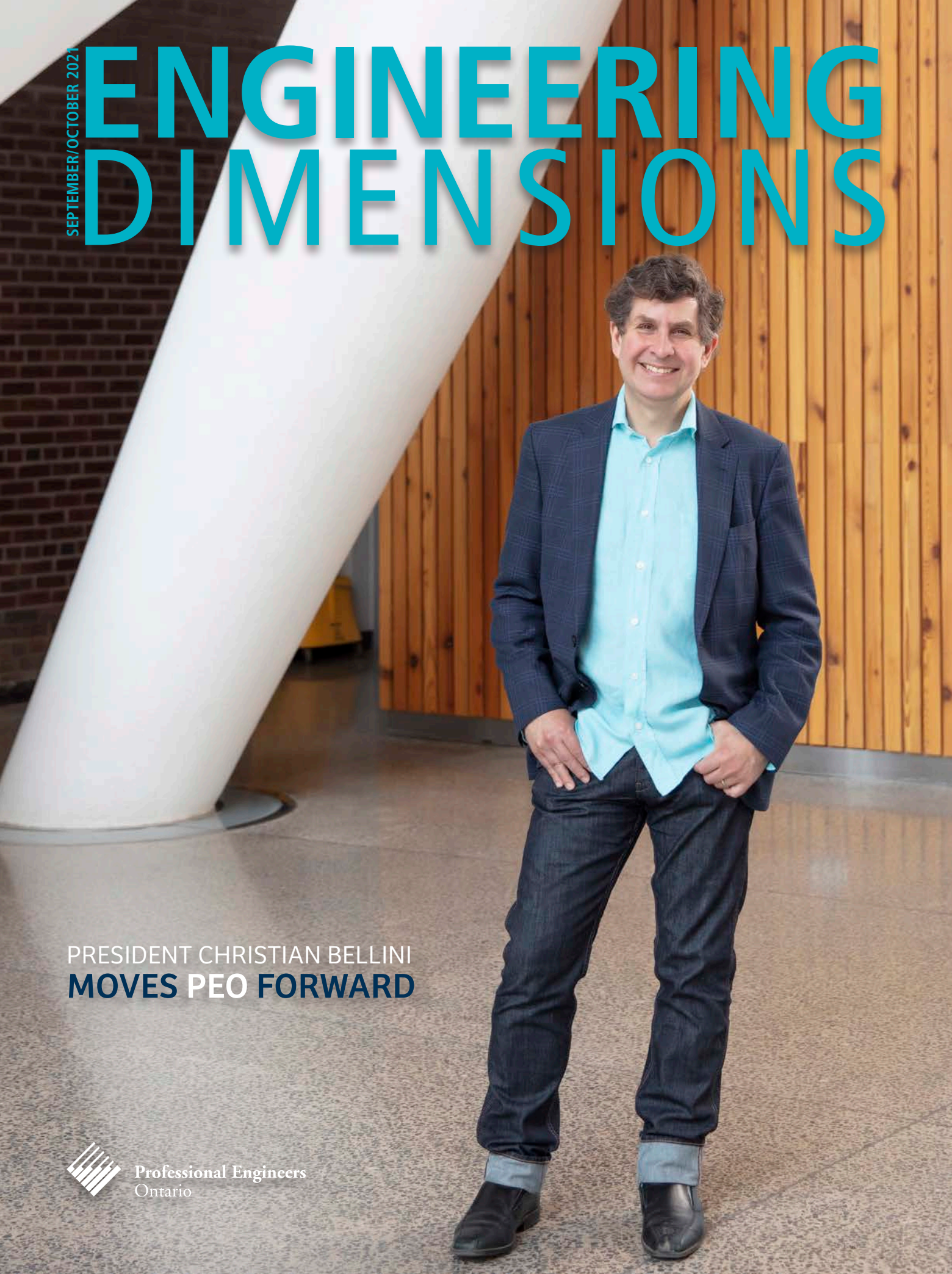
SEPTEMBER/OCTOBER 2021

ENGINEERING DIMENSIONS



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DEALING WITH ONTARIO'S MOST DANGEROUS WASTE

By Nicole Axworthy

For our annual environment theme this issue, we're unearthing a topic that is not often discussed: Ontario's ever-accumulating nuclear waste. For decades, we have been piling up highly radioactive used nuclear fuel—currently, there is more than 58,000 tonnes of it—in above-ground holding tanks at reactor sites across the country. But up until recently there was no permanent plan for it.

I, like many others, have been a complacent beneficiary of nuclear power and never seriously considered the sometimes uncomfortable truths of the industry, including the potential consequences of its waste. Although just 15 percent of the electricity produced in Canada comes from nuclear power, Ontario produces most of it—its 18 reactors supply nearly 60 per cent of the province's electricity. Given that nuclear waste is among the most dangerous stuff on Earth, what's the safest and most effective way to store it?

In our feature article this issue ("Deep geological repositories: Ontario's long-term solution to nuclear waste," p. 29), Associate Editor Adam Sidsworth details the province's strategy. It involves burying the waste in deep geological repositories—carefully planned and intentionally placed man-made caves—far below the surface of the Earth. Because nuclear waste remains hazardous indefinitely, engineers at the Nuclear Waste Management Organization have been tasked with creating and testing this complicated underground facility and barrier system so it has little chance of leaks. The in-depth article is a truly fascinating read.

This issue we're also featuring PEO's 2021–2022 president, Christian Bellini, P.Eng., FEC, whom you see on our cover page. As you'll read in "Christian Bellini helps build a solid foundation for change" (p. 18), Bellini is leading PEO through critical steps on its transformation journey to become a stronger and more modern regulator. And as part of that effort, he's prioritizing governance renewal to empower Council with the much-needed tools to move forward with the important task of regulatory reform.

On a similar note, it's almost Council elections season. On page 35, you'll find the call for nominations for PEO's 2022 Council elections, along with the procedures for candidate publicity and voting. Given that PEO is undergoing its most significant transformation in its nearly 100-year history, there's no better time to join the regulator's highest leadership team to help shape its future.

Finally, I'd like to thank everyone who took the time to send in their suggestions during our annual call for ideas. Rest assured I read every email. Your input is invaluable as we finalize our editorial themes for 2022. **e**

THIS ISSUE PEO is partway through its governance renewal, and it is also implementing the recommendations of the 2019 external review of its performance as the provincial engineering regulator. In this issue, we profile how PEO President Christian Bellini, P.Eng., FEC, plans to use his year-long term to implement many of those changes. And we explore how engineers are using their expertise to develop long-term solutions to the storage of Ontario's nuclear waste.

MOVING THE DIAL FORWARD TO ACHIEVE POSITIVE CHANGE

By Christian Bellini, P.Eng., FEC

It's hard to imagine that, as I write this message, summer is winding down. This summer brought some elements of what we might recognize as normal, with opportunities to see family and friends, albeit in a modified way. And yet so many things are still not normal. I continue to work primarily from home, only visiting my office now and then. As a structural engineer, I occasionally find myself on construction sites, and I can say with some certainty that there are not many work experiences worse than spending time onsite on a hot day wearing a hardhat, glasses and a mask.

At PEO, we are also still operating in pandemic mode, with most staff still not back in the office. And yet staff and volunteers have made great progress in getting us back on track by carrying out our essential work. While we are still working our way through pandemic backlogs, many of the process enhancements we have made will continue to provide benefits long after the pandemic has passed.

On the Council front, we have launched our four new governance committees, and they have begun the process of familiarizing themselves with and working through their new mandates. These committees are composed solely of councillors, and their role is to provide Council-level oversight over Council's four main areas of responsibility: Audit and Finance, Governance and Nominating (GNC), Human Resources and Compensation and Regulatory Policy and Legislation. The creation of these committees was one of the cornerstones of Phase 2 of the Governance Roadmap and seeks to bring clarity to the roles of Council, staff and volunteers regarding strategy, direction and operations.

MAXIMIZING LEADERSHIP COMPETENCIES

We are now entering Phase 3 of the Governance Roadmap, in which we focus on Council composition. The current make-up of Council comprises 17 elected seats, as well as additional government appointees, and it has remained unchanged for decades. It is based on a mixture of regional representation, directly elected officers and government appointees. The work to be done in this phase will include looking at things like representation (geographic, discipline, other), competencies (what are they, what would a Council skills matrix look like) and experience (engineering, regulatory, governance, other). Council size will also be considered and should be reflective of Council's compositional needs. In the end, what we are looking to achieve is a Council whose composition maximizes PEO's ability to be an effective, modern regulator.

The job of stewarding the ongoing governance work has—rightly—been given to the GNC, which met to discuss kicking off this phase in early August. Later that month, the full Council met in a plenary session and then again at the September Council meeting to continue these discussions. This is a big and important task, and it is critical to take the time needed to get it right.

> WITH OUR ONGOING MULTI-FACETED CHANGE PROJECT, WE NEED THE EXPERTISE OF ENGINEERS TO EMERGE AS A STRONG, MODERN REGULATOR.

FAIRNESS IN REGULATORY PRACTICES

Another important Council initiative is the work of the Anti-racism and Anti-discrimination Exploratory Working Group (AREWG), which presented its report at the June Council meeting. Please take the time to read the report, which is posted on the PEO website (www.peo.on.ca/sites/default/files/2021-06/AREWGConsultantsReport.pdf).

The AREWG was created last year and tasked with scoping out risks related to racism and discrimination facing PEO. Council accepted the report and asked the working group to return with recommendations for next steps. I cannot overstate the importance of this work. Fairness in regulatory practices cuts to the very core of our responsibility as a regulator. Having identified the risks we face, we must dig deeper into them, understand what their impact on PEO might be and take steps to ensure they are addressed. Our primary role as a regulator is to work to regulate the practice of professional engineering and engineers to protect the public interest—it is the public to whom we are responsible. If our regulatory processes protect unevenly or in a discriminatory way, we are letting the public down. Fairness really must be at the heart of our work.

A NEED FOR ENGINEER EXPERTISE

Lastly, I would like to make a few comments on PEO's upcoming election. By the time you read this, the opening of nominations for seats on Council will be almost upon us. Engineering in Ontario (and, indeed, across Canada) is a self-regulated profession. To me, this means the public benefits when we have the knowledge of experienced engineers around the Council table to make decisions on how best to regulate our profession. Take some time to consider the role of PEO as a regulator, the role of Council and the challenges that face our profession today. With our ongoing multi-faceted change project, we need the expertise of engineers to emerge as a strong, modern regulator. Whether you are a voter or a candidate, please think about how you can play a part in achieving that goal. e

PREPARING FOR A NEW WAY FORWARD

By Johnny Zuccon, P.Eng., FEC

As the summer months draw to a close, I hope you had the opportunity to safely enjoy some time and good weather with your families and loved ones. As I've said before, it's important to always make those we care about our priority, especially in these uncertain times.

It has been 18 months since we closed our office at 40 Sheppard Avenue West to the public, our volunteers and most of our staff, while transitioning to a virtual work environment. As of this writing, the province—thanks to vaccinations and other public health measures—has moved to a point where we can plan for a staged return to the office.

Of course, our physical office hasn't been closed completely to all work. Select staff have been granted access as allowed, and as needed, to complete essential regulatory work. For example, a team of 12 has been working five days a week on our Information Discovery and Digitization Capability (IDDC) project. The IDDC is a records conversion process that aims to transform 21,000 paper applications into usable digital information accessible from PEO's licensing and licence holder system. It started in earnest in March 2021, after the initial lockdown was lifted, and has been running continuously since except for during the second, shorter lockdown just after Easter. The project is part of a larger digital transformation journey to enable greater automated processing, deeper business intelligence and overall greater efficiencies.

OUR RETURN-TO-OFFICE PRIORITIES

As we continue to strive to fulfill our goal of becoming a more modern regulator, our priorities for returning to the office are two-fold. Our foremost priority remains protecting the health and safety of our employees and others who engage with us. Secondly, we aim to ensure we can all perform our work effectively and deliver on our mandate to regulate in the public interest. We will base all our decisions regarding both the timing and the nature of the return to the office on these two principles.

Assuming the reopening of Ontario proceeds as planned and anticipated, and of course assuming there are no further large waves or lockdowns in the intervening period, staff will begin returning to the office this month. This does not mean all staff will be working full time in the office. Rather, it means we will begin a gradual return, where most staff will be in the office at least one or two days a week. Moreover, those with functions that were mostly paper based and those who support those functions will be prioritized for the return to the office on a more frequent basis, provided this can be done safely.

“AS WE CONTINUE TO STRIVE TO FULFILL OUR GOAL OF BECOMING A MORE MODERN REGULATOR, OUR PRIORITIES FOR RETURNING TO THE OFFICE ARE TWO-FOLD. OUR FOREMOST PRIORITY REMAINS PROTECTING THE HEALTH AND SAFETY OF OUR EMPLOYEES AND OTHERS WHO ENGAGE WITH US.

The COVID-19 pandemic will likely forever change the way we work, and it has always been clear that the way forward would not simply be to a return to "business as usual." Today, there is near universal agreement that flexible working models have proven to be better and more productive than most would have imagined possible—yet another sign of how this pandemic has forced us to rethink our current working style.

A HYBRID WORK MODEL

In May, staff were invited to take part in a hybrid work model survey, and the results revealed that employees adapted well to the work-from-home environment and were interested in maintaining a flexible working model, even once the pandemic has ended.

Keeping in view the needs of employees and creating a balance between remote and onsite presence, we intend to promote a hybrid work arrangement that best matches the needs of each department. A hybrid workplace mitigates many of the downsides of pure remote working, creating a professional space outside the home for employees to collaborate with colleagues. It offers the best of both onsite and offsite accessibility for employees.

In addition to devising a model that promotes productivity and enables it to be measured, our priority will be to encourage greater collaboration when employees are working from different locations. We also want to ensure employees feel supported and enabled regardless of where they are working.

Apart from being an effective regulator, we also strive to be an employer of choice, especially in this new and challenging work environment. Our staff will continue to change and evolve the way in which they work, collaborate and communicate with each other. The new work model will create a more resilient and flexible organization, which will support and encourage adoption of PEO's future workplace strategy. e

PEO PUBLISHES NEW GUIDELINE ON PERFORMANCE AUDITS AND RESERVE FUND STUDIES FOR CONDOS

By Adam Sidsworth

PEO has published the new practice guideline *Professional Engineers Conducting Performance Audits and Reserve Fund Studies*. The publication follows a four-year wait in producing the guideline due to delays in the implementation of some of the province's 2015 amendments to the *Condominium Act* (CA).

The guideline defines best practices and emphasizes engineers' duties to their employers, clients and the public while carrying out reserve fund studies and performance audits for condo corporations. These best practices apply to all condo types (standard, leasehold, vacant land, commercial, industrial and common element) and all building styles (high-rise, mid-rise, low-rise and townhouse).

The purpose of a performance audit is to develop a list of deficiencies in the performance of the common elements that may give rise to a claim for payment under the *Ontario New Home Warranties Plan Act*. Additionally, a reserve fund study helps a condo board adequately save for major repairs or replacement of a condo's common elements and assets of the condo corporation.

"This guideline is not intended to replicate the requirements in the *Condominium Act* and regulation, but rather to provide engineers who provide these services with some guidance with respect to reasonable expectations for service delivery, as well as enhanced practices," notes the guideline. "It is also hoped that this guideline will be read by condominium boards of directors and condominium property managers so they understand the services they should expect to receive from engineers responsible for providing performance audit and reserve fund study work."

FOLLOWING UPDATED LEGISLATION

PEO Council initially instructed the Professional Standards Committee (PSC) to create a subcommittee to develop a condo audit and reserve fund study guideline in July 2012, following the province's decision a month earlier to review the CA. By the end of 2015, the province had passed the *Protecting Condominium Owners Act*, which amended the CA; the *Ontario New Home Warranties Plan Act*, which engineers performing performance audits should be familiar with; and introduced smaller amendments to related acts. It also introduced the *Condominium Management Services Act*, an independent piece of legislation.

By the middle of 2016, the PSC's subcommittee posted draft documentation on PEO's website and initiated a stakeholder consultation process with external organizations, including Tarion Warranty Corporation, the Ministry of Government and Consumer Services, Consulting Engineers of Ontario (now Association of Consulting Engineering Companies–Ontario) and the Ontario Society of Professional Engineers. However, the subcommittee paused its work in 2017, after the province delayed the implementation of many of the acts' amendments, which were further delayed by a change of government in 2018. Although the majority of provisions have yet to be brought into force, drafting of the guideline resumed in 2020. Consequently, PEO's guideline is published to advise engineers under the current requirements of the CA.

Anticipated regulatory changes are outlined where appropriate; however, readers are cautioned that "such changes are the 'best guess' of the authors of this guideline and are provided simply to give a 'heads-up' to users of this guideline as to changes that may occur," and "a new version of this guideline will be published once the new regulations are published."

PROFESSIONAL RESPONSIBILITY AND LIABILITY

Conducting performance audits falls within the practice of professional engineering and architecture since they are:

- Acts of evaluating, advising and reporting;
- Safeguarding of life, health, property or the public welfare is concerned; and
- Requiring the application of engineering and architecture principles.

However, the guideline also notes that "while the regulations in force at the time of publication of this document allow non-engineers to conduct reserve fund studies, it is the position of the Professional Standards Committee [based on a legal opinion] that under the following circumstances, a comprehensive reserve fund study or a reserve fund study with a site visit should be conducted by an engineer within the meaning of the *Professional Engineers Act*:

- Buildings four or more storeys in height;
- Buildings with suspended structural slabs that support parking, driveways or landscaping;

- Buildings with balconies, other than wood balconies that are fully exposed;
- Post-tensioned structures; and
- Other high-risk structures."

Engineers are required to stamp their reserve fund study reports as per the *Use of the Professional Engineer's Seal* guideline if any of the above-mentioned scenarios are present. However, it is also recommended that engineers stamp all reserve fund study reports. The guideline also notes that the list of qualified people allowed to conduct reserve fund studies may be shortened as new regulations are introduced. Nevertheless, the guideline recommends that engineers follow their professional obligations under the *Professional Engineers Act*, noting: "Engineers must bear in mind that their duty to protect the public welfare is their highest duty. This duty could involve not following a direction from the client, where the direction would conflict with the duty to protect the public welfare."

The *Professional Engineers Conducting Performance Audits and Reserve Fund Studies* guideline is available under the Knowledge Centre tab on PEO's website, under Practice Advice Resources and Guidelines. For further information about this or any other PEO guideline, contact PEO's practice advisory team at practice-standards@peo.on.ca.

