Human Factors in Nuclear Resiliency

Getting to acceptance

Through human performance & collaboration

Climate change and the resulting need for low carbon generation options has created one of the most compelling cases for the use of nuclear power in the history of the technology. Increasingly, continuous improvement of operating methods and equipment management is improving its safety and economics.

Yet, especially in western countries, the use of nuclear for electricity generation continues to decline in both current operation and in future planning scenarios.

There are several factors impacting on nuclear's competitive position. But when they are boiled down, the concern remains one of public and political confidence in the safety and the cost. The negative perceptions are, in part, based on lack of understanding of a complex technology and on global events like Chernobyl and Fukushima, which due to their scale, remain in the public consciousness. But even small performance events at generally strong performing plants can erode public confidence in their jurisdiction, creating additional legislative and regulatory hurdles to both continued operation and new nuclear builds.

In September, CANDU Owners Group President Fred Dermarkar spoke at the ***International Atomic Energy Agency's (IAEA) technical meeting on Strengthening Resiliency in Nuclear Power Plant Operations in the Face of Current and Future Challenges***. The meeting brought together global nuclear leaders to consider how the industry can improve its collective performance. and in doing so, improve the likelihood the world will see nuclear technology as a solution to the planet's carbon challenge and a way to meet its increasing need for environmentally-sustainable, affordable and safe electricity.

In two sessions, Dermarkar shared COG's experience and his own observations on both human and technical aspects of nuclear practices.

In Part 1 of a two-part series, we feature highlights of Dermarkar's presentation on human aspects in nuclear resiliency. Part 2, highlighting technical aspects, will appear in the Winter 2017 edition of COGnizant.

Highlights

COG President Fred Dermarkar on Human Aspects contributing to Nuclear Resiliency IAEA, Vienna, September 2016

Seventy per cent of nuclear plant significant events can be traced back to human error. And, if you consider the times the event pre-conditions were caused by human aspects (latent conditions that could have been averted with the correct preventative behaviours), it is likely much higher.

At the two plants impacted by the tsunami in Fukushima – Daini and Daiichi -- there were two very different outcomes. Daini's was positive because in the face of extraordinary external challenges, the team managed to avert three core meltdowns. At Daiichi, we know, it was a devastatingly negative outcome. Both relate back to human and organizational factors.

And, it is not just a nuclear phenomenon.

The 2013 train crash in Lac Mégantic, Quebec that killed 47 people and led to the destruction of all but three of the more than 60 buildings in the downtown region is recognized as having its roots in human and organizational factors, extending systemically to both the operator and the regulator.

It is true as well of the event that caused injury to eight sailors on the USS Dwight D. Eisenhower in March 2016. In this event, a plane failed to slow in its landing on the aircraft carrier, after a cable snapped. At first blush it might seem like equipment failure. But the investigation revealed missed steps during troubleshooting by workers as the cause, pointing more fundamentally at human and organizational factors.

Creating a system for success

These events may appear to be faulty individual actions, just in the way counterfeit parts finding their way into airplanes or nuclear plants may seem like random acts of corruption.

But in each case, when you review the root causes, you can find system-related issues that allowed precursor conditions to these events. For example, in the case of the aircraft carrier, the precursor to the failed troubleshooting has been identified as insufficient training.

These are human aspects over which we almost always have control.

By contrast, pilot, Chester B. Sullenberger and his crew, were lauded as heroes for split-second decision-making that resulted in their plane's safe landing in the Hudson River following engine failure caused by geese striking the plane. Just as with the Fukushima Daini plant that managed to avert disaster, we should learn from these successes and ask ourselves:

- What leadership, culture and learned behaviours allowed these crews to make the decisions required;
- What underpinning cultural factors provided the respective leaders the support from their team in that deciding moment?

