worker behavior, worker and leadership behaviors.

In the case you mention, we began to see some behaviors from the front-line leadership and workforce that we didn't like. We were concerned that those could lead to safety issues. These behaviors were "at-risk" behaviors. Safety behaviors are always a precursor to production behaviors. If you can get the safety behaviors right, the production behaviors follow.

OPG's and our prime contractors' organizations showed a behavioral trend that we weren't happy with. It involved our workforce, but it also involved several levels of leadership in the field and on the team.

In that case, we shut the critical path down for a day and we brought three hundred leaders into the mockup. We spent the day going through exactly what behaviors we wanted, identifying what were the barriers to producing those behaviors, what was causing these.

We also discussed what did we need to adjust in our process, in our procedures or in our leadership approach to get square with that, and tried to align that leadership team around those.

Once we decided what we needed to do, we asked every leader at the end of that day to commit to it personally. Frankly, we had some leaders who wouldn't commit, and so we asked those

The harder you drive results, the harder you must drive behaviors. A lot of our oversight focuses on worker and leadership behaviors.

leaders to leave the project. They're not helping us if they're not all in, and I respect their honest answer.

That's a great example, I think, of oversight producing feedback to the leadership team that says, "You've got a problem and the problem involves leadership." And then taking the time to realign, recommit, and reengage that leadership team.

Folks said, "Jeff, you've lost a day or two on critical path. Isn't that a terrible thing?" My response was, "No, it's not a terrible thing at all," because those behaviors that we were seeing put us at risk of having a safety event that can shut the project down for months.

Just as importantly, those behaviors tell me we're not being as efficient and productive as we can be. So, standing it down to get it right, I'll earn those two days back in the next thirty, guaranteed, because production will go up.

People's confidence will go up. Their clarity will go up and as a result, their output will go up. [PDF](#)