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BC REGULATOR GRANTS VOTING RIGHTS TO ENGINEERING AND GEOSCIENCE TRAINEES

By Adam Sidsworth

Beginning this year, Engineers and Geoscientists BC's (EGBC's) 8000-plus members-in-training (MITs) will be allowed to vote in the regulator's council elections and propose and vote on motions at annual general meetings (AGMs).

MITs, who consist of engineers- and geoscientists-in-training, were extended the right to vote after delegates at EGBC's 2017 AGM approved a submission asking EGBC's Council to consider extending voting rights to MITs. EGBC's Council in September 2018 initially supported the submission; however, implementation of the decision would have required an amendment to the then-current *Engineers and Geoscientists Act* (EGA). But at the time, the EGA was under review, as the province was in the midst of regulatory changes that saw the eventual repeal of the EGA and its incremental replacement by the *Professional Governance Act*, an umbrella piece of regulatory legislation that took full effect just this year (see "Mandatory professional development coming for BC engineers," *Engineering Dimensions*, May/June 2021, p. 12).

The decision to extend voting rights to MITs followed a recommendation from EGBC's Nomination and Election Review Task Force, which reviewed the 2017 AGM submission. The task force completed an environmental scan of other engineering, geoscience and engineering regulators and found inconsistencies across the country. The task force found that, at the time, Manitoba's engineering and geoscience regulator allowed interns to vote for one reserved position on its council, while in Saskatchewan, New Brunswick, Newfoundland and Labrador and Nova Scotia, interns could vote, and, in some instances, stand for election to their respective councils. But in Prince Edward Island, Alberta and Ontario, interns could not vote at all.

Following EGBC Council's acceptance of the task force's report, EGBC initiated a member consultation process, during which some MITs expressed that they didn't attend AGMs because they couldn't vote but said they would attend if voting rights were extended to them. Additionally, some members also expressed hope that including MITs in governance matters may boost the involvement of MITs in self-regulation and maybe even increase the retention of women in industry. With EGBC's adoption of full voting rights for MITs into its bylaws, MITs will be able to vote for this year's Council elections this fall and introduce and vote on motions at this year's virtual AGM on October 25.

EIT VOTING RIGHTS AT PEO

PEO does not currently extend any voting rights to its engineering interns (EITs). EITs registered with PEO can neither vote for Council elections nor introduce or vote on submissions at PEO's AGMs. However, at PEO's 2019 AGM, Michael Martin, P.Eng., seconded by then-East Central Region Councillor Arthur Sinclair, P.Eng., introduced two submissions on behalf of Vanessa Raponi, EIT, the second of which asked Council to allow EITs to vote in PEO Council elections (see "2019 AGM focuses on the role of the regulator," *Engineering Dimensions*, July/August 2019, p. 7). The submission carried among members at the AGM, with 63 per cent of attendees voting for the submission. Member submissions that are brought forward to AGMs are non-binding on Council and those passed by AGM delegates are brought to a future Council meeting for discussion.

Raponi addressed Council at its September 2019 meeting, where Council members considered that year's AGM submissions. At the meeting, after much discussion, Council ultimately passed a motion allowing for the submission—allowing EITs to vote in Council elections—to be reconsidered at a future Council meeting (see In Council, *Engineering Dimensions*, November/December 2019, p. 50). Nevertheless, the issue has not appeared on any subsequent Council meeting agendas since then.

BITS & PIECES

The Nuclear Waste Management Organization's Adaptive Phased Management plan requires used nuclear fuel to be contained and isolated in a deep geological repository. A multiple-barrier system made up of a series of engineered and natural barriers will work together to contain and isolate used nuclear fuel from people and the environment over the long term at a depth of about 500 metres below the surface.
Photo: ilker

Researchers at the University of Toronto Institute of Biomedical Engineering, in collaboration with Sunnybrook Health Sciences Centre, Public Health Ontario and Mount Sinai Hospital, have engineered a diagnostic test that uses a smartphone camera to track COVID-19 patients. Researchers engineered quantum dot barcoded microbeads and a secondary label to search for antibodies against COVID-19 antigen in a patient's blood, and finding antibodies leads to a change in microbead emission colour.
Photo: Ajay Suresh

UNIVERSITY OF WATERLOO INTRODUCES AUTONOMOUS CAMPUS SHUTTLE BUS

By Adam Sidsworth

The University of Waterloo's (U of W's) Mechatronic Vehicle Systems (MVS) Laboratory is hoping to introduce a fleet of autonomous vehicles (AVs) as a regular shuttle service on the university's main campus this month in what the university is billing as "a significant milestone in a multi-year initiative to demonstrate and integrate autonomous transportation onto the campus."

Lead researcher Amir Khajepour, PhD, P.Eng., Canada research chair in mechatronic vehicle systems, senior NSERC/General Motors industrial research chair in holistic vehicle control and professor of mechanical and mechatronics engineering at U of W, hopes to receive the necessary permission from the Ontario Ministry of Transportation to introduce the WATonoBus, a proposed 2.7-kilometre, five-stop service on the university campus's The Ring Road, where it would operate in mixed traffic and connect with ION light rail, which serves the Kitchener-Waterloo area; and the local Grand River Transit bus system and GO Transit regional bus routes.

"The Ring Road goes all around the south campus," says Khajepour, who is leading the research team of postgraduate engineering students, research engineers, technicians and other faculty members. "This road sees any vehicle types, from large trailers and buses to passenger cars and bicycles, and, especially during the time that students go from one building to another building, it becomes crazy…WATonoBus will experience all the components of an urban drive environment."

WATonoBus is the result of funding from the federal and provincial governments through the Canada Foundation for Innovation, Natural Sciences and Engineering Research Council of Canada and Ontario Research Fund and the private sector, notably Applanix, RoboSense and Rogers. It is through the collaboration with telecommunications giant Rogers that WATonoBus is the first AV in the country to operate remotely on Rogers' 5G network. "The modem onboard will communicate through the Rogers 5G network with the MVS lab control centre," Khajepour says. "In the control centre, a remote operator will monitor the WATonoBus operations and take over control when needed to ensure safe movement."

WATonoBus follows a December 2019 agreement between U of W and Rogers to advance 5G research in the Toronto-Waterloo tech corridor. Since going live in September 2020, the Rogers-U of W partnership has added next-generation network technology and capabilities on the campus, including 5G mmWave (28GHz) small cells, which provide ultra-low latency and high bandwidth to aid in numerous 5G research projects at the university, including WATonoBus.

THE WATONOBUS VEHICLE

WATonoBus operates with an onboard sensor system that gives the vehicle its intelligence and control; additionally, the vehicle is equipped with a series of front, rear and side cameras that provide a 360-degree panoramic view and light detection and ranging active remote sensing systems used for detecting objects. However, an operator will be required to be on WATonoBus while in operation to meet regulations. Khajepour notes that the operator would step in only if the situation warrants human intervention.

An operator on board the WATonoBus, an autonomous shuttle being developed by the University of Waterloo to service the university's main campus

The WATonoBus as seen on the University of Waterloo campus

Amir Khajepour, PhD, P.Eng. (fourth from right), and members of his research team in front of the WATonoBus, an autonomous vehicle that may be permitted by the province to serve as a shuttle on the University of Waterloo campus

In 2016, Ontario launched its Automated Vehicle Pilot Program, a 10-year plan that allows for the testing of AVs on Ontario roads. In the province, AVs are defined as "a passenger or commercial motor vehicle or a streetcar, excluding a motorcycle or motor-assisted bicycle, with an automated driving system that operates at the Society of Automotive Engineers (SAE) International driving automation level three, four or five."

Khajepour anticipates that once WATonoBus obtains the necessary provincial approval, it will likely operate at either level three (conditional automation), with the vehicle as a co-pilot and managing most of the safety and critical driving functions but with the operator prepared to take over control of the vehicle at any time; or level four (high automation), where the vehicle can control all functions, although the operator still has the option to take control. "At four, it means it can handle more scenarios and environments," Khajepour notes. "In our case, the road is fixed, and the environment is fixed." But regardless of the level it ultimately operates, WATonoBus, like all AVs in Ontario, would be likely subject to the *Highway Traffic Act* and must be covered for liability insurance, accept responsibility for any at-fault collisions that it causes and be subject to standard police collision reporting rules.

Khajepour says that once operational, anyone will be able to utilize the WATonoBus, although he anticipates that it will likely be U of W students and faculty who ride the most. Additionally, Khajepour notes that anyone with a smartphone will be able to engage with WATonoBus. "We have a mobile app on both Apple and Android," Khajepour explains. "You download it, and it shows you exactly where the bus is. You can put in any building on campus, and it shows you where to take the bus and where to get off the bus. And that will help somebody who's coming to campus navigate."

THE FUTURE FOR AUTONOMOUS SHUTTLES

Khajepour notes that developing a permanent AV fleet of shuttle vehicles is likely in the distant future. "We're hoping to turn this into not only a service for the campus but in time a test for cities and other companies," Khajepour admits. "But there are many, many questions that we don't have any answers for [when it comes to AVs], especially for the cities."

ENGINEERS CANADA REPORTS ON REGULATORS' LICENSURE ASSISTANCE AND EMPLOYER AWARENESS PROGRAMS

By Adam Sidsworth

A new report commissioned by Engineers Canada presents a gender-based analysis (GBA+) of engineering licensure assistance programs (LAP) and employee awareness programs (EAP) provided by the 12 provincial and territorial engineering regulators. It makes three recommendations for Engineers Canada in its efforts to achieve greater equity, diversity and inclusion (EDI) in the profession.

The release of the report is timely, given that Engineers Canada announced its 2022–2024 strategic plan, which includes championing an equitable, diverse, inclusive and trustworthy engineering profession.

For the report, Prairie Research Associates (PRA) analyzed the regulators' individual LAPs and EAPs through a GBA+ lens, which means it specifically examined the impacts on various groups of women, men and gender diverse people. The report notes that for such programs to be effective, it is important that measures within these programs exist to address the barriers facing women and other underrepresented groups, and it summarizes those challenges underrepresented groups may face along the path to licensure.

The report also gathered regulator perspectives on the Engineers Canada–led 30 by 30 goal, a collaborative effort among Engineers Canada and all 12 engineering regulators, including PEO, to have women represent 30 per cent of newly licensed engineers by 2030. Several regulators questioned if the goal can be met; but they were hopeful that programs and initiatives put in place for 30 by 30 will result in positive effects not only for women but also for other underrepresented groups.

As part of its analysis, PRA environmentally scanned regulators' websites, annual reports, policy documents and other relevant publicly available material for evidence of GBA+ considerations; an online survey was sent to all regulators to understand the programs and services they offer to undergraduate engineering students, EITs and newly licensed engineers; and interviews were conducted with representatives of each of the regulators. In its report, PRA recommended that:

- Engineers Canada and the 12 regulators should engage in a GBA+ review of their activities, policies and procedures related to licensure and employer awareness to align their collective goals on EDI;

- Engineers Canada should develop a strategy for data collection on diversity demographics across the country that reflects the needs of the regulators; and
- Engineers Canada should strategically target national engineering employers as an important stakeholder group in the engineering ecosystem, recognizing that they play a critical role in the representation of women and in the achievement of the 30 by 30 goal. Conversely, should the regulators wish to undertake such engagement themselves, Engineers Canada could support these efforts.

BARRIERS TO LICENSURE AND FINDING WORK

The report noted that both LAP and EAP are "critical to promoting engineering licensure while simultaneously supporting increased diversity and inclusivity within the profession." However, the programs need to understand the barriers to licensure for underrepresented groups in the application process. Notable demographic-specific barriers include:

- Pressures faced by women, who leave the engineering profession earlier and at a higher rate than men because the profession is perceived as not welcoming of women, because of family pressures or because of a lack of women mentors, peers and leaders;
- Lack of access to engineering education for Indigenous Peoples because their secondary education doesn't offer the necessary prerequisites to engineering programs; and
- A lengthier, costlier, and more discouraging licensing application process for internationally trained engineers.

PRA noted in its report that Canada's engineering regulators offer various supports through LAP and EAP; however, "given that these supports are but a small part of the factors that influence the attraction of students and the retention of engineers to the profession, it is challenging to say with certainty the extent to which these supports are helping to creating a more robust pathway to licensure. Notwithstanding, while the value of these supports cannot be measured, regulators consulted through this review agreed that these initiatives and programs are helpful."

THE ROLE OF REGULATORS IN INCREASING ENGINEERING DIVERSITY

PRA noted that all 12 provincial and territorial engineering regulators agree that their role is to regulate the engineering profession and protect the public interest. However, only some include EDI or support systems to specific demographics.

"THE REPORT NOTED THAT BOTH LAP AND EAP ARE "CRITICAL TO PROMOTING ENGINEERING LICENSURE WHILE SIMULTANEOUSLY SUPPORTING INCREASED DIVERSITY AND INCLUSIVITY WITHIN THE PROFESSION." HOWEVER, THE PROGRAMS NEED TO UNDERSTAND THE BARRIERS TO LICENSURE FOR UNDERREPRESENTED GROUPS IN THE APPLICATION PROCESS.

"Some believe that, as regulators, they can do much more to encourage adoption of policies and practices that embrace [EDI] and to recognize when existing policies and practices act as barriers to underrepresented groups," the report states. "Several regulators suggested they could outline expectations of private employers and their employees; collect more detailed data on members; encourage private employers to publicly report on diversity and inclusion metrics to increase accountability; provide more information to volunteers, regulatory staff and employers about why [EDI] is important; and encourage workplaces to take training in things like implicit bias."

This approach closely resembles what could be taken by PEO Council, which, at its June 2021 meeting, accepted the Anti-Racism and Anti-Discrimination Exploratory Working Group's report, *Anti-Racism and Anti-Discrimination: A Bridge to PEO's More Successful Future*, and is awaiting further recommendations from the working group (see "PEO's anti-discrimination working group presents report to Council," *Engineering Dimensions*, July/August 2021, p. 23). However, the report notes that regulators' roles are limited: They have little say on who applies to study in a post-secondary engineering program; they have little say to how many or the types of international engineering graduates apply for licensure; and engineering employers have a much greater role in determining workplace engineering culture. However, organizations going the route of EDI often note that it is important to have an EDI champion with institutional power and to have dedicated and permanent financial and human resources who understand the language of EDI and have institutional support to implement EDI.

FORESEEABILITY AND EXTREME WEATHER IN BUILDING AND INFRASTRUCTURE DESIGN

By Sherin Khalil, P.Eng., PMP, and José Vera, P.Eng., MEPP

In 2017, the Canadian federal budget included an announcement of a new Disaster Mitigation and Adaptation Fund (DMFA) to adapt infrastructure projects to extreme weather due to climate change. One project funded by DMFA is the construction of new flood barriers and effluent pumping stations in London, ON, to deal with flooding events brought on by climate change.

Additionally, as part of the Climate-Resilient Buildings and Core Public Infrastructure Initiative, the National Research Council Canada (NRC) has undertaken work to integrate climate resilience into building and infrastructure design, guides and codes. For example, because of this initiative, the recent 2019 Canadian Highway Bridge Design Code now includes provisions related to climate change, sustainability and resilience, as well as fully updated historical data.

In Ontario, after flooding affected several parts of the province, Ontario's Flooding Strategy was released, in part to reduce flood risk. And, under Ontario's Build Back Better program, municipalities can obtain funding to rebuild damaged infrastructure and make it more resilient to extreme weather.

PROFESSIONAL OBLIGATIONS AND CLIMATE CHANGE RISK

Canada, including Ontario and local municipalities, is taking initiatives to tackle the effects of extreme weather due to climate change, such as flash flooding. These initiatives will influence infrastructure and building design in the coming years. Considering these events, do practitioners have a duty to account for extreme weather due to climate change in their infrastructure and building designs?

A compelling assertion is made in the law article "Unexpected effects: Infrastructure stakeholders may soon find themselves liable for the effects of climate change," by Sabrina Gherbaz and Patricia Koval of Torys LLP. The authors point out: "On the basis of Canadian case law, it's easy to imagine circumstances in which liability could be extended to owners, design professionals, contractors and governmental authorities who negligently failed to adapt infrastructure to climate change–related risk or to warn of such risk."

Practitioners are reminded that section 72(1) of Regulation 941 of the *Professional Engineers Act* contains the following definition of negligence:

> "negligence" means an act or an omission in the carrying out of the work of a practitioner that constitutes a failure to maintain the standards that a reasonable and prudent practitioner would maintain in the circumstances.

Furthermore, practitioners have a responsibility to follow current professional standards and account for foreseeable risks in their work, as per *The Canadian Law of Architecture and Engineering* (2nd ed., 1994). Authors Justice Beverley McLachlin, Wilfred Wallace and Arthur Grant say: "…the architect or engineer is to be judged by the professional standards prevailing at the time the work was done, not by what may be known or accepted at a later date, or what may be seen only with the benefit of hindsight…."

For more information on the relationship between professional negligence and foreseeable risks, refer to the Professional Practice article "Foreseeability and negligence in equipment and structure failures" (*Engineering Dimensions*, September/October 2019, p. 23).

Finally, it is important to note that legal definitions of professional standards not only include written standards such as codes, but also "knowledge or experience generally available in the…engineering community" as noted in the case *Hilton Canada Inc. v. S.N.C. Lavalin Inc., 1999 CanLII 1352 (NS SC)*.

Based on the above, a reasonable and prudent practitioner would make responsible provision to comply with current written standards and take heed of the prevailing knowledge or experience available in their engineering community to account for foreseeable risks. This concept applies perfectly to practitioners designing infrastructure and buildings considering climate change risks. They may need to design infrastructure and buildings to a higher standard than current written standards, if their engineering community determines, based on prevailing knowledge and experience, that adopting a higher standard is necessary to account for foreseeable climate change risk. The legal article "Climate risks become major regulatory concern for insurers" by Norton Rose Fulbright supports this conclusion: "Professionals such as architects, engineers and civil engineers can face liability claims where they fail to take climate risks into account in their designs if foreseeable damage to buildings occurs in extreme weather events."

STANDARDS NOW REFER TO FORESEEABLE CLIMATE CHANGE RISKS

Ultimately, practitioners are responsible for accounting for foreseeable climate change risks in their work even if these risks might not be covered in a specific written standard. However, some written standards now refer to the obligation to account for foreseeable or anticipated climate change risks, such as the Ontario Building Code, which notes that buildings constructed in flood plains shall be designed to withstand anticipated hydrostatic pressure:

3.1.1.3. Building in Flood Plains

(1) Buildings constructed on flood plains shall,

(a) be designed and constructed in accordance with good engineering practice to withstand anticipated vertical and horizontal hydrostatic pressures acting on the structure.…

How do practitioners account for foreseeable extreme weather risks in their designs of infrastructure or buildings, especially when current written standards might be considered outdated by their engineering community? We mentioned above that practitioners may need to design to a higher standard. However, how do they determine this higher standard?