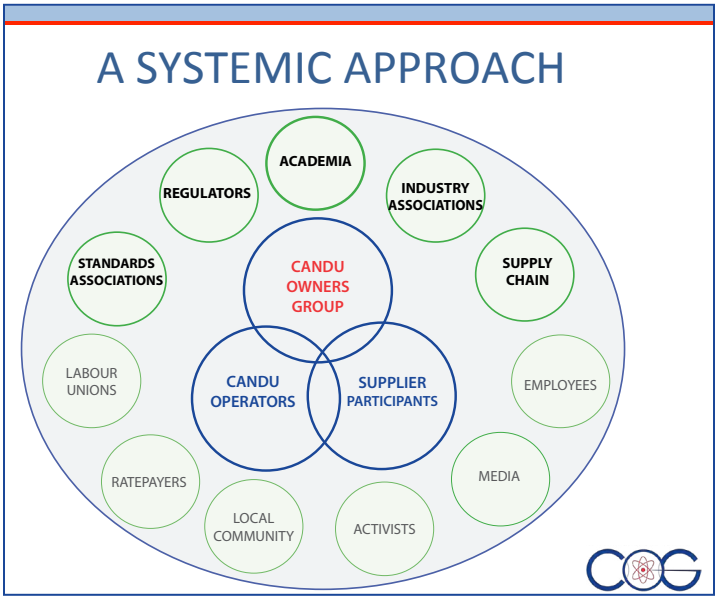
Influencing Human Factors

If we consider human aspects systematically, we can think of it as leadership directing and enabling culture throughout the company and in the plant. In turn, this sets the tone for the individual behaviours, communication systems and processes people call upon in their work every day – the things that either drive or undermine safety, reliability and cost. And, in those rare but high impact events, the internalized culture drives instict.

Human Aspect Trends

There are a number of human aspect issues chief nuclear officers are flagging in their work environments including:

- Demographic shifts, which continue at a high rate as they have for more than a decade;



Today nuclear operators have a host of external factors to consider when contemplating the factors that affect their operations. They must break down silos both inside and outside of the plant. Above, a slide from COG President Fred Dermarkar's presentation at the IAEA Nuclear Resiliency Technical Committee Meeting in September 2016.

- The impact on the plant of public and regulatory expectations and perceptions. More than ever, we see safety and economic regulatory expectations that take a systemic approach: They place increased value on societal expectations with input from multiple stakeholders including labour unions, neighbouring communities, suppliers, standards organizations, academia, activists, and others;
- And within the plant we wrestle with human inclination to create silos and tribes – the instinct to throw work over the departmental fence or to secret it away to avoid the challenge of criticism. There are complex reasons for this behaviour and unravelling them to create a culture of transparency is equally complex.

It requires deep work in building leadership, building teams, building trust and understanding of human dynamics. Here, too, we need to take a systemic approach of involving many internal stakeholders.

Collaboration models are needed to provide a sense of safe space and mutual accountability; one that rewards people for working together; that values team outcomes rather than individual superstars.

And finally, we need to integrate decision-making competencies into our processes and our training. We need to develop systems that provide people the skills and resilience to make decisions in extreme situations: the ability to make decisions and execute in those moments when paralysis is the worst choice of all.

A Systemic Approach

Many stakeholders influence the operation of nuclear power plants. Addressing the human aspects that influence plant operation requires consideration of the complex interactions between these stakeholders. At COG, our focus has been primarily on operators, and it has recently expanded to include supplier participants. To better support our members, the CANDU operators, we are playing an increasingly prominent role in interactions and collaborations involving academia, industry associations, the supply chain, standards associations and regulators.

COG's Role: Strengthening Resiliency

The low-hanging fruit is found in our reverse pyramid of leadership, culture and personal behaviours.

In 2014, COG began a training program for leadership development, which has grown significantly, including with our international members. In China, CNNO put 140 of its management team through this three-week program and continues to enroll its team in the course.

Similarly, COG offers a safety culture course that was recently delivered to KHNP in Korea. The course was divided into three sessions, targeted at executives, managers and then engineers. Courses like these help to set up the systems required to make and sustain deep changes in leadership and culture.

Training the next generation

COG provides its member the ability to transfer knowledge from one generation to another.

Through a number of joint projects, we have been able to capture knowledge and operating experience through textbooks and other documents from a generation of nuclear professionals who have, or are about to, retire. It is not an exaggeration to say we have an encyclopedia set worth of data and knowledge captured to share. And, we continue to look for the best ways to share this knowledge through updates to our web-based systems, through improvements to our workshops, through new training opportuni-

ties and peer teams, and through extended international collaborations across organizations and with our partners and at forums such as this one across organizations. And, we are currently looking at how we can improve this by better understanding the communication patterns of millennials coming into the workforce.