CONSIDERING FORESEEABLE EXTREME WEATHER RISK

A key point is that foreseeable extreme weather risk can differ by project, specifically by location and type of infrastructure. For example, flooding and strong winds due to extreme weather vary by region—notably, some regions are more prone to flooding or damaging winds than others. Also, some types of infrastructure, such as stormwater drainage systems, are already stressed by climate change in several locations in Ontario. So, as often happens in professional engineering, there is no one answer; rather, the response would depend on the particulars of each situation. In other words, practitioners need to adopt a case-by-case approach when considering climate change risk in their work.

As per the Code of Ethics, practitioners have a duty to "act at all times with…knowledge of developments in the area of professional engineering relevant to any services that are undertaken." Consequently, practitioners are advised to research and become well informed on the latest climate change adaptation technical literature applicable to their projects and consider taking professional courses in this subject. A good starting point is the guide *Principles of Climate Change Adaptation for Engineers* from Engineers Canada (www.peo.on.ca/sites/default/files/2019-07/Principles%20of%20Climate%20Change%20Adaptation%20for%20Engineers%20.pdf). This above guide contains helpful principles and elements that assist practitioners in integrating climate adaptation into their practice, such as reviewing the adequacy of current standards, working with specialists and stakeholders and applying risk management principles for uncertainty, to name a few.

Practitioners should have conversations with their clients about incorporating climate change adaptation in their projects. Furthermore, because extreme weather risks could result in claims, practitioners should contact their professional liability insurance providers for advice in these matters. Because practitioners primarily rely on climatic design data contained in codes and standards, such as the various governments' building codes, these codes and standards agencies have a responsibility to update those documents to reflect current research and address climate change in a timely manner. However, practitioners are cautioned not to rely on a government agency doing so but rather to use their judgment to assess whether the design data they obtain from the current code being referenced is appropriate for the specific situation being considered. **e**

Foreseeable extreme weather risk can differ by project, specifically by location and type of infrastructure. In other words, practitioners need to adopt a case-by-case approach when considering climate change risk in their work.

FURTHER READING

1. "Unexpected effects: Infrastructure stakeholders may soon find themselves liable for the effects of climate change," by Sabrina Gherbaz and Patricia Koval of Torys LLP www.lexology.com/library/detail.aspx?g=89469eb0-13fa-4f6a-beab-2ccf318c79e1
2. "Climate risks become major regulatory concern for insurers," by Norton Rose Fulbright https://www.nortonrosefulbright.com/en/knowledge/publications/4ad1fb5f/01-sea-change-climate-risks-become-major-regulatory-concern-for-insurers

Sherin Khalil, P.Eng., PMP, is PEO's standards and guidelines development coordinator. José Vera, P.Eng., MEPP, is PEO's manager of standards and practice.

NUCLEAR ENGINEER GIVES BACK TO OTHERS AFTER FINDING SUCCESS

By Adam Sidsworth

Jothi Bavan, P.Eng., was inspired to give back to engineering students at her alma mater after receiving an act of generosity from an English-as-a-second-language (ESL) teacher.

"It was my ESL teacher, Mrs. Edwards, [who donated] her own money to the top ESL student entering university," says Bavan of the $1,000 scholarship Edwards gave Bavan when she entered her first year at the University of Waterloo, where she earned her undergraduate degree in chemical engineering. "Why did she have to do that? It's her own money," Bavan asks. It was Edwards' generosity, along with a second first-year bursary Bavan received from the University of Waterloo, that inspired Bavan earlier this year to start the $2,000 Kanagampikai Suntharampillai Entrance Bursary, which will be awarded to a woman in her first year of undergraduate studies in chemical engineering at the University of Waterloo. Bavan named the bursary in honour of her late mother, who passed away at the age of 81 in January 2020.

"I wanted to give back to Waterloo because I also got that help," explains Bavan, who is currently a senior manager at Ontario Power Generation's (OPG's) Darlington Nuclear Generating Station, where she leads four teams that are supporting the nuclear reactors, as well as the reactor that is currently being refurbished. "But I needed to be in the state to do it. And I thought, 'There will never be the right time. We need to buy a house. The kids need to go to school; we put them in extracurricular classes, and before we know it, they'll be in university.' But with my mom's passing, it made me want to recognize her as a single mother. Traditionally [in Sri Lankan culture], people don't remarry."

Jothi Bavan, P.Eng., is a senior manager at Ontario Power Generation. She was inspired by an ESL teacher to give back to engineering students in the form of a $2,000 scholarship named after her late mother.

A MEMORY—AND A LOSS

Bavan's mother raised Bavan and her five older brothers and younger sister singlehandedly in extreme poverty from the late 1980s onwards, after the death of Bavan's father, who had a brief fight with esophagus cancer in the family's native Sri Lanka; Bavan was just 12 when he died. Sadly, Bavan's father had lost his father at the age of nine, forcing him to work at various jobs, starting off as grocery store cashier and eventually becoming a bookkeeper. Bavan was the first girl born in her family, and Bavan says that her father instilled in her a desire to become a professional, even though her parents lacked the opportunity themselves to obtain a higher education.

"A lot of people think that in Sri Lanka, women are denied their education and are expected to stay at home and take care of chores until they are married off to be a housewife, but that's not very common—unless they are forced to do manual labour due to family circumstances," Bavan asserts. "Even when I was little, my dad would carry me on his shoulders, and people would ask me what I wanted to be when I grew up. At that time, I would say I wanted to be a lawyer. My dad wanted me to be a lawyer because I was born on the same day as my mom's second cousin, whom my dad really respected, and he was a lawyer. He was telling me I need to be a career woman. He always treated me like I was just as equal to my brothers, or even better."

SRI LANKA'S CIVIL WAR INTENSIFIES

Bavan was born into a Sri Lanka torn apart by civil war. The war had begun in 1983 as a clash between the Sinhalese-dominated Sri Lankan government and the Liberation of Tigers of Tamil Eelam (LTTE), which represented Tamils. However, Bavan notes that the civil war intensified in the years following her father's death. "We got displaced in October 1991," Bavan recalls. "There was a bombing two houses down the road; my mom's cousin, her husband, his brother and a young boy from the neighourhood were killed." Additionally, a 13-year-old classmate of Bavan was shot after coming face to face with the army. "That's how horrible it was," Bavan says. "I came to Canada in 1994, and I still look up at planes. We were taught that if you see a plane, just go lie on the ground."

Despite her family's move to another city, which was under LTTE control, Bavan remained a committed student and strived for good grades. "When I studied, I used a little lantern, and we would find a water bottle made out of glass and put kerosene in it, as electricity was denied to LTTE-controlled areas." Bavan adds, "The war left a lot of scars." To this day, Bavan and her family send money to Sri Lanka so that university students from low-income families can have scholarships.

> THROUGH HER OPG CO-OPS, BAVAN GAINED PRACTICAL EXPERIENCE IN NUCLEAR ENGINEERING, FOR WHICH SHE DISCOVERED A PASSION, AND IT WAS THROUGH OPG THAT BAVAN EARNED HER MASTER'S DEGREE IN NUCLEAR ENGINEERING AT MCMASTER UNIVERSITY.

It was because of the civil war that Bavan's family came to Canada. Bavan's oldest brother came first, and once he obtained his permanent residency, he sponsored the rest of the family's move to Canada, settling in the Greater Toronto Area. Bavan arrived at 17 and faced the burden of not speaking English; she recalls registering at Wexford Collegiate Institute (now Wexford Collegiate School for the Arts) and not really understanding what was going on because of her lack of English. She enrolled in ESL classes while studying the Ontario high school curriculum, including math and science classes. Because of her developing English skills, Bavan struggled to bond with fellow high school students. But she credits one math teacher, Mr. Carefoote, for helping her break out of her shell. "He knew how great I was doing at math," Bavan recalls. "People looked at me as a dumb girl who couldn't speak English. Mr. Carefoote would ask me to write the answers on the board, and I was getting perfect answers, and the class realized, 'Oh, she isn't a dumb person; she just doesn't speak English. In science class I was originally struggling because of the language, but I was able to get help from the friends I was helping in math."

A SUCCESSFUL STUDENT DISCOVERS ENGINEERING

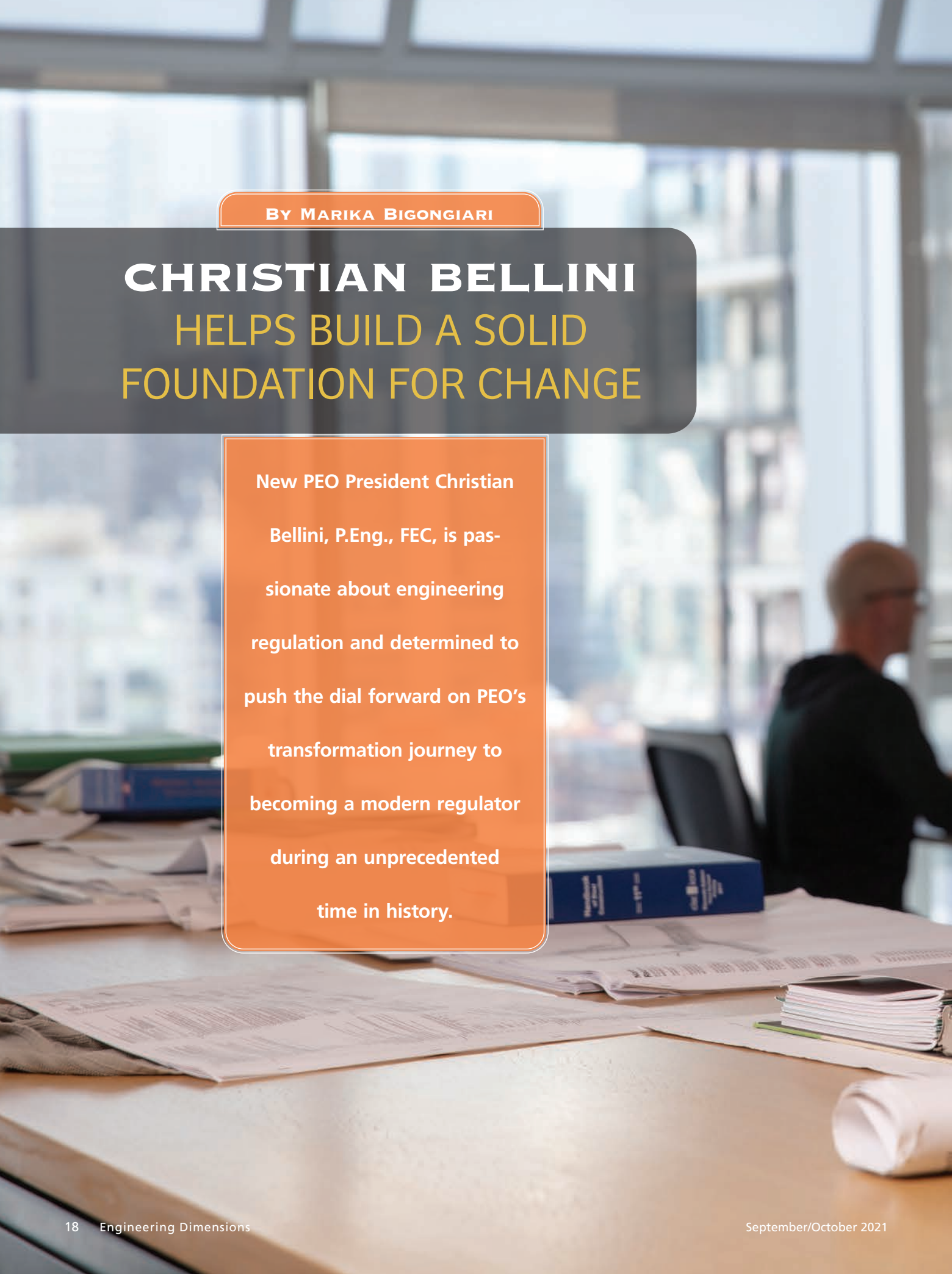
While in high school, Bavan had aspirations of becoming a medical doctor. But after a discussion with an ESL teacher, who advised Bavan that medical schools in Canada were apparently tough to get into, Bavan decided to change focus. "I'm a practical girl," Bavan says, "so I said, 'I love math and chemistry, and I always take things apart and put things together, even at a young age, so I'll do my second choice.' I chose chemical engineering." Admittedly, Bavan's knowledge of engineering at the time wasn't extensive. "I had an idea that it's a field in which you could use math and science. That's all I knew."

The refurbishment of Darlington's Unit 3 nuclear generator. Jothi Bavan, P.Eng., leads teams of the Darlington refurbishment supply chain.
Photo: Ontario Power Generation

Bavan chose the University of Waterloo because of its co-op placements, which she hoped would help her find job prospects. "I knew I had to go to a university where I could get work experience and to help pay for [school]," Bavan concedes. But the co-op placements at Waterloo were advantageous: She graduated with minimal debt, and her two co-op placements at OPG led to a full-time job offer before she completed her last year of university. Through her OPG co-ops, Bavan gained practical experience in nuclear engineering, for which she discovered a passion, and it was through OPG that Bavan earned her master's degree in nuclear engineering at McMaster University through the University Network of Excellence in Nuclear Engineering, a collaborative program between government, industry and Canadian and international universities. "I took my courses when I was on maternity leave because I wanted to keep my brain active," Bavan says. "My husband would bring the baby to class so I could nurse him, and I did the courses on weekends."

It was Bavan's mother who provided Bavan with incredible support as she completed her education and started a career. "When I was studying at Waterloo, I ended up getting an apartment, and she came and stayed with me in my room when I was feeling stressed or homesick," Bavan recalls. "When I started work, she would call me to see if I got to work okay because I was driving from Scarborough to Bowmanville. She would call me every day, even after I got married. When I was doing my master's degree, she would come and help me with the kids."

Bavan remains thankful to the role models in her life, from her parents to her teachers. She particularly recognizes the spark ignited by Edwards—with whom Bavan stays in touch—who recognized Bavan's talents and helped her financially. And because Edwards continued to donate, including a scholarship to Bavan's sister and one of her brothers, it sparked Bavan's commitment to give back. **e**



By Marika Bigongiari

CHRISTIAN BELLINI HELPS BUILD A SOLID FOUNDATION FOR CHANGE

New PEO President Christian Bellini, P.Eng., FEC, is passionate about engineering regulation and determined to push the dial forward on PEO's transformation journey to becoming a modern regulator during an unprecedented time in history.

PEO President Christian Bellini, P.Eng., FEC, credits his father for setting him on the path to becoming an engineer. "He was a strong believer in the value of an engineering education," Bellini recalls. "And he strongly recommended that I get an engineering degree and then do whatever I want." Bellini entered the University of Waterloo's civil engineering program without knowing if he'd ultimately pursue a career in the field. What hooked him were the co-op placements that made up part of the university's core engineering program and the real-world, hands-on experience they offered. Like his father, Bellini developed an appreciation for engineering's practicality, which would soon grow to become a full-blown passion for the profession.

Bellini's father's work took him abroad, meaning frequent moves growing up and studying overseas, including stints in the United Kingdom and Italy, where Bellini attended high school. Living in Rome afforded Bellini the opportunity to get to know his father's extended family, something for which he's grateful—a silver lining found where others might find the circumstances of moving to a foreign land challenging. "Italy is where my father's family is from, so it was a bonus to be able to live there and also be able to spend time getting to know all my relatives who, up until then, I hadn't known that well," explains Bellini, whose flexibility and optimism were imbued at a young age. Armed with these qualities and a healthy dose of pragmatism, Bellini was more than ready to take the wheel of the PEO presidency at a time that, between the COVID-19 pandemic's fallout and PEO's transformation journey, is unprecedented in both PEO's and the world's history.

Christian Bellini remains optimistic that PEO can meet its goal to become a cutting-edge regulator if it does the work now to lay the necessary foundation for change.

AN ENGINEERING LIFER

Bellini is a principal at Blackwell Structural Engineers in Toronto, ON, where he's a practising structural engineer—and could be considered a lifer at the firm, since he joined 21 years ago as an EIT soon after graduating from university. Finding a job straight out of school is something he's extremely grateful for, especially given the circumstances of the day. "I graduated in 1994 at the tail end of a really bad recession, and there wasn't a lot of work," Bellini recalls. "In fact, I think in my class of 60 or so, only a handful of us found work in engineering, and the majority found work outside of the field because there was little available in the way of jobs." Bellini began his journey at Blackwell as one of two employees in the wake of downsizing due to the recession. Today, the firm has grown to a staff of over 60, with offices in Toronto; Waterloo; Halifax, NS; and Victoria, BC, and an international portfolio of projects. As a principal, Bellini splits his time between design engineering and managing the firm. "We have a really strong philosophy at Blackwell that everybody does engineering, including partners—so, I spend a good portion of my week doing engineering," he explains.

Being a practising engineer and business leader lends Bellini useful insight into the PEO presidency. In a season that demands strategic leadership at PEO, Bellini brings decades of hands-on engineering and business experience to the Council table. "I think, particularly in the field I'm in, it puts a very real lens on why we regulate engineering," he says. "Structural engineers design structures to make sure the buildings and bridges stand up, that they work the way they're supposed to and the lives of the people who use them are safeguarded. If you distill it down, that is the purpose of regulating engineering."

For Bellini, being a practising engineer in a traditional field gives him a real sense of what it is PEO is trying to accomplish and what its role is as a regulator. It's also a lens

PEO can look through to make sense of newer disciplines, which is especially relevant today with new engineering disciplines emerging at a seemingly exponential pace. "Once you get past the technological advances and scientific achievements that have led to all these different fields in engineering, the fundamental thing is still that we are trying to protect the public interest," Bellini points out. "That is the fundamental reason why PEO is around, and I think that when you're serving on Council, you need to see everything through that lens."

THE ROAD TO COUNCIL

In addition to his professional engineering background, Bellini boasts extensive hands-on regulatory experience through his long history of volunteerism. Giving back to the profession is something he strongly believes in. "I always thought it would be interesting and useful to be able to find a way to help other people advance in the profession, but I didn't really know how to get that opportunity in the early days," Bellini explains. A chance encounter with a contractor he was working with on a building designed by Blackwell led to PEO reaching out to invite Bellini to sit on PEO's Experience Requirements Committee (ERC). Bellini joined the ERC in 2005, serving in later years as both vice chair and chair. "That's where it all started," he explains. Over the years, Bellini has served on and chaired many more PEO regulatory committees and task forces, including the Legislation, Overlapping Practices, Finance, Licensing, Consulting Engineer Designation and Executive committees, the Advisory Committee on Volunteers and the National Framework, 30 by 30 and National Mobility task forces. Bellini was first elected to PEO Council in 2016 as councillor-at-large and served as vice president in 2019–2020 and president-elect in 2020–2021.

Among those appointments, Bellini currently serves as vice chair on PEO's 30 by 30 Task Force, whose mandate supports the Engineers Canada initiative to achieve the milestone of seeing 30 per cent of newly licensed engineers be women by 2030. "I put my name forward because it's important to me; it's important to me on many fronts," Bellini says. "It's important because I look at engineering and think we could be better. I have a daughter, and if engineering happened to be a career she was interested in, I'd love to think that the pathway would be just as easy for her as it would be for anybody else." That perspective drove home the importance of the initiative for Bellini, as well as the realization this is a critical issue that has loomed over the profession for a long time and must be addressed. "It's even more discomforting when you look at other professions that have made more progress than we have," Bellini points out. "I think that really shows poorly on the casual way we have dealt with it in the past, and we need to be intentional about it going forward."

A BIG-PICTURE VIEW

Bellini has contributed to and participated on several Engineers Canada initiatives and groups, including the competency-based assessment project, the Canadian Framework for Licensure and the Licensing Affairs Committee. He was also a member of the Canadian Engineering Qualifications Board until May 2020, as well as a member of the Finance, Audit and Risk Committee and a director representing PEO on the Engineers Canada board until May of this year. Bellini

Christian Bellini and his daughter, Micaela, enjoy the view from an old bridge outside Venice on a trip to Italy.

With decades of experience as a professional engineer, business leader and PEO and Engineers Canada volunteer, Christian Bellini brings a useful big-picture perspective to the presidency.

is currently a member of the Engineers Canada President's Group. Engineers Canada is the national body that supports the 12 provincial and territorial engineering regulators by helping create consistent standards in regulation, working to improve public confidence and encouraging growth within the profession.

Bellini's experience working with Engineers Canada gives him an especially valuable big-picture view of the profession. And although many PEO presidents have joined the Engineers Canada board at the end of their term, Bellini, who was appointed to the board as a director in 2018, comes to the presidency with the unique perspective of having already served on it. "I think it's one of the most valuable things I've done in terms of both understanding where we're at and doing the work at PEO," Bellini reflects. "At the end of the day, PEO is the only organization responsible for regulating engineering in Ontario, but we are part of a group of 12 regulators who, all together, regulate engineering across the country. And if we are to regulate effectively, we need to be able to do it in a way where we work together and ensure we don't have varying standards across the country."

There can't be a situation, for example, where the bar is lowered in one province, making it easier for someone to become licensed as an engineer in that province compared to the rest, explains Bellini. He also clearly sees that all regulators face similar issues in terms of how they regulate and where they want to go. "It's important for PEO to be in sync with what's happening across the country. And we're all facing the same questions about whether we're being effective in regulating and asking if there are things we could be doing better," Bellini stresses. "If we assemble that brain trust of people from across the country, then we're going to come up with better solutions to those problems." Bellini also points out that some provinces have had change forced upon them by external forces and that, knowing what happened in those situations and bringing that background to discussions at PEO, can help the regulator be proactive and stay ahead of those potential forces, rather than being reactive.

THE GOAL OF REGULATORY REFORM

Passionate about engineering regulation—and the self-regulation model especially—Bellini ran for Council in previous years on a platform of regulatory reform. "I've believed for many years, and I'm not the only one, that we need to take a good look at the way we regulate engineering," says Bellini, who explains that PEO's current methods are mostly reflective of processes and tools that have been in place for decades and are not necessarily suited for the new way engineering is being practised in the country today. "Maybe my discipline—structural engineering—hasn't changed that much, but there are a lot of newer disciplines that have. And many have identified that as one of our biggest risks—that we are not good at regulating all those other parts of engineering," Bellini observes. "What I've come to realize the more I become involved is that many well-intentioned people have run for Council with ideas for change for a decade, but little progress has been made on that front."

After reflecting on that fact and having been involved with regulatory work for a while, Bellini came to some hard conclusions. "I think what is getting in our way as an obstacle to regulatory change is our governance system, which means that, if we want to make that change that I think is so critical and important, we first have to deal with the governance issue," Bellini explains. "And then we can move on and deal with those other things that are also critical, but it's just that they have to happen in that priority sequence."

Although he hasn't changed his mind on the goal of regulatory reform, Bellini is 100 per cent onboard with the idea that the first thing to be done is to install an updated governance model that will empower Council with the tools to make that needed change, as well as take a deeper dive into what PEO must do to modernize the way it regulates. And although he'd very much like to pursue that line personally, he recognizes that regulatory reform can't happen until the foundation it's built on is solid. Bellini believes it's critical that PEO takes this opportunity to modernize as it works through the recommendations of the 2019 regulatory performance review, which was led by external consultant Harry Cayton and included 15 recommendations for regulatory improvement—including the governance transformation work in which PEO is currently engaged. He sees it as a unique opportunity to modernize PEO's regulatory activities in a thoughtful way that will result in an effective regulator that has the flexibility to adapt to today's evolving engineering environment.

PRIORITIZING GOVERNANCE RENEWAL

As such, Bellini's primary focus as president is to ensure PEO stays on track with its plan for governance renewal. Council is currently engaged in Phase 3 of the two-year Governance

Roadmap workplan, which is focused on Council composition—a particularly crucial stage of the project (see p. 46). Bellini recognizes that completing this work will extend beyond his term of office but knows that the groundwork must be laid now. "This is a project we initiated formally last year—and informally the year before that—and it's a multi-year project, so in a way I'm the one who gets to shepherd it, hopefully towards its conclusion," Bellini says. The workplan is scheduled to come to its conclusion at the end of Bellini's term. "It's the most important thing to do right now and the single most important thing we can do to modernize the way we regulate," he says.

Bellini also thinks it's critically important that a more organized reporting structure be put in place between the work that gets done by PEO staff and work that's done by committees and by Council. "The lines on that have become quite blurry over the years, and I really do believe—I believe this strongly—that is one of the things that is an impediment to change and progress," says Bellini, who thinks that tackling these tasks this year will put PEO in good stead for future change. "And then hopefully, we'll be able to launch into that real regulatory reform work that is so critical but also needs to happen."

Pushing such an important agenda forward has been especially challenging given the unusual circumstances of the current Council year, as well as the previous one, in which Council hasn't met in person due to the COVID-19 pandemic and the resulting extended lockdown in Ontario. "It's tough to work this way," Bellini observes. "It really does make it harder to develop that common ambition and vision about where it is we want to go. Council years are not that long, and you've got a limited amount of time to build that rapport." That said, he thinks that Council has done quite well and met, albeit virtually, much more often than in previous years and got a lot done. Being intentional during this time, he says, is more important than ever. "It's going to take a lot of thought and planning and work to get us to where we need to be."

"It's the most important thing to do right now and the single most important thing we can do to modernize the way we regulate," Bellini says.

For Bellini, the most important thing for PEO to do now is keep pushing forward—as opposed to starting something brand new. His view of his presidency is a realistic one, which he characterizes as "jumping into the middle of something big with the intent to keep it moving along." Although he doesn't view it as particularly glamorous, he stresses its importance in this time of significant change, especially if PEO is to become the cutting-edge regulator it aims to be. "These are all things that have been the subject of task forces for as many years as I can remember but somehow never translated into actual action until now," Bellini says. "I'm hoping that this time, after putting these new governance structures in place, we'll be able to bring this one across the finish line." **e**

PEO President Christian Bellini with his daughter, Micaela, at an Engineers Canada event.

Attend Virtually

The following events can be attended via videoconferencing (see individual websites for details).

September 2021

SEPTEMBER 23–24
Engineers Nova Scotia Annual General Meeting & Eng'ing Conference
engineersnovascotia.ca/events/view/?event.id=1454

SEPTEMBER 30
International Conference on Artificial Intelligence, Robots and Mechanical Engineering
academicsconference.com/Conference/13269/ICAIRME

SEPTEMBER 30
International Conference on Control System, Power and Electrical Engineering
academicsconference.com/Conference/13270/ICCSPEE

October 2021

OCTOBER 5
Green Building Festival
sbcanada.org/conferences/green-building-festival-2021

OCTOBER 6–7
The Future of Engineering Conference
www.engineeringconference.ca/2021

OCTOBER 28
Zero Waste Conference
zwc.ca

OCTOBER 30
Engineers and Geoscientists BC Annual General Meeting
egbc.ca/About/Governance/Annual-General-Meeting

OCTOBER 30
International Conference on Astronomy, Astrophysics, Space Science
academicsconference.com/Conference/13531/ICAASS

OCTOBER 30
International Conference on Environment, Agriculture and Biotechnology
academicsconference.com/Conference/13523/ICEABT

Listen

Engineering With Nature
The US Army Corps of Engineers offers a podcast that explores the development and implementation of nature-based solutions for infrastructure, engineering and water projects
decisionpartners.libsyn.com

Speaking for the Trees Podcast
An exploration of environmental issues from two environmental engineers' perspectives, in laymen's terms
treesspeaking.family.blog

The Energy Gang
A podcast that explores the fast-changing world of energy, with weekly debates on the latest trends in energy, cleantech, renewables and the environment
art19.com/shows/the-energy-gang

Watch

Could Earth's Heat Solve Our Energy Problems?
One of humanity's biggest challenges is the quest to transition to renewable energy.
youtube.com/watch?v=vZLo0-lwK1k

Environmental Engineering at the University of Waterloo
At Waterloo, students nurture their passion for sustainability, mathematics and science and learn how to apply them to the built environment, water systems, atmosphere and energy infrastructure.
youtube.com/watch?v=7xXDMmnz0Io

What is Environmental Engineering?
Environmental engineering is about more than clean energy, solar panels and hydroelectric power.
youtube.com/watch?v=T2xFDIdjX88

Read

Defending Biodiversity: Environmental Science and Ethics, by Jonathan A. Newman, PhD, Gary Varner, PhD, and Stefan Linquist, PhD, 2017: A critical examination of arguments commonly offered in support of biodiversity conservation, in which the authors adopt a skeptical viewpoint to test the strength of each perspective

Environmental Ethics: The Central Issues, by Gregory Bassham, PhD, 2021: An accessible, lively and timely introduction to the central issues and controversies inherent to environmental ethics aimed at students, environmental scientists, environmental policy makers and anyone curious about the environmental challenges we face

SUMMARY OF DECISION AND REASONS

In the matter of a hearing under the *Professional Engineers Act*, R.S.O 1990, c. P.28, and in the matter of a complaint regarding the conduct of SERGIO A.R. PANETTA, P.ENG., a member of the Association of Professional Engineers of Ontario.

A panel of the Discipline Committee met at the Association of Professional Engineers of Ontario in Toronto, on October 17, 2019, to hear and determine allegations of professional misconduct against Sergio A.R. Panetta, P.Eng. The hearing proceeded on an uncontested basis because the parties had an Agreed Statement of Facts and a Joint Submission on Penalty.

The Agreed Statement of Facts, dated October 15, 2019, stated:

1. At all material times, the Respondent, Sergio Panetta, P.Eng. (Panetta), was a professional engineer licensed pursuant to the *Professional Engineers Act*. Panetta holds both a bachelor's degree and a master's degree in electrical engineering.

2. On or about April 11, 2017, a fire prevention officer with the City of Brampton's Fire and Emergency Services (Brampton Fire) performed a routine inspection at a multi-unit rental property owned by Panetta in Brampton, Ontario (the Rental Property).

3. During the inspection, Brampton Fire discovered that two of the windows of the Rental Property were within 3 metres of a fire escape and were not adequately protected as required by Division B of Ontario Regulation 213/07 (the Fire Code). Attached [to the Agreed Statement of Facts] as Schedule "A" is a photograph showing the Rental Property and the unprotected openings.

4. Brampton Fire issued a Fire Safety Inspection Order dated April 11, 2017, for the contraventions. The Order required Panetta to install approved protection, such as wired glass screens, on the affected openings. Attached as Schedule "B" [to the Agreed Statement of Facts] is a copy of the Order.

5. Under section 1.3.2 of Division C of the Fire Code, an "alternative solution" may be permitted in certain circumstances. An "alternative solution" is a permitted design that will achieve the same level of performance as that provided by an "acceptable solution" under the Fire Code. An "alternative solution" must be submitted to and approved by the Chief Fire Official in advance of construction and must bear the signature and seal of a professional engineer or architect, or both.

6. In response to the Fire Safety Inspection Order, Panetta installed sprinklers in the two affected dwelling units. Panetta completed the work without obtaining the required approval of the Chief Fire Official, and at the time the work was completed, no signed and sealed "alternative solution" proposal had been submitted to Brampton Fire.

7. Brampton Fire conducted a re-inspection of the Property on November 21, 2017, and, at that time, observed that Panetta had installed sprinklers near the relevant windows in question. As a result, Brampton Fire advised Panetta that he was required to submit appropriate documentation by December 15, 2017, failing which he could be subject to prosecution.

8. Panetta signed and affixed his seal to a purported "alternative solution" for the Rental Property dated December 15, 2017, which he submitted to Brampton Fire. The document proposed the sprinklers that had already been installed. Attached as Schedule "C" [to the Agreed Statement of Facts] is a copy of this document. Panetta's training and experience, primarily in the field of electrical engineering, did not make him sufficiently competent to prepare the "alternative solution."

9. Brampton Fire rejected Panetta's purported "alternative solution" because it was incomplete. Panetta was charged with an offence under section 28(1)(c) of the *Fire Protection and Prevention Act* as a result of his failure to comply with the Fire Safety Inspection Order referred to above.

10. Panetta thereafter undertook to install fire shutters with a fusible link that would close in the event of a fire. However, the shutters initially proposed by Panetta were not accepted by Brampton Fire, because the Fire Code required compliance of the fusible link with an Underwriter's Laboratory Canada standard. It took Panetta

several months to locate and install fire shutters which were acceptable to Brampton Fire.

11. On July 16, 2018, Panetta pleaded guilty to the charge referred to above, and was convicted. He was required to pay a fine in the amount of $2,500. Attached as Schedule "D" [to the Agreed Statement of Facts] is a copy of the transcript of the hearing in Provincial Court. As can be seen from the attached transcript, by the time of the court hearing, Panetta had installed the required protection over the affected openings.

12. Based on these facts, it is agreed that Panetta is guilty of professional misconduct as follows:
    a. He undertook work he was not competent to perform by virtue of his training and experience, contrary to section 72(2)(h) of Regulation 941 under the *Professional Engineers Act*; and
    b. He has been found guilty of an offense relevant to suitability to practise, contrary to section 28(2)(a) of the *Professional Engineers Act*.

PLEA OF THE MEMBER

Mr. Panetta admitted the allegations set out in the Agreed Statement of Facts. The panel conducted a plea inquiry and was satisfied that Mr. Panetta's admission was voluntary, informed and unequivocal.

REASONS FOR DECISION

The panel accepted Mr. Panetta's plea and the facts as set out in the Agreed Statement of Facts. The panel found Mr. Panetta guilty of professional misconduct under section 28(2)(a) of the *Professional Engineers Act* and under section 72(2)(h) of Regulation 941 of the *Professional Engineers Act*.

PENALTY AND COSTS

The parties' Joint Submission as to Penalty and Costs, also dated October 15, 2019, stated:

1. Sergio A. R. Panetta (Panetta) was at all material times a member of the Association of Professional Engineers of Ontario (PEO).

2. Panetta is the subject of a proceeding before a panel of the Discipline Committee of PEO pursuant to section 28 of the *Professional Engineers Act*.

3. PEO and Panetta make the following joint submission on penalty and costs:
    a) Pursuant to s. 28(4)(f) of the *Professional Engineers Act*, Panetta shall be reprimanded, and the fact of the reprimand shall be recorded on the register for a period of one year;
    b) The findings and order of the Discipline Committee shall be published in summary form under s. 28(4)(i) of the *Professional Engineers Act*, with names;
    c) Pursuant to s. 28(4)(b), (d) and (k) of the *Professional Engineers Act*, Panetta shall successfully complete PEO's Professional Practice Examination (PPE) within eighteen (18) months of the decision of the Discipline Committee, failing which his licence shall be suspended until such time as he successfully passes the PPE;
    d) Pursuant to s. 28(4)(b), (h) and (k) of the *Professional Engineers Act*, Panetta shall be required to pay a fine in the amount of twenty-five hundred dollars ($2,500) within thirty (30) days of the decision of the Discipline Committee, failing which his licence shall be suspended until such time as he pays the fine; and
    e) There shall be no order with respect to costs

Counsel for the association, Ms. Leah Price, reviewed the elements of the penalty and how they addressed the five objectives of penalty: the protection of the public, the maintenance of the reputation of the profession in the eyes of the public, general deterrence, specific deterrence and rehabilitation. Ms. Price noted that the Joint Submission was the product of settlement negotiations and compromise by the parties, and she submitted that the panel should accept it as agreed upon by the parties. Ms. Price argued that the panel should not modify the agreed-to penalty unless the panel thought that the penalty would bring the administration of justice into disrepute or was otherwise contrary to the public interest. Ms. Price also cited three previous decisions of the Discipline Committee in support of her submissions that the agreed-to penalty was within the range of appropriate penalties.

The panel accepted that the elements of penalty were appropriate. However, it had jurisdictional concerns regarding its power to order paragraphs 3(c) and (d) of the penalty, which sought to impose a suspension under section 28(4)(k) in the event that Mr. Panetta did not complete the PPE within 18 months (paragraph 3(c)) or pay the $2,500 fine within 30 days (paragraph 3(d)). The panel's concern was twofold: first, that section 28(4)(k) does not permit the panel to impose a future suspension on a member as an additional penalty for the pos-

sible failure of the member to satisfy an imposed penalty when that suspension was not imposed as a penalty based on the merits of the matter; and second, that the panel was not empowered to impose an indeterminate suspension since section 28(4)(b) of the *Professional Engineers Act* stipulates that a suspension imposed by the Discipline Committee cannot exceed 24 months.