We also seek out experts beyond our own industry. Human and organizational factors that apply to nuclear are often the same ones that have been studied and implemented elsewhere. For example, managing counterfeit parts in the nuclear industry has similarities to the approach in aviation. Similarly, safe behaviors in a nuclear plant have the same roots as safety in rail management or infectious disease control.

Suppliers and operators working together

An initiative that has provided a lot of excitement at COG in the past couple of years is our supplier participant program. We continue to have new suppliers joining and even more interacting with COG and its members as the role and significance of suppliers' behaviour in outcomes becomes further understood.

Through bi-monthly meetings facilitated by COG, leaders in the supplier community are stepping up and sharing operating experience from their projects. One year ago, they would have viewed this information as contributing to their competitive advantage and would not have been open to sharing. Now, they see the linkages between their work and the success of the operators, and the need to ensure that the lessons learned from a mistake made by one supplier are shared within the supplier community to prevent repeat event by another supplier. Importantly, they are taking ownership for their role in the success of the industry.

COG is very appreciative of the strong working relationship we have been able to forge with the ***Organization of Canadian Nuclear Industries*** in these efforts. As well, we have built on the work of INPO, IAEA and others. This initiative is a case study in the value of collaboration.

COG's international reach

As mentioned earlier, actions taken far away reverberate around the globe. There may be no other sector that underscores how small our world has become in the same way nuclear does. What happens in a plant in Japan or India; in New York or Ontario is felt across Europe, North America, Asia and Africa in varying degrees.

So, we see it as a real strength that COG's reach is increasingly international with strong support and partnership flowing between our Canadian members and our international members. COG also works to be a conduit between our members and other organizations like EPRI, WANO and IAEA, to help them get the most from this knowledge network by channeling the knowledge and information most relevant to them into tangible activities and work programs.

COG wants to make the world smaller, in a positive way, by bringing lessons learned from multiple settings with all the nuances different cultural norms bring to the workplace. We can learn from each other's diverse experiences: both the successes and the failures. We can adopt ideas into our own operations, including those that would not have been inherent to our own societal norms.

For a couple of years now COG has been helping our CANDU-6 fleet members connect in a more formal way with periodic meetings and other peer opportunities. For the people who run this subset of CANDU technology, the commonalities they share combined with the diversity of perspectives they bring, offers tremendous learning opportunities.

The human in equipment reliability

Equipment reliability seems to be a technical issue. After all, how can you get more technically focused than equipment condition?

And yet, COG members have seen excellent progress through the equipment reliability peer teams whose focus has been very much on culture change and human performance. They have moved the bar by changing how people work with each other across teams and functions. New requirements for more-fulsome, more-frequent communications with more analysis of what worked and what didn't, has created a quarter-over-quarter improvement between 2013, when the initiative was launched, and today.

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Excellence through Collaboration

I feel fortunate to be president of COG because so much of what we do relates to harnessing the positive side of human performance and to working with CANDU operator and supplier leaders in this area.

The work of these colleagues brings to mind the value of risk sharing in relation to operators and suppliers. I will expand it here to internal plant stakeholders and departments.

Successful risk sharing requires a systemic approach that includes:

- Oversight of quality assurance and control;
- Leadership through human performance program oversight; and
- A culture of partnering and alignment.

Through these three steps we can achieve the personal behaviours necessary to reduce the frequency of events and minimize the severity of events. It is in our control.

These are the details of the work that must be observed day over day to achieve that simple, yet large, goal of excellence through collaboration, which is COG's vision.

The outcome of living this day-over-day is the opportunity it affords for us to demonstrate our safety and affordability in a way persuasive to governments, regulators, financers and the public. It builds trust.

We can do this. Not only for ourselves, but also for the millions of people who rely on us to provide them power that is safe, clean and affordable… and that is an excellent tool in fighting one of the planet's toughest challenges today – the impacts of climate change.

The COGnizant Winter 2017 Edition will feature Part 2 of this article: Nuclear Resiliency through Technical Factors based on Fred Dermarkar's second presentation to the IAEA Technical Committee in Vienna this past September, 2016.