The panel sought advice from independent legal counsel on the jurisdictional issue and the parties were given an opportunity to respond to that advice. The parties then agreed to review the penalty provisions in paragraphs 3(c) and (d) with a view to concluding this matter on consent as planned. The parties ultimately provided two revised versions of the Joint Submission as to Penalty and Costs as alternatives for the panel to consider. The first version was the version the parties preferred as the simpler of the two. It contained the following new paragraphs 3(c) and (d):

c) Pursuant to s. 28(4)(b), (d), and (k) of the *Professional Engineers Act*, it shall be a term or condition on his licence that Panetta successfully complete PEO's Professional Practice Examination (PPE) within eighteen (18) months of the decision of the Discipline Committee, failing which his licence shall be suspended for a period of ten (10) months, or until such time as he successfully passes the PPE, whichever comes first;

d) Pursuant to s. 28(4)(d) and (h) of the *Professional Engineers Act*, it shall be a term or condition on Panetta's licence that he shall pay a fine in the amount of twenty-five hundred dollars ($2,500) within thirty (30) days of the decision of the Discipline Committee[.]

In considering the first version, the panel remained concerned that it did not have the power under section 28(4)(k) to impose a future suspension on Mr. Panetta in the event that he did not satisfy the imposed penalty of successful completion of the course within 18 months. Accordingly, the panel accepted the second version of the Joint Submission as to Penalty and Costs. The second version contained provisions that the panel believed it was empowered to order under section 28 of the *Professional Engineers Act*. The second version contained the following provisions starting at paragraph 3(c):

c) Pursuant to s. 28(4)(b) of the *Professional Engineers Act*, Panetta's licence shall be suspended for a period of ten (10) months;

d) Pursuant to s. 28(4)(k) of the *Professional Engineers Act*, the suspension referred to above shall be suspended, pending compliance by Panetta with the term and condition set out in paragraph (e) below, within the time set out below—thereafter, the suspension shall take effect, but shall be again suspended if and when Panetta passes the examination referred to below;

e) Pursuant to s. 28(4)(d) of the *Professional Engineers Act*, it shall be a term and condition on Panetta's licence that he shall successfully complete PEO's Professional Practice Examination (PPE) within eighteen (18) months of the decision of the Discipline Committee;

f) Pursuant to s. 28(4)(d) and (h) of the *Professional Engineers Act*, it shall be a term and condition on Panetta's licence that he shall pay a fine in the amount of twenty-five hundred dollars ($2,500) within thirty (30) days of the decision of the Discipline Committee; and

g) There shall be no order with respect to costs

PENALTY AND COSTS DECISION

The panel approved the second revised version of the Joint Submission as to Penalty and Costs that was agreed to by the parties. In accordance with that Joint Submission as to Penalty and Costs, the panel orders that:

a) Pursuant to s. 28(4)(f) of the *Professional Engineers Act*, Mr. Panetta shall be reprimanded, and the fact of the reprimand shall be recorded on the register for a period of one year;

b) The findings and order of the Discipline Committee shall be published in summary form under s. 28(4)(i) of the *Professional Engineers Act*, with names;

c) Pursuant to s. 28(4)(b) of the *Professional Engineers Act*, Mr. Panetta's licence shall be suspended for a period of ten (10) months;

d) Pursuant to s. 28(4)(k) of the *Professional Engineers Act*, the suspension referred to above shall be suspended, pending compliance by Mr. Panetta with the term and condition set out in

paragraph (e) below, within the time set out below—thereafter, the suspension shall take effect, but shall be again suspended if and when Mr. Panetta passes the examination referred to below;

e) Pursuant to s. 28(4)(d) of the *Professional Engineers Act*, it shall be a term and condition on Mr. Panetta's licence that he shall successfully complete PEO's Professional Practice Examination (PPE) within eighteen (18) months of the decision of the Discipline Committee;

f) Pursuant to s. 28(4) (d) and (h) of the *Professional Engineers Act*, it shall be a term and condition on Mr. Panetta's licence that he shall pay a fine in the amount of twenty-five hundred dollars ($2,500) within thirty (30) days of the decision of the Discipline Committee; and

g) There shall be no order with respect to costs.

REASONS FOR PENALTY AND COSTS DECISION

The panel was satisfied that the agreed-to penalty satisfied the objectives of penalty as submitted by Ms. Price for the parties. Professionalism was a primary concern in Mr. Panetta's unprofessional use of his seal. The imposition of the PPE will address this concern and satisfy the important objective of remediation. Completion of the PPE as a term or condition of Mr. Panetta's licence will also satisfy the objectives of specific and general deterrence. Ordering publication of Mr. Panetta's name and recording the fact of his reprimand on the register also satisfy the objectives of specific and general deterrence. The imposition of a considerable fine and a reprimand shows that the association takes seriously the proper use of an engineer's seal and serves the objective of maintaining the reputation of the profession in the eyes of the public, as well as the objective of deterrence. Finally, the panel accepted that it was appropriate not to order costs in this matter, which was uncontested and straightforward, as agreed between the parties.

W. Turnbull, P.Eng., chair of the discipline panel, signed the Decision and Reasons on November 12, 2019, on behalf of the other panel members: S. Ball, LLB, T. Kirkby, P.Eng., V. Sahni, P.Eng., and G. Thompson, P.Eng.

NOTICE OF LICENCE SUSPENSION, ALI D. TAHA

Ali D. Taha's professional engineering licence was suspended on June 22, 2021, in accordance with a Registrar's Notice of Proposal issued pursuant to subsection 14(2)(c) of the *Professional Engineers Act* on April 9, 2021. Mr. Taha's licence shall remain suspended for six months or until he writes and passes PEO's National Professional Practice Exam, whichever comes first.

NOTICE OF LICENCE SUSPENSION, SERGIO PANETTA

Sergio Panetta's professional engineering licence was suspended on April 18, 2021, pursuant to the terms of a penalty order made by the Discipline Committee on October 17, 2019. Mr. Panetta's licence shall remain suspended for 10 months, or until he passes PEO's National Professional Practice Examination, whichever comes first.

By ADAM SIDSWORTH

DEEP GEOLOGICAL REPOSITORIES

Ontario's long-term solution for nuclear waste

Roughly 60 per cent of Ontario's electricity comes from nuclear power. And although Ontario Power Generation notes the cost effectiveness and low carbon footprint of nuclear power, the big concern is the resulting radioactive nuclear waste. However, engineers are now exploring long-term options to store the waste in an environmentally responsible way.

Nestled across the street from a commuter train station in suburban Oakville, ON, is a non-descript two-storey commercial building that hosts mostly private businesses. Also renting space here is the Nuclear Waste Management Organization (NWMO), a federal company employing engineers busily exploring solutions for the long-term storage of high-level nuclear waste generated by nuclear reactors supplying electrical power to Ontario and New Brunswick.

"If you're at a party, and you're having a discussion that you're not really into…tell them you work in nuclear waste," jokes Alan Murchison, P.Eng., manager of repository engineering for the NWMO. Murchison was referring to some of the public's often negative perception of nuclear power. Murchison, along with Chris Boyle, P.Eng., director of engineering and chief engineer at the NWMO, and a team of engineers design and implement the technology to transport, repackage and safely emplace high-level used nuclear fuel. This includes reviewing and modifying existing technologies and building full-scale prototype equipment in a lab setting.

The NWMO was created in 2002 as a result of the *Nuclear Fuel Waste Act* and receives much of its funding from Ontario Power Generation (OPG), New Brunswick Power Corporation and Hydro-Québec, the three provincial-level electricity generators that have operated nuclear generators. (Quebec decommissioned its Gentilly-2 nuclear generating station in 2012 but is still responsible for the waste it has created.) Atomic Energy of Canada Limited, a federal Crown corporation that researches nuclear science and technology, also provides funding.

The NWMO is ultimately responsible to the Canadian Nuclear Safety Commission (CNSC)—the federal agency tasked with regulating nuclear energy—and is subject to the *Nuclear Safety and Control Act*. The NWMO is also subject to Transport Canada regulations mandating how nuclear waste is transported across the country. Additionally, provinces and territories regulate nuclear activity, including in Ontario, where the ministries of labour, training and skills development; the solicitor general; health; and long-term care have regulations connected to the nuclear industry. Additionally, since 1957, Canada has committed itself to standards set by the International Atomic Energy Agency, which, in a February 2020 report, issued a positive outlook on Canada's emergency preparedness and response framework for nuclear and radiological emergencies.

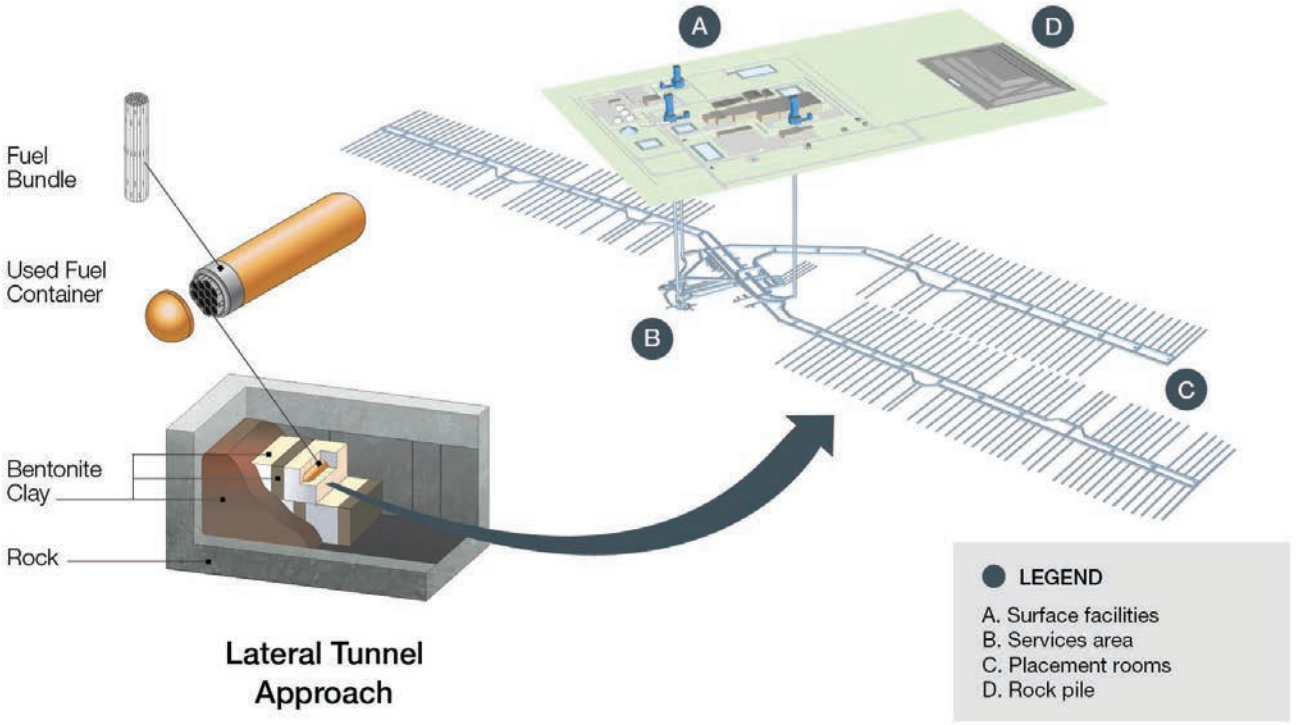
After a three-year-long dialogue with specialists and the general public, including Indigenous communities, the NWMO in June 2007 introduced Canada's Adaptive Phased Management plan for the long-term management of used nuclear fuel. The plan is composed of both a technical method and a management system and is, according to the NWMO, consistent with long-term management best practices adopted by other countries with nuclear power programs, such as Finland, France, Sweden, Switzerland and the United Kingdom, many of whom Canada has signed international nuclear agreements with. However, central to the technical method of the plan is the centralized containment and isolation of used nuclear fuel in a deep geological repository.

WHAT ARE DEEP GEOLOGICAL REPOSITORIES?

The deep geological repository (DGR) is a proposed multiple-barrier system being designed to safely contain high-level used nuclear fuel for an indefinite amount of time. Based on current design plans, it will likely be 500 metres below the ground, have a network of placement rooms for used fuel containers and clay-based sealing systems and a series of access tunnels and shafts to allow for accessibility and monitoring. The underground footprint of the DGR would likely be approximately two kilometres by three kilometres, or 600 hectares. On ground level above the DGR would be the surface facility, where 120,000 used fuel bundles per year would be processed for burial in the DGR. That may sound like a lot, but consider that by the middle of 2015, there were roughly 2.6 million bundles of high-level used nuclear fuel in all of Canada, of which 2.3 million were generated by OPG. If stacked like cordwood, those bundles would fit into seven hockey rinks from the ice surface to the top of the boards. There were closer to three million used nuclear bundles generated in Canada by the middle of 2020.

If the DGR design and construction begin in 2033 as anticipated—all future dates are conditional on consultation from local and Indigenous communities and regulatory authorization from the CNSC—there will likely be 4.6 million used nuclear fuel bundles from across the country to deposit. And with OPG refurbishing some of its nuclear reactors, there could eventually be as many as 5.5 million bundles by mid-century—when the DGR is scheduled to be up and running.

"Used nuclear fuel contains radioactive nuclides, which can emit ionizing radiation in the form of gamma rays,



An NWMO display of what the deep geologic repository (DGR) may look like once it is built. The DGR is a multiple-barrier system designed to house high-level used nuclear fuel and is planned to be in operation by 2043. Photo: NWMO

neutrons, alpha particles and beta particles," the NWMO explains on its website. "Used nuclear fuel is most radioactive when it is first removed from a reactor. After 10 years of cooling at the reactor site, more than 99 per cent of the radioactivity decays away. While the hazard continues to diminish over time, for practical purposes, used nuclear fuel remains hazardous, essentially indefinitely."

OPG currently stores its high-level used nuclear fuel on an interim basis at above-ground facilities of the nuclear generation station where it is produced—either at the privately operated and leased Bruce Power or the OPG-operated Pickering and Darlington power stations. High-level nuclear fuel is stored in dry storage containers that are made of concrete and steel and, when full, weigh up to 79 tonnes and have a design life of 50 years. The dry storage follows a minimum of 10 years in storage in a water-filled bay built of reinforced concrete designed to resist earthquakes and lined to prevent leaks. Water storage is done both to allow the waste to cool down and the radioactivity to decline.

High-level nuclear waste is the spent uranium used in the Canadian Deuterium Uranium (CANDU) reactors that OPG uses to generate electricity; high-level waste contains 99 per cent of the radioactive by-products of nuclear reactors and is radioactive for a million years. It should be distinguished from low-level nuclear waste derived from contaminated industrial items such as mops, rags and paper towels used during routine maintenance activities, which remain radioactive for up to 300 years and are hazardous for just a short period of time. They are processed and stored in steel containers and secured in buildings at OPG's Western Waste Management Facility at Bruce Power. There is also intermediate-level waste, consisting of resins and filters used to keep reactor systems clean; they are stored in the ground in steel-lined concrete containers at the Western facility and have a radioactive life of 100,000 years. Although OPG remains responsible for the low- and medium-level nuclear waste it generates, the NWMO's focus is on the high-level nuclear fuel waste generated by OPG and ultimately aims to place it in DGRs.

WHERE NWMO IS GOING WITH ITS RESEARCH

The NWMO has offered members of the public tours of the Oakville research facility in hopes of helping people visualize the reality of used nuclear fuel. "It's a very emotional subject," Murchison admits. "People become very polarized. And I get it; I grew up near Chalk River, not too far from the Chalk River nuclear research facility. Growing up,

Fuel bundles hold multiple fuel elements, which in turn hold the fuel pellet, a high-density form of uranium used to power the CANDU nuclear reactors. There may be roughly 5.5 million bundles by the time the DGR is anticipated to open in 2043. Photo: NWMO

I had no idea what they did there. It wasn't until I started working in the industry that I started to understand it." Boyle adds: "Public engagement and education are critical, as it's hard for anyone to wrap their heads around the concept of radiation and how to safely manage it. There is a lot of misinformation."

Indeed, during their public tour, they show a mock version of the uranium dioxide (the Oakville facility has no radioactive materials onsite), which is processed into ceramic pellets for use in the CANDU reactors. The pellet weighs no more than a few grams and is the size of a quarter. In the CANDU reactors, the pellets are placed in tubes called fuel elements, which are welded together to form bundles. The bundle is half a metre in length, 10 centimetres wide and is shaped like a fire log.

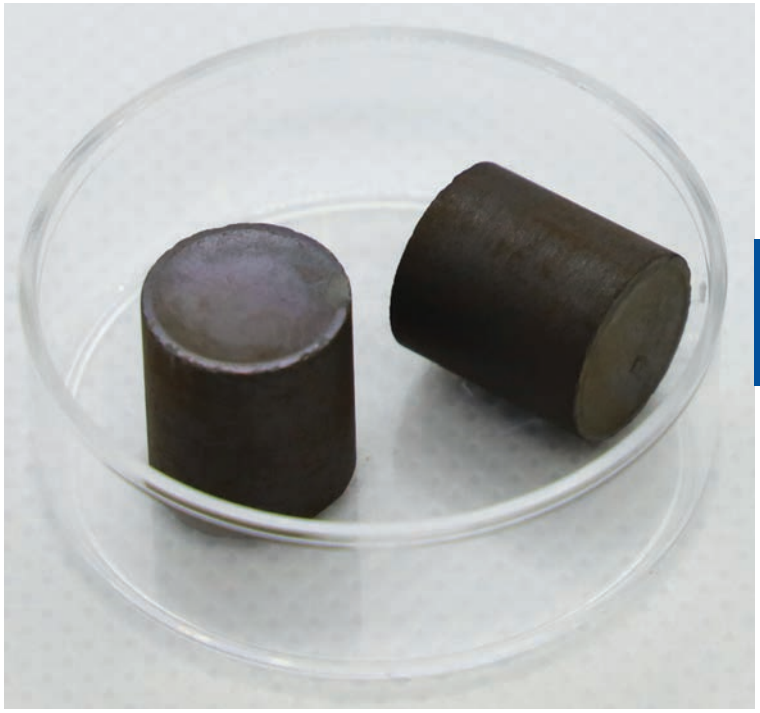
The NWMO has two sites under consideration for DGRs in Ontario: South Bruce in southwestern Ontario and Ignace, northwest of Thunder Bay. NWMO President and CEO Laurie Swami asserts that the national infrastructure project could be an economic engine for many decades for the community in which it ends up living. The project is estimated to cost more than $26 billion over its 150-year timeframe, and it is expected to create thousands of jobs. But whether high-level nuclear waste ends up being buried in southwestern Ontario or the province's northwest, Ontarians will likely question if DGRs are practically safe for the environment or for humans.

Indeed, South Bruce is actively engaging its community in the possible location of a DGR within its borders. "Between December 2019 and February 2020, South Bruce led a comprehensive visioning process to get input on what people care about most," the municipality reports on its website. "This and other community input, such as significant correspondence from community members and additional engagement, helped shape the 36 guiding principles…focus[ing] on safety for people and the environment, ensuring the project brings meaningful benefits to the community and ensuring the municipality has a voice in decision-making."

Yet Bruce County politicians have debated the merits of allowing a DGR in their community. "I am strongly opposed," Brockton Mayor Chris Peabody said during a council debate last year. "The proposal is to bury the waste under the Teeswater River…I've got several communities down river that get their drinking water from aquifers along that river." Notably, Brockton contains within its boundaries the community of Walkerton, which was the site of a contaminated water crisis that sickened 2300 people and killed seven (see "Keeping Ontario's drinking water safe," *Engineering Dimensions*, May/June 2021, p. 24).

Yet the DGR is a highly engineered multiple-barrier system:

- The fuel pellet, the NWMO notes, is a hard, high-density ceramic. Ceramics do not readily dissolve in water, and their resistance to wear and high temperatures make them one of the most durable engineered materials;
- Fuel pellets are placed together within the fuel element, which is made from a corrosion-resistant metal called zircaloy (and the fuel elements are bundled together to form the fuel bundle);
- Fuel bundles are placed in the 2.5-metre-long by 0.6-metre-wide used nuclear fuel container, which has three main components: the inner steel basket to hold the used fuel, an outer carbon steel pipe for structural strength, which is in turn coated by corrosion-resistant copper layer. The container is designed to withstand the pressures of overlying rock and loading from three-kilometre-thick glaciers that could form during a future ice age;
- The used nuclear fuel container will be stored in a highly compacted bentonite clay buffer box; and



The fuel pellet is the basic unit of uranium used to power CANDU nuclear reactors. It is the size of a coin and, once used, can remain radioactive for a million years.

- Everything will be buried in the geosphere, approximately 500 metres below the surface, where the rock formation selected will have low permeability, which means there will be little groundwater movement. "The traces of water that exist at [that] depth, known as porewater, can take 1000 years to move one metre through the rock and well over 100,000 years to reach the surface," the NWMO says on its website.

Murchison notes that DGRs are based on the best available research, development and demonstration of technologies and techniques. "Every country with a commercial nuclear power program is considering deep geological disposal to protect people, water and other environmental features over a very long term," he says. "We remain on track to complete a full-scale emplacement demonstration in 2022. This demonstration will integrate all of the bentonite technologies developed for the engineered barrier system into one trial. In parallel, we will complete the used fuel container demonstration program around container fabrication and assembly, and by 2023 we expect to complete the basic proof of concept and move on to preliminary engineering of the deep geological repository system."

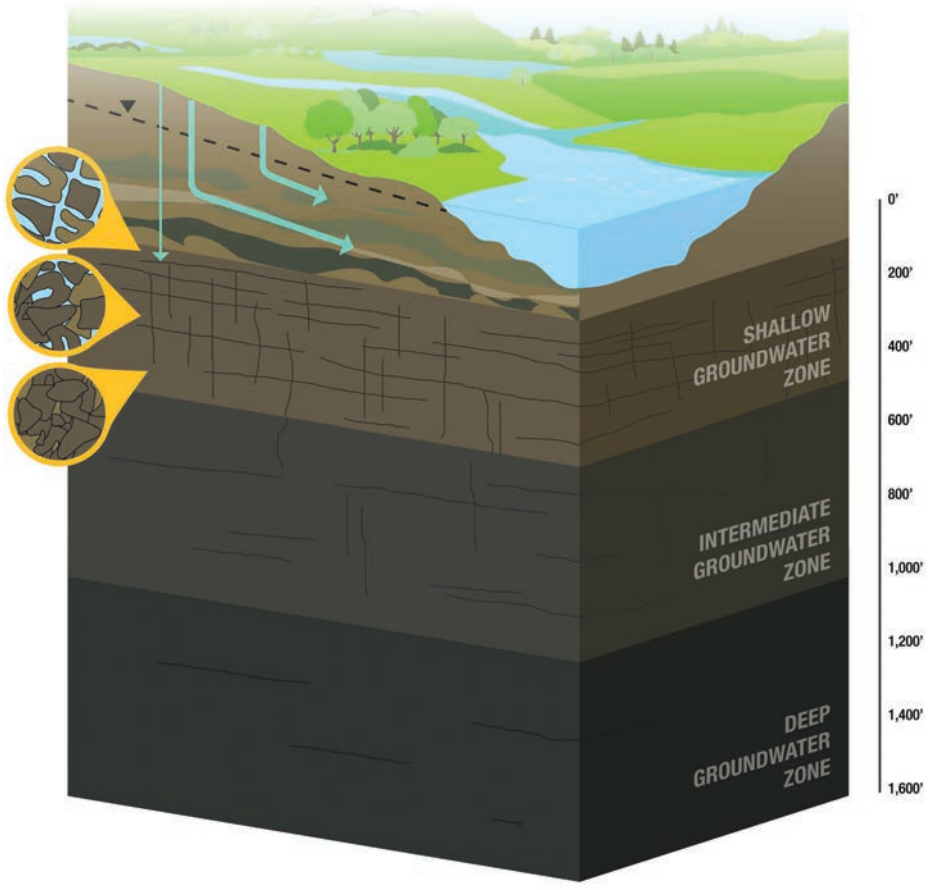
EXPLORING DGR SAFETY

"Usually when we think about groundwater, we ask ourselves if it is safe to drink and whether it is suitable for other uses, such as industrial applications. That type of water comes from aquifers, which are geological formations that hold a lot of water. The DGR is not going to be located in an aquifer," notes Magdalena Krol, PhD, P.Eng., associate professor of environmental engineering at York University's Lassonde School of Engineering. "Although the final location of the DGR is still being determined, it will be located in a rock formation deep in the subsurface that does not have a lot of pore space and has a very low permeability This means the groundwater will move very slowly, compared to water in an aquifer."

Krol is part of a multi-disciplinary, multi-university research team that received $4 million in grants from the Ontario Research Fund to study the long-term stability of used nuclear fuel containers in DGRs. Researchers from York, Western University, the University of Toronto and the University of Waterloo are working collaboratively to explore how the NWMO's engineered multi-barrier system will interact with the environment. The study is also receiving some funding from the NWMO, with which Krol has had a working relationship since her post-doctorate research days at the University of Toronto. Importantly, though, they are working collaboratively.

"Most of my work to date has been on numerical simulation of groundwater flow under thermal gradients," Krol notes. "This temperature gradient may arise from thermal remediation technologies, geothermal heating or storage of used nuclear fuel. My work focuses on modelling such scenarios and examining the effects of heat on species transport through groundwater. For example, I have examined the effect of buoyant flow, gas generation and soil heterogeneity on remediation efficiency. I have also researched the impact of ground source heat pumps on brownfield sites and how this renewable heating/cooling system can benefit contaminated sites."

Interestingly, Krol is focused not on if the used fuel will escape the multiple barriers but rather if the environment will penetrate into the multiple barriers. "The DGR will rely on the [multi-barrier system], which will consist of copper-coated used fuel containers surrounded by bentonite clay, to contain and isolate the used fuel," Krol explains. "The clay serves many purposes, one of which is to retard the movement of corrosive species, such as bisulphide, to the canister, which could potentially corrode the copper surface of the canisters. If corrosive compounds—in this case



The NWMO states that the rock formations considered for a DGR have low permeability, meaning there will be little groundwater movement. According to Magdalena Krol, PhD, P.Eng., the movement of the tiny traces of water that exist at that depth—porewater—is very slow, potentially taking up to 1000 years to move one metre through the rock. Photo: NWMO

bisulphide—reach the used fuel container, they could potentially corrode the canister. The bisulphide could come from a reaction that is aided with sulphide-reducing bacteria that could be present in the rock-bentonite interface. The purpose of my research is to develop a numerical model to estimate bisulphide transport through bentonite under various DGR conditions, including high temperatures and different saturation scenarios. I am also conducting experiments to quantify transport parameters, such as diffusion and sorption coefficients." Krol's research solely focuses on the transport phenomena while linking to the larger research goal of helping to ensure the safe and reliable disposal of used nuclear fuel.

Krol's research is scheduled to go until 2023, based on available funding and the research goals of the NWMO and Krol and her research colleagues. And although it's too early for Krol to generate conclusions into her research, she remains optimistic with what she sees with the NWMO's engineered approach. "[Bentonite] is a natural material that's been in the ground for a long time," Krol notes. "We know how it's going to behave in certain conditions. I think that's one of the reasons for choosing a material that is quite well known to us. If you were to put in use a nanomaterial for example, you don't know what it's going to do in a million years. But we know how clay behaves." Krol is glad that NWMO's DGR planning is a decades-long process, given what it is responsible for storing. "What NWMO is proposing is good and safe storage for used nuclear fuel," she declares. **e**

Once fuel bundles are ready to enter the DGR, they will be placed in a 2.5-metre-long used nuclear fuel container, which consists of an inner steel basket, an outer carbon steel and a corrosion-resistant copper layer. The used nuclear fuel container is encased in a bentonite clay buffer box. Photo: NWMO

Professional Engineers Ontario

2022 COUNCIL ELECTIONS CALL FOR CANDIDATES

All PEO members are invited to become candidates for the positions of president-elect, vice president, councillor-at-large and regional councillor (one for each of PEO's five regions) on PEO Council.

1. Any member may be nominated for election to Council as president-elect, vice president or councillor-at-large, by at least 15 other members. The nomination must include at least one member resident in each region. [Regulation 941/90, s. 14(1)]
   (a) The position of president-elect is for a one-year term, after which the incumbent will serve a one-year term as president and a one-year term as past president.
   (b) The position of vice president is for a one-year term.
   (c) The councillor-at-large position is for a two-year term. One councillor-at-large is to be elected in 2022.
2. Any member residing in a region may be nominated for election to Council as a regional councillor for that region by at least 15 other members who reside in the region. [Regulation 941/90, s. 14(2) and s. 15.1(2)]
   (a) The position of regional councillor is for a two-year term.

A member nominated for election to Council must complete a nomination acceptance form that states he, she or they are a Canadian citizen or has the status of a permanent resident of Canada and is a resident in Ontario [section 3(3) of the *Professional Engineers Act*] and consents to the nomination [Regulation 941/90, s. 15]. Nomination petitions for collection of nominators' signatures and nomination acceptance forms may be obtained from the PEO website at www.peo.on.ca, or Ralph Martin, PEO, 40 Sheppard Avenue West, Suite 101, Toronto ON M2N 6K9. Email: rmartin@peo.on.ca; Tel: 416-840-1115; 800-339-3716, ext. 1115.

Completed nomination petitions and nomination acceptance forms are to be sent only electronically and only to the chief elections officer at elections@peo.on.ca, by 4 p.m., November 26, 2021. No personal delivery of forms will be accepted. For further information on becoming a candidate, please refer to the 2022 Council Elections Guide posted on PEO's website.

2022 VOTING PROCEDURES

The 2022 voting and election publicity procedures were approved by the Council of PEO on June 25, 2021. Candidates are responsible for familiarizing themselves with these procedures. Any deviation could result in a nomination being considered invalid. Candidates are urged to submit nominations and election material well in advance of published deadlines so that any irregularities may be corrected before the established deadlines. Nominees' names are made available on PEO's website as received; all other election material is considered confidential until published by PEO.

1. The schedule for the elections to the 2022–2023 Council is as follows:

Date nominations open	October 18, 2021
Date nominations close	4 p.m., November 26, 2021
Date PEO's membership roster will be closed for the purposes of members eligible to automatically receive election material[1]	January 7, 2022
Date a list of candidates and voting instructions will be sent to members	no later than January 10, 2022
Date voting will commence	on the date that the voting packages are sent to members, no later than January 14, 2022
Date voting closes	4 p.m., February 18, 2022

All times noted in these procedures are Eastern Time.

[1]Members licensed after this date may call in and request that election information be mailed to them by regular mail or, upon prior written consent by the member for use of his, her or their email address, via email or via telephone.

2. Candidates' names will be listed in alphabetical sequence by position on the list of candidates sent to members and on PEO's website. However, the order of their names will be randomized when voters sign in to the voting site to vote.
3. A person may be nominated for only one position.
4. Nomination papers are to be submitted only by email (elections@peo.on.ca) for tracking purposes. Forms will not be accepted in any other format (e.g. fax, personal delivery, courier, regular mail).
5. Only nomination acceptance and nomination forms completed in all respects, without amendment in any way whatsoever, will be accepted.
6. Signatures on nomination forms can be hand-signed or electronic.
7. Signatures on nomination forms may be hand-signed or electronic.

8. Signatures on nomination petition forms do not serve as confirmation that a member is formally endorsing a candidate.
9. In the event a candidate changes his, her or their mind on a position and decides to run for a different position after submitting nomination forms, a newly completed nomination petition form, in addition to a new nomination acceptance form, will be required.
10. Candidates should allow sufficient time for their emails to go through the system to ensure that the completed papers are, in fact, received by the chief elections officer by 4 p.m. on November 26, 2021. In the event of a dispute as to when the forms were sent versus received, a candidate can provide the chief elections officer with a copy of his, her or their email to PEO that would indicate the time the nomination forms were sent from his, her or their computer.
11. Council has appointed a Central Election and Search Committee to:
    - encourage members to seek nomination for election to the Council as president-elect, vice president or a councillor-at-large;
    - assist the chief elections officer as may be required by him, her or them;
    - receive and respond to complaints regarding the procedures for nominating, electing and voting for members to the Council; and
    - conduct an annual review of the elections process and report to the June 2022 Council meeting.

12. Candidates will be advised when a member of the Central Election and Search Committee has declared a conflict of interest should an issue arise that requires the consideration of the committee.
13. Council has appointed a Regional Election and Search Committee for each region to encourage members residing in each region to seek nomination for election to the Council as a regional councillor.
14. Council has appointed an independent chief elections officer to oversee the election process and to ensure the nomination, election and voting are conducted in accordance with the procedures approved by Council.
15. The chief elections officer will be available to answer questions and complaints regarding the procedures for nominating, electing and voting for members to the Council. Any such complaints or matters that the chief elections officer cannot resolve will be forwarded by the chief elections officer to the Central Election and Search Committee for final resolution. Staff is explicitly prohibited from handling and resolving complaints and questions, other than for administrative purposes (e.g. forwarding a received complaint or question to the chief elections officer).
16. Voting will be by electronic means only (internet and telephone). Voting by electronic means will be open at the same time the electronic election packages are sent out.
17. An independent agency has been appointed by Council to receive, control, process and report on all cast ballots. This "official elections agent" will be identified to the members with the voting material.
18. If a candidate withdraws his, her or their nomination for election to PEO Council prior to the preparation of the voting site, the chief elections officer shall not place the candidate's name on the voting site of the official elections agent or on the list of candidates sent to members and shall communicate to members that the candidate has withdrawn from the election. If the candidate withdraws from the election after the electronic voting site has been prepared, the chief elections officer will instruct the official elections agent to adjust the voting site to reflect the candidate's withdrawal.
19. All voting instructions, a list of candidates and their election publicity material will be sent to members by the official elections agent. All voters will be provided with detailed voting instructions on how to vote electronically. Control numbers or other access control systems will be sent to members by email after the election package has been sent out. The official elections agent will send out an eblast with the control numbers (PINs) every Monday during the election period.
20. Election material sent to members electronically or by mail will contain information related to the All Candidates Meetings.
21. If the official elections agent is notified that an elector has not received a complete election information package, the official elections agent shall verify the identity of the elector and may either provide a complete duplicate election information package to the elector, which is to be marked "duplicate," by regular mail or email or provide the voter's unique control number to the voter and offer assistance via telephone. In order to receive such information via email, the elector must provide prior written consent to the use of his, her or their email address for this purpose.
22. Elections staff shall respond to any requests for new packages as usual—i.e. if the member advises that he, she or they has moved and has not received a package, the member is to be directed to the appropriate section on the PEO website where the member may update his, her or their information with Document Management Centre (DMC).
23. DMC staff shall advise elections staff when the member information has been updated; only then shall the elections staff request the official elections agent to issue a replacement package with the same control number.
24. Verification of eligibility, validity or entitlement of all votes received will be required by the official elections agent. Verification by the official elections agent will be by unique control number to be provided to voters with

detailed instructions on how to vote by internet and by telephone.

25. Voters need not vote in each category to make the vote valid.
26. PEO will post total votes cast in the election on the PEO website on each Friday of the voting period and will post final vote totals by candidate after voting has closed. No other information related to vote totals will be made available.
27. The official elections agent shall not disclose individual voter preferences.
28. The official elections agent shall keep a running total of the electronic ballot count and shall report the unofficial results to the chief elections officer, who will provide the candidates with the unofficial results as soon as practically possible.
29. There shall be an automatic recount of the ballots for a given candidate category for election to Council or bylaw confirmation where the vote total on any candidate category for election to Council between the candidate receiving the highest number of votes cast and the candidate receiving the next highest number of votes cast is 25 votes or less for that candidate category or where the votes cast between confirming the bylaw and rejecting the bylaw is 25 votes or less.
30. Certification of all data will be done by the official elections agent.
31. On or before the close of nominations on November 26, 2021, the president will appoint three members or councillors, who are not running in the election, as returning officers to:
    - approve the final count of ballots;
    - make any investigation and inquiry as they consider necessary or desirable for the purpose of ensuring the integrity of the counting of the vote and report the results of the vote to the registrar no later than March 11, 2022.
32. Returning officers shall receive a per diem of $250, plus reasonable expenses to exercise the duties outlined above.
33. Reporting of the final vote counts, including ballots cast for candidates that may have withdrawn their candidacy after the opening of voting to PEO, will be done by the returning officers to the registrar, who will advise the candidates and Council in writing at the earliest opportunity.
34. Upon the direction of the Council following receipt of the election results, the official elections agent will be instructed to remove the electronic voting sites from its records.
35. Election envelopes that are returned to PEO as undeliverable are to remain unopened and stored in a locked cabinet in the Document Management Centre (DMC) without contacting the member until such time as the election results are finalized and no longer in dispute.
36. Elections staff are not to have access to, or control of, returned envelopes.
37. After the election results are finalized and no longer in dispute, the chief elections officer shall authorize the DMC to unlock the cabinet containing the unopened returned ballot envelopes so that it may contact members in an effort to obtain current information.
38. After the DMC has determined that it has contacted as many members whose envelopes were returned as possible to obtain current information or determine that no further action can be taken to obtain this information, it shall notify the elections staff accordingly and destroy the returned elections envelopes.
39. In the event a chapter holds an All Candidates Meeting, the chapter must invite to the meeting all candidates for whom voters in that region are eligible to vote.
40. Candidates for PEO Council may submit expense claims. The travel allowance to enable candidates to travel to chapter events during the period from the close of nominations to the close of voting will be based on the distance between chapters and the number of chapters in each region. Such travel expenses are reimbursed only in accordance with PEO's expense policy.
41. These procedures may only be amended if approved by the current Council.
42. All questions from, and replies to, candidates are to be addressed to the chief elections officer:

By email: elections@peo.on.ca

By letter mail: Chief elections officer
c/o Professional Engineers Ontario
101–40 Sheppard Avenue West
Toronto, ON M2N 6K9

The Election Publicity Procedures form part of these Voting Procedures.

2022 ELECTION PUBLICITY PROCEDURES

IMPORTANT DATES TO REMEMBER

Deadline for receipt of publicity materials for publication in *Engineering Dimensions* and on the PEO website, including URLs to candidates' own websites	4 p.m., December 10, 2021
Deadline for submission of candidate material to eblast to members	1. January 10, 2022—1st eblast 2. January 24, 2022—2nd eblast 3. February 7, 2022—3rd eblast
Dates of eblasts to members	1. January 17, 2022 2. January 31, 2022 3. February 14, 2022
Date of posting period	January 14, 2022 to February 18, 2022
Dates of voting period	12 p.m., January 14, 2022 to 4 p.m., February 18, 2022
Dates of All Candidates Meetings	The week of January 3, 2022

Note: All times indicated in these procedures are Eastern Time.

1. Names of nominated candidates will be published on PEO's website as soon as their nomination is verified.
2. Names of all nominated candidates will be forwarded to members of Council, chapter chairs and committee chairs and published on PEO's website by November 29, 2021.
3. Should a candidate wish to withdraw from the election, their name will remain on the website and the word "withdrawn" will appear beside their name on the PEO website.
4. Candidates will have complete control over the content of all their campaign material, including material for publication in *Engineering Dimensions*, on their additional material on PEO's website and on their own websites.
5. Candidate material is readily available to the public and should be in keeping with the dignity of the profession at all times. Material will be published with a disclaimer. The chief elections officer may seek a legal opinion prior to publishing/posting of any material if the chief elections officer believes campaign material could be deemed libelous. The chief elections officer has the authority to reject the campaign material if so advised by legal counsel.
6. Candidate material may contain personal endorsements provided there is a clear disclaimer indicating that the endorsements are personal and do not reflect or represent the endorsement of PEO Council, a PEO chapter or committee or any organization with which an individual providing an endorsement is affiliated.
7. Candidate material for publication in *Engineering Dimensions* and any additional material they wish to publish on the website must be forwarded to the chief elections officer via email at elections@peo.on.ca no later than 4 p.m. on December 10, 2021, and **must be in accordance with these procedures and Schedule A attached**.
8. Candidates have the option of using one of two templates to present their election material in *Engineering Dimensions*. Both templates are included in Schedule A of these procedures. The size of both templates is the equivalent of one-half page, including border, in *Engineering Dimensions*.
   a. Option 1: Candidates using the blank template will have discretion over the presentation of their material, including but not limited to font style, size and effects. Candidates using the blank template will be permitted to include their portrait within the template.
   b. Option 2: Candidates using the fillable template must provide responses to the questions provided in the allotted space. The presentation of the fillable template is fixed and no modifications will be permitted. Candidates using the fillable template must submit their portrait separately for insertion into the designated location by PEO staff.
9. Candidates shall not use the PEO logo in their election material.
10. Candidates may include links to PEO publications but *not* a URL link to a third party in their material on PEO's website. Links to PEO publications are not considered to be to a third party. For clarity, besides links to PEO publications, the only URL link that may be included in a candidate's material on PEO's website is a URL link to the candidate's own website.
11. If campaign material is submitted by a candidate without identifying information, PEO staff are authorized to contact the candidate and ask if he, she or they wishes to resubmit material. If campaign material is received by the chief elections officer and returned to the candidate for amendment to comply with the Election Publicity Procedures, and the amended material is not returned within the prescribed time, staff will publish the material with a notation explaining any necessary amendments by staff.
12. The chief elections officer is responsible for ensuring that all candidate material (whether for *Engineering Dimensions*, PEO's website or eblasts) complies with these procedures. Where it is deemed the material does not satisfy these procedures, the chief elections officer will, within three full business days from receipt of the material by the chief elections officer, notify the candidate, who is expected to be available during this period by telephone or email. The candidate will have a further three full business days to advise the chief elections officer of the amendment. Candidates are responsible

for meeting this deadline. Should a candidate fail to re-submit material within the three-business-day period, the candidate's material will be published with a notation explaining any necessary amendments by staff.

13. Candidate publicity material will be published as a separate insert in the January/February 2022 issue of *Engineering Dimensions* and to PEO's website in January 2022, and included in any hardcopy mailing to eligible voters with voting instructions. Links to candidate material on PEO's website will be included in any electronic mailing to eligible voters.
14. Candidate material will be considered confidential and will be restricted to staff members required to arrange for publication until published on PEO's website. All candidates' material will be published to PEO's website at the same time.
15. Candidates may submit updates to their material on PEO's website once during the posting period. Any amendments to a candidate's name/designations are to be considered part of the one-time update permitted to their material during the posting period.
16. Candidates may post more comprehensive material on their own websites, which will be linked from PEO's website during the posting period. Candidates may include active links to their social media accounts (Facebook, Twitter, LinkedIn, etc.) in material appearing in *Engineering Dimensions*, published on PEO's election site (i.e. the 1000-word additional information candidates may submit) or included in an eblast of candidate material.
17. PEO will provide three group email distributions to members of candidate publicity material beyond the material published in *Engineering Dimensions*. Material to be included in an eblast must be submitted to the chief elections officer at elections@peo.on.ca in accordance with Schedule A. In the event of a dispute as to when the material was sent versus received, the material will be accepted only if a candidate can provide the chief elections officer with a copy of his, her or their email to PEO sent from his, her or their computer indicating a sent time before the deadline.
18. All material for the eblast messages must be submitted in a Word document only and must not be included as part of the message in the transmission email. Where the email message is received in a font size or style that is different from the specifications, but otherwise meets all the requirements, the chief elections officer may authorize staff to change only the size and font of the material so it conforms to specifications. Staff are prohibited from amending material in any way except with the written permission of the candidate.
19. Candidates are responsible for responding to replies or questions generated by their email message.
20. PEO will provide candidates the opportunity to participate in All Candidate Meetings, which will be held at PEO offices during the week of January 3, 2022. The All Candidate Meetings will be video recorded for posting on PEO's website. On the day of the first All Candidates Meeting, an eblast will be sent to members announcing that these video recordings will be posted on the PEO website within two business days.
21. Candidate materials from previous elections will remain on PEO's database as part of the record of the election.
22. Caution is to be exercised in determining the content of issues of membership publications published during the voting period, including chapter newsletters. Editors are to ensure that no candidate is given additional publicity or opportunities to express viewpoints in issues of membership publications distributed during the voting period from January 14, 2022, until the close of voting on February 18, 2022, beyond his, her or their candidate material published in the January/February issue of *Engineering Dimensions* and on the PEO website. This includes photos (with or without captions), references to, or quotes or commentary by, candidates in articles, letters to the editor and opinion pieces. PEO's communications vehicles should be, and should be seen to be, non-partisan. The above does not prevent a PEO publication from including photos of candidates taken during normal PEO activities (e.g. licensing ceremonies, school activities, GLP events, etc.) provided there is no expression of viewpoints. For greater clarity, no election-specific or election-related articles, including Letters to the Editor and President's Message, are to be included in *Engineering Dimensions* during the voting period. *Engineering Dimensions* or other PEO publications may contain articles on why voting is important.
23. Chapters may not endorse candidates, or expressly *not* endorse candidates, in print, on their websites or through their list servers, or at their membership meetings or activities during the voting period. Where published material does not comply with these procedures, the chief elections officer will cause the offending material to be removed if agreement cannot be reached with the chapter within the time available.
24. Councillors may use their positions to encourage candidates to stand for PEO office and members to participate in the election process but may not endorse candidates for PEO election.
25. Candidates may attend chapter annual general meetings and network during the informal portion of the meeting. Candidates are permitted to attend chapter functions in their current official capacity but are prohibited from campaigning while operating in their official capacity.
26. The Central Election and Search Committee is authorized to interpret the voting and election publicity guidelines and procedures and to rule on candidates' questions and concerns relating to them.

These Election Publicity Procedures form part of the Voting Procedures.

SCHEDULE A: 2022 ELECTION PUBLICITY PROCEDURES

SPECIFICATIONS FOR CANDIDATE MATERIALS

FORMAT FOR CANDIDATE STATEMENTS IN *ENGINEERING DIMENSIONS*

All submissions will be published with a border. If submissions are received without a border, one will be added as shown on the templates. If submissions do not fit within the chosen template, they will be mechanically reduced to fit.

Option 1: Blank template

Candidates using the blank template to present their material for publication in *Engineering Dimensions* must ensure the content fits in the bordered template provided at the end of these specifications. The template dimensions are 6.531 inches wide and 4.125 inches in height.

All material for publication must be submitted as a PDF document, with images in place for reference, *and* in Word format only, showing where images are to be placed. No other formats will be accepted.

Portraits must also be submitted as specified in the next section.

The publications staff needs both a PDF file and Word file of candidate material so they will know how candidates intend their material to look. If there are no difficulties with the material, the PDF file will be used. The Word file is required in case something isn't correct with the submission (just a bit off on measurement, for example), as it will enable publications staff to fix the problem, if possible. A hard and/or digital copy of a candidate's portrait is required for the same reason and for use on the PEO election website.

Option 2: Fillable template

Candidates using the fillable template must provide responses to the questions provided in the allotted space. The completed template must be submitted as a PDF document.

Portraits must be submitted separately, as specified in the portraits section below, and will be added to the template by PEO staff.

The presentation of the fillable template is fixed and no modifications will be permitted.

The profile template will be available on PEO's elections website, www.peovote.ca

A hard and/or digital copy of a candidate's portrait is also required for use on the PEO elections website.

PORTRAITS/PHOTOGRAPHS

Photographs must be at least 5" x 7" in size if submitted in hard copy form so that they are suitable for scanning ("snapshots" or passport photographs are not suitable).

Only pictures taken in the last five years will be accepted.

If submitted in digital form, photographs must be JPEG-format files of at least 300KB but no more than 2MB.

Candidates can submit a digital photo at the specifications noted, or hard copy as noted, and preferably both. In case the digital file is corrupted or not saved at a sufficiently high resolution, publications staff can rescan the photo (hard copy) to ensure it prints correctly, as indicated on the PDF.

PEO WEBSITE (CANDIDATES' ADDITIONAL INFORMATION)

Candidates may publish additional information on PEO's website by submitting a Word or Word-compatible file of no more than 1000 words, and no more than three non-animated graphics in JPEG or GIF format. Graphics may not contain embedded material.

Candidates may post additional material on their own websites. No link will be provided to candidates' own websites. URLs for candidates' websites must be active by December 10, 2021.

Candidates may include links to PEO publications but *not* a URL link to a third party in their material that is to be posted on PEO's website. Links to PEO publications are not considered to be to a third party. For clarity, the only URL link that may be included in a candidate's material on PEO's website is the URL to the candidate's own website. Candidates may include active links to their social media accounts (Facebook, Twitter, LinkedIn, etc.)

EBLAST MATERIAL

Candidates are permitted a maximum of 300 words for email messages. Messages are to be provided in 11 pt. Arial font; graphics are not permitted. For clarity, a "graphic" is an image that is either drawn or captured by a camera.

HELP

Candidates should contact the chief elections officer (elections@peo.on.ca) if they have questions about requirements for publicity materials.

Option 1: Blank template

Option 2: Fillable template

Name:

Employer and position:

Degree(s), school(s) attended, year(s) of graduation:

Employment history:

Participation on PEO Council, committee/task forces, chapters:

Other professional affiliations and community service:

Years of registration in Ontario:

Candidate statement:

ONTARIO ENGINEERS WIN PRESTIGIOUS AWARDS

By Marika Bigongiari

Every year, the Engineers Canada Awards celebrate excellence in engineering and recognize the notable work and achievements of the trailblazers within the profession. This year, Engineers Canada honoured six members of the engineering community who have contributed to improving the lives of not just Canadians but others around the world through their innovation, enthusiasm and commitment to professional engineering. This year's winners include **Claire Kennedy, LLB, P.Eng.,** partner at law firm Bennett Jones LLP, who won the Meritorious Service Award for Community Service. Kennedy is a passionate volunteer with almost two decades of diverse community involvement who has demonstrated her commitment to serving the engineering community and beyond. **William Cluett, PhD, P.Eng.,** professor in the department of chemical engineering and applied chemistry and director of the division of engineering science at the University of Toronto (U of T), was awarded the Medal for Distinction in Engineering Education. Cluett is a celebrated engineering educator who is known for engaging and inspiring students through innovative courses, teaching and mentorship. And **Catherine Mavriplis, PhD, P.Eng.,** mechanical engineering professor at the University of Ottawa, Natural Science and Engineering Research Council of Canada (NSERC) chair for women in science and engineering and an expert in computational fluid dynamics, won the Award for the Support of Women in the Engineering Profession. Mavriplis has served the engineering profession for nearly four decades as a professor and researcher and has been an exceptional advocate for the advancement of women in engineering through volunteering, mentorship and the development of resources.

The Canadian Academy of Engineering (CAE) welcomed 50 newly elected fellows and two international fellows at the academy's 2021 virtual annual general meeting in June. The CAE induction ceremony, which will honour both the 2020 and 2021 elected fellows, will take place virtually in October 2021. The CAE is an independent, self-governing and non-profit organization through which individuals who have made outstanding contributions to engineering in Canada provide strategic advice on matters of critical importance to

Top left: Alex Czekanski, PhD, P.Eng., associate professor of mechanical engineering at York University and Canadian Engineering Education Association (CEEA) president, was named a fellow of the CEEA. Photo: Lassonde School of Engineering

Top right: Marin Litoiu, PhD, P.Eng., professor of electrical engineering and computer science at the Lassonde School of Engineering and School of Information Technology at York University, was named a fellow of the Canadian Academy of Engineering. Photo: Lassonde School of Engineering

Matthew Perras, PhD, P.Eng. (bottom left), and Usman Khan, PhD, P.Eng. (bottom right), received a $250,000 research award from the Government of Canada's New Frontiers in Research Fund, Exploration stream, for leading the project "Using machine learning to understand ancient climatic influences on the stability of cliffs and tombs in the Theban Necropolis of Egypt." Photo: Lassonde School of Engineering

Canada and Canadians. Fellows of the CAE are nominated and elected by their peers in recognition of their distinguished achievements and service. This year's cohort includes **Franco Berruti, PhD, P.Eng.,** professor at Western University, founding director of the Institute for Chemicals and Fuels from Alternative Resources and NSERC industrial research chair in thermochemical conversion of biomass and waste to bioindustrial resources; **James Burpee, P.Eng.,** board chair at Atomic Energy of Canada Ltd., whose extensive expertise is borne of more than 40 years of experience in the electricity sector; **Mark Diederichs, PhD, P.Eng.,** professor of geological engineering at Queen's University, a sought-after international expert, prominent lecturer and top researcher with an exemplary

record of contributing to the profession and positively influencing students and peers; **Thomas Duever, PhD, P.Eng.,** dean of the faculty of engineering and architectural science and professor of chemical engineering at Ryerson University, an award-winning instructor and accomplished researcher; **Ashraf El Damatty, PhD, P.Eng.,** professor and chair of the department of civil and environmental engineering at Western University, chair of the department of civil engineering and research director of the Wind Engineering, Energy and Environment Research Institute and an international leader in structural and wind engineering; **M. Hesham El Naggar, PhD, P.Eng.,** distinguished university professor at Western University and internationally acclaimed scholar in the fields of foundation dynamics, deep foundations and geotechnical earthquake engineering; **Mark Green, PhD, P.Eng.,** professor of civil engineering, provost and vice-principal (academic) at Queen's University, an internationally recognized leader in applications of fibre reinforced polymer materials to concrete structures and the dynamics of bridge-vehicle interaction; **James Johnson, PhD, P.Eng.,** professor of mechanical and materials engineering and surgery at Western University, director of the Bioengineering Research Laboratory and an internationally recognized innovator and researcher in the field of upper limb biomechanics; **Marin Litoiu, PhD, P.Eng.,** professor of electrical engineering and computer science at Lassonde School of Engineering and School of Information Technology at York University, where he leads the Centre for Research in Adaptive Software and is a world-renowned pioneer in the field of adaptive and self-managing software systems; **Catherine Mavriplis, PhD, P.Eng.** (see Engineers Canada Awards on p. 42); **Kim McAuley, PhD, P.Eng.,** professor in the department of chemical engineering at Queen's University, an award-winning researcher in mathematical modelling of chemical processes and lab leader of the Chemical Process Mathematics Lab, a multi-institutional laboratory of the Fields Centre for Quantitative Analysis and Modelling; **Kenneth Ogilvie, PhD, P.Eng.,** president of Kenneth Ogilvie Consulting, who has had a notable career in the environmental field, including roles with both the federal government and provincial governments of Manitoba and Ontario; **Beth Parker, PhD, LEL,** professor at the University of Guelph, NSERC industrial research chair in hydrogeology and global leader in fractured porous geologic media contamination working to protect water supplies in Guelph and many

Claire Kennedy, LLB, P.Eng., a partner at Bennett Jones LLP, won the Meritorious Service Award for Community Service from Engineers Canada.
Photo: Roberta Baker/U of T Engineering

William Cluett, PhD, P.Eng., professor in the department of chemical engineering and applied chemistry and director of the division of engineering science at the University of Toronto, was awarded the Medal for Distinction in Engineering Education from Engineers Canada.
Photo: William Cluett

Elvino Sousa, PhD, P.Eng., electrical and computer engineering professor and Jeffrey Skoll chair in computer networks and innovation at the University of Toronto, was named a fellow by the Canadian Academy of Engineering.
Photo: U of T Engineering

Konstantinos Plataniotis, PhD, P.Eng., electrical and computer engineering professor at the University of Toronto, was inducted as a fellow to the Canadian Academy of Engineering.
Photo: U of T Engineering

other communities; **Konstantinos Plataniotis, PhD, P.Eng.,** electrical and computer engineering professor at U of T, whose outstanding contributions and adaptive imaging framework have been internationally recognized; **Elvino Sousa, PhD, P.Eng.,** electrical and computer engineering professor and Jeffrey Skoll chair in computer networks and innovation at U of T, internationally recognized for his contributions to cellular system modeling and performance optimization, including CDMA systems and transmitter diversity techniques; **Bruce Taylor, P.Eng.,** president of Enviro-Stewards Inc. and an innovative entrepreneur, who founded an award-winning engineering firm and established Safe Water Social Ventures, which provides safe drinking water and employment to developing communities in east Africa; **Rajiv K. Varma, PhD, P.Eng.,** professor of electrical and computer engineering at Western University and an internationally recognized researcher, inventor and leader in FACTS, solar and wind power systems; **Daryl Wilson, P.Eng.,** executive director of Hydrogen Council and pioneer in the application of hydrogen for clean energy; and **Fei Richard Yu, PhD, P.Eng.,** professor at the School of Information Technology and department of systems and computer engineering at Carleton University, director of NSERC collaborative research and training experience program for building trust in connected and autonomous vehicles and internationally recognized research leader in mobile systems.

The Canadian Engineering Education Association (CEEA) named its newest fellows, a designation that honours individuals who have demonstrated noteworthy service to engineering education, engineering leadership or engineering design education through their work with CEEA. The new CEEA fellows include **Jason Bazylak, P.Eng.,** professor, teaching stream, mechanical engineering and Hart Teaching Innovation professor at U of T, who coordinates an award-winning first-year design course called engineering strategies and practice, conducts research into reducing the underrepresentation of women and Indigenous Peoples in engineering and is the dean's advisor on Indigenous initiatives. As the dean's advisor on Indigenous initiatives and a member of the Eagles' Longhouse Indigenous Initiatives Steering Committee, Bazylak was a key author of the *Blueprint for Action,* a report that includes 34 calls to action for the faculty to progress towards reconciliation. **Alex Czekanski, PhD, P.Eng.,** associate professor of mechanical engineering at York University, CEEA president, CSME senior vice president, NSERC/Quanser chair in design engineering for innovation and director of the Centre for Automotive Research, was also named a CEEA fellow for his research on design engineering education and contributions to engineering education society. Czekanski, whose work focuses on computational and experimental mechanics, multi-scale modelling, additive manufacturing and educational engineering, is also the principal investigator for "Additive Manufacturing: Engineering Design and Global Entrepreneurship," an NSERC CREATE grant awarded in 2020, as well as the co-principal investigator for an NSERC CREATE grant awarded in 2021, "Smart Autonomous Robotic Technology for Earth and Space Exploration."

Jason Bazylak, P.Eng., professor, teaching stream, mechanical engineering and Hart Teaching Innovation professor at the University of Toronto, was inducted as a fellow to the Canadian Engineering Education Association. Photo: Jeremy Sale

Mark Diederichs, PhD, P.Eng., professor of geological engineering at Queen's University, was named a fellow of the Canadian Academy of Engineering. Photo: Queen's University

University of Windsor civil engineering professor **Ram Balachandar, PhD, P.Eng.,** has been recognized with a national engineering fellowship by the Canadian Society for Civil Engineering (CSCE). Balachandar was elected as a fellow during the CSCE's virtual 2021 annual conference. In 2019, Balachandar received the CSCE's Camille A. Dagenais Award for his research on open channel flows, fluid-structure interaction and efforts in the area of scour. The CSCE recognizes members for their career achievements and technical papers excellence. The society was created to develop and maintain high standards of civil engineering practice in Canada and to enhance the public image of the field.

Thomas Adams, PhD, P.Eng., associate professor and associate chair, graduate with the department of chemical engineering at McMaster University, has been awarded the 2021 David Himmelblau Award for Innovations in Computer-based Chemical Engineering Education by the American Institute of Chemical Engineers. The award recognizes an individual or group making new and novel contributions to computer aids for chemical engineering education. Adams

Mark Green, PhD, P.Eng., professor of civil engineering, provost and vice-principal (academic) at Queen's University, was named a fellow of the Canadian Academy of Engineering. Photo: Queen's University

Kim McAuley, PhD, P.Eng., professor in the department of chemical engineering at Queen's University, was named a fellow of the Canadian Academy of Engineering. Photo: Queen's University

is the first recipient of the international award working at a Canadian university. Adams has made significant contributions to chemical engineering education through widely adopted educational tools and is fostering a more open research ecosystem in chemical engineering by making government-funded research data available, as well as chemical process models and simulations.

York University researchers have received research awards from the Government of Canada's New Frontiers in Research Fund (NFRF), Exploration stream. The NFRF was launched in 2018 to support world-leading interdisciplinary, international, high-risk/high-reward, transformative and rapid-response Canadian research. **Matthew Perras, PhD, P.Eng.,** assistant professor, department of civil engineering at the Lassonde School of Engineering at York University, is the principal investigator on a project that uses machine learning to understand ancient climatic influences on the stability of cliffs and tombs in the Theban Necropolis of Egypt, a UNESCO World Heritage site near Luxor, Egypt. Perras leads an international research team that includes his Lassonde colleague **Usman Khan, PhD, P.Eng.,** assistant professor in the department of civil engineering and co-principal investigator on the project. The tombs show evidence of rock mass collapses during construction through to recent deterioration leading to potential instabilities. Several factors, including climatic variations, lead to challenges in determining when instabilities will develop and problems designing preservation strategies. Understanding the current measurements, past influences and applying it to predict future instabilities will help identify key areas for protection and aid in preserving the UNESCO site. The project received $250,000 in funding. **e**

NEW COMMITTEES PUT FOCUS ON COUNCIL'S GOVERNANCE ROLE

The recent implementation of four new governance committees is a crucial step towards PEO's goal to be a more focused, modern regulator.

By Marika Bigongiari

PEO Council recently completed Phase 2 of the four-phase Governance Roadmap workplan. Phase 2 focused on PEO committees and improving their structures and mandates. As part of this phase, Council formally approved the implementation of four new board (governance) committees: Regulatory Policy and Legislation, Audit and Finance, Human Resources and Compensation and Governance and Nominating. At the same time, several other PEO committees were formally stood down, while others will be phased out over time. Additionally, the responsibility for stewardship of the Governance Roadmap was transferred from the Executive Committee to the new Governance and Nominating Committee (see "Council approves establishment of new governance committees," *Engineering Dimensions*, May/June 2021, p. 20).

SUPPORTING GOVERNANCE REFORM

"The fulfillment of the governance workplan, including the new governance committees, will help PEO become the modern regulator it is committed to becoming," says Liz Maier, PEO's vice president, governance, who was recruited earlier this year to advance PEO's completion of the multi-year roadmap. Maier stresses the importance of having a Council that is not involved in PEO's day-to-day operations but rather one that functions as a governing board and thinks strategically.

The new governance committees are composed exclusively of councillors. And, as of PEO's 2022 Annual General Meeting (AGM), councillors will no longer serve on non-governance committees. "The governance committees are where councillors will examine relevant data and background information, mostly assembled by professional staff, in order to develop best practices and make appropriate recommendations to Council," Maier explains. The focus of the new committees, as well as of the work of Council generally, will be on separating operational activities—which are the responsibility of PEO staff—from governance activities.

The four new committees have the following mandates:

- **Governance and Nominating Committee,** which aims to gain reasonable assurance as to the effectiveness of corporate governance, Council, committees and Council members; and assists in overseeing Council renewal, nominations and elections and both governance and regulatory committee appointments;
- **Regulatory Policy and Legislation Committee,** which focuses on the development, review and revisions of legislative changes, regulations, standards, guidelines, bylaws and policies related to PEO's regulatory mandate and protecting and serving the public; as well as the identification of regulatory issues for addressing, monitoring and reviewing policy proposals and providing regulatory impact analysis, providing policy coordination with the Attorney General as per Council's approved intents and reviewing draft legislation for the alignment between policy intent and legislative provisions;
- **Human Resources and Compensation Committee,** which provides oversight on behalf of Council on PEO's relationship with the CEO/registrar and on human resources policies and plans, including its compensation, benefits plans and Code of Conduct; and
- **Audit and Finance Committee,** which focuses on the integrity of PEO's financial reporting and financial management, including audits and controls; reviews financial information that will be provided to stakeholders; and has principal oversight responsibility with respect to financial matters that are material to PEO's activities and align with PEO's strategic plan and priorities.

> "THE FULFILLMENT OF THE GOVERNANCE WORKPLAN, INCLUDING THE NEW GOVERNANCE COMMITTEES, WILL HELP PEO BECOME THE MODERN REGULATOR IT IS COMMITTED TO BECOMING, LIZ MAIER SAYS.

Each committee's mandate was developed at Council's behest by external consultant Governance Solutions Inc. (GSI). The mandates were refined to reflect input from councillors and senior staff, and they are subject to further adjustment, especially as Council gains experience with the new structure. Councillors were appointed to the new governance committees at Council's May 2021 meeting, following PEO's AGM, where the new 2021–2022 Council was installed. Council members serving on particular governance committees are encouraged to have, to a reasonable extent, appropriate backgrounds and experience and commit to enhancing relevant competencies after their appointment.

THE ROAD AHEAD

Council has begun work on Phase 3 of the Governance Roadmap workplan. This phase focuses on Council composition and renewal, including its councillor selection process. "For Phase 3, we're implementing totally

new onboarding and a new orientation to help councillors understand what it means to be part of a regulatory board, specifically what it means to be a governing type of board, modelling the direction and control and keeping out of operational weeds," Maier explains.

A competency matrix is also being developed to evaluate potential councillors. "The most important part of Phase 3 is deciding on the competency profile and Council composition. Phase 4 will be for Council to decide what will be done with activities that have been categorized as non-governance and non-regulatory," says Maier, explaining that this will start to happen in February 2022. The initial task of defining the purpose of PEO's non-regulatory and non-governance activities—to ensure they are both necessary and fit for regulatory purposes—will fall to the new Governance and Nominating Committee, which will eventually present recommendations to Council. "This is important," Maier points out. "Because it's being worked on by councillors, so when it's presented to Council, it's coming from them and not coming from the outside."

HOW WE GOT HERE

In March 2020, Council approved a two-year Governance Roadmap for the achievement of its governance reform objectives, and in November 2020, Council approved a timed workplan to support the roadmap's completion. The workplan commits Council to reaching specific milestones of the roadmap at key dates over the course of two years, with an end date set for mid-2022.

The roadmap was implemented as a necessary step towards making Council more effective and appropriately focused on high-level strategy with the understanding that Council should guide PEO as a regulatory leader and leave operational decisions to the CEO/registrar and staff. The workplan divides the defined governance work into four phases that highlight reviewing and improving governance effectiveness as follows:

- Phase 1: Council policies, enhancing its effectiveness through regulatory and governance mandates;
- Phase 2: PEO committees, with an aim to improve their structures and mandates;
- Phase 3: Council composition and renewal, including its selection process; and
- Phase 4: Chapters, volunteers and other areas, with an aim to review their governance effectiveness.

The Governance Roadmap and resulting workplan were drafted and implemented by GSI as part of PEO's response to a 2019 external review of its regulatory performance, which levied 15 recommendations on the regulator and highlighted areas for improvement, including some that concerned governance. Maier leads the governance strategy behind the regulator's cultural change, as well as the work to restructure PEO's secretariat office to ensure the structure, processes and practices needed for the organization's statutory mandate are supported, while also respecting the separate accountabilities of Council and the CEO/registrar. Maier is also the interim vice president, organizational effectiveness. e

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Deadline for November/December 2021 is October 7, 2021. Deadline for January/February 2022 is December 2, 2021.

Subterranean engineering-themed issue relatable and appreciated

Carole Ahmad,
Schomberg, ON

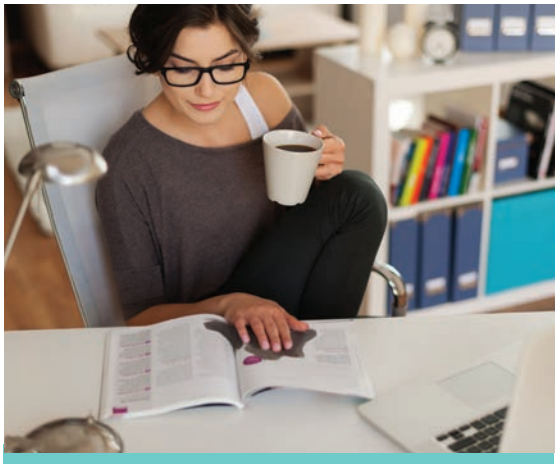
I have just finished reading the July/August 2021 issue of *Engineering Dimensions* (ED), as I do every issue, and was especially interested and appreciate the feature article "6 Ontario projects illuminate subterranean engineering" (p. 42) and Bits and Pieces (p. 13).

The magazine comes to my husband, Shaheen Ahmad, P.Eng., and because I have been hearing about and learning about engineering, especially all things underground, for the past 53 years of our time together, I continue to be curious and enjoy reading ED.

One thing I might suggest, since your magazine is meant for a diverse population of engineers in Ontario, is that your labelling of carefully chosen photographs, such as the loon and chick (2020/2021 PEO Annual Review insert, p. 9) and the Tobermory picture (2020/2021 PEO Annual Review insert, p. 11), extend to PEO inserts that are included within the magazine. I see it as a further opportunity to educate about Ontario.

We have escalated through the Billy Bishop Tunnel ("6 Ontario engineering projects illuminate subterranean engineering," p. 49); we have driven through the Detroit-Windsor Tunnel many times on our way over to discos in Detroit in the late 1960s (Bits and Pieces, p. 13); and my father worked on machinery production for the Adam Beck Generating Station ("6 Ontario engineering projects illuminate subterranean engineering," p. 48).

Kudos to your publication staff. Please keep these valuable features coming.



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Our print edition is still available, but to receive it instead of the digital edition, you must change your subscription preference in PEO's online member portal.

Go to **WWW.PEO.ON.CA,** log in to the portal (be sure to have your licence number handy) and change the *Engineering Dimensions* delivery method back to the print edition through the *Dimensions* tab.

IN ADDITION, you will be asked to choose your subscription preference as part of the annual renewal process.

AD INDEX

PEO must regulate new technologies to protect workers and the public

Tapan Das, PhD, P.Eng., Ottawa, ON; Peter DeVita, P.Eng., Richmond Hill, ON; Ray Barton, PhD, Ottawa, ON

PEO, in its regulatory role, should get involved with new technologies, such as nanotechnology, artificial intelligence, 5G networks, 3D printing and oceanography.

Nanotechnology involves materials and devices built on the scale of atoms and molecules with applications in nanomedicine, nanoelectronics, biomaterials and consumer products. Graphene, the hardest material known, is a single layer of carbon atoms and a super conductor of electricity and heat. Carbon nanotube, a nano-sized cylinder of carbon atoms, is approximately 100 times stronger than steel of the same diameter and six times lighter. Products benefiting from nanotechnology include sunscreen, self-cleaning glass and nanorobots capable of working as neurosurgeons at a level, which, according to one study, is 1000 times more precise than the sharpest scalpel. Inhaled nanoparticles may cause serious health problems, such as lung inflammation, heart problems and brain damage.

Artificial intelligence (AI) refers to the creation of human-like intelligence with a computer that can learn, reason, plan, perceive or process natural language. Google's deep learning, a subset of machine learning, is designed to learn and think like we do. Stephen Hawking, Bill Gates and Elon Musk have all warned of the potential consequence of AI if not regulated and controlled. The singularity of AI is the future period when the pace of technological change is so rapid, and its impact so deep, human life will be irreversibly changed. AI is being rapidly pursued and developed by many nations, and unless it is regulated by an organization like the United Nations, it is going to cause serious destruction in the world.

Additive manufacturing, or 3D printing, is the construction of a three-dimensional object under computer control from a CAD or digital 3D model, using additive processes by laying down successive layers of material. It creates ultrafine particle emissions with the potential to harm respiratory health and demands proper protection of workers.

Although these numbers are constantly in flux and vary among providers, 5G, the fifth-generation mobile network, operates in a frequency range of about 24 GHz to 86 GHz with a bandwidth of 10 gigabits and is designed to connect virtually everything. The network can support up to a million devices per square kilometre. Privacy and data security are the biggest regulatory concerns. A 3G network has a typical response time of 100 milliseconds, whereas 5G networks are as low as one millisecond. Concerns have been raised about the potential health risks of 5G, and data security and privacy are also of concern.

Oceanography deals with the physical and biological properties of the sea. Several companies, such as AML Oceanographic, work in this area. PEO should work with these institutions to keep up to date, as the field work of oceanographers can be hazardous.

PEO must stay abreast of new technologies to fulfill its role of regulation—it's an extension of the Professional Standards Committee (PSC) of PEO to stay abreast of new practices—and PEO/PSC should get involved with the Canadian Institute for Advanced Research, the Canadian Radio-television and Telecommunications Commission and the Canadian Meteorological and Oceanographic Society to do so.

LETTERS TO THE EDITOR are welcomed, but must be kept to no more than 500 words, and are subject to editing for length, clarity and style. Publication is at the editor's discretion; unsigned letters will not be published. The ideas expressed do not necessarily reflect the opinions and policies of the association, nor does the association assume responsibility for the opinions expressed. Emailed letters should be sent with "Letter to the editor" in the subject line. All letters pertaining to a current PEO issue are also forwarded to the appropriate committee for information. Address letters to editor@peo.on.ca.

We need people who are passionate about engineering and want to make a difference in the profession.

There's no better time to join PEO Council and help shape the regulator's future as it undergoes its most significant transformation since its creation in 1922. If you've never thought of running for Council before, consider the impact you can make by influencing regulatory initiatives and critical policy issues at the profession's highest level.

PEO is seeking candidates for positions on the 2022–2023 Council who reflect the diversity of the profession, can provide a problem-solving attitude to all discussions and are knowledgeable about board governance.

Find the 2022 Council Elections Call for Candidates on page 35 of this issue. Nominations open on October 18. But hurry—you only have until November 26 to nominate yourself or a fellow engineer.

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