ANS Meetings

Utility Working Conference and Vendor Technology Expo

25TH CONFERENCE – NUCLEAR RISING TO THE CHALLENGE

2018
Knowledge Base

August 5-8, 2018
Omni Amelia Island Plantation
Amelia Island, FL

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Zach Lassman *(Missouri University of Science and Technology)*
Jorge Narvaez *(University of Tennesee - Knoxville)*
Diana Peck *(Texas A&M University)*
Michael Tampas *(University of South Carolina)*

This version of the Knowledge Base (August Release) is still missing a few presentations. Look for an update in September with missing and INPO presentations linked,

CONTENTS

Plenaries

Industry Awards Presentation & Opening Plenary: Continuing the Pursuit of Excellence

This plenary will focus on the main driver for our industry's success, the continuous pursuit of excellence. What can we learn from others outside our industry that can help us on our journey?

United Nuclear Industry Alliance/General Introduction (see Wed UNI slides)

Donald Hoffman *(UNI)*

- UNI
  - "Don't need an another organization for the sake of other organizations"
  - Doesn't replace NEI… rather incorporate business from the supply chain perspective as NEI has done for the Utility/Operator community

ANS President's Introduction (no slides)

John Kelly *(ANS)*

- Importance of strategic continuity
- Highlight the initiatives started by most recent past presidents:
  - Andrew Klein PhD. for the "Nuclear Grand Challenges" initiative that will inspire technical divisions to focus on the most challenging issues that need to be solved in the not too distant future
  - Bob Coward for focus on increasing ANS value for members and potential new members. Bob's vision led to the revision of the ANS Strategic Plan, which simplifies and clarifies where the Society should invest resources
- Objectives/Goals for his presidency
  - Promoting nuclear technology innovation, engaging students and the public, and advocating for nuclear technology
  - Becoming "one" ANS, in which the national organization along with the Local and Student Sections work together
  - Increase utility engagement
- At a crossroads for the nuclear industry at many levels
  - Presidential level: President Trump ordered a top-down review of our nation's nuclear policies. John is optimistic that this review will benefit the industry
  - State level: Zero emissions credit (ZEC) policies support the benefits of nuclear energy in states such as New York, New Jersey and Illinois
  - Federal level: strong bipartisan support of nuclear energy
- Advanced nuclear technologies (SMRs, GenIV, microreactors)
  - Attracts the best and brightest minds in the world. Now is the time for ANS to be a part of the national and global discussion
  - Starting to form an ANS Special Committee on Advanced Reactors
- We need to find ways to develop and nurture our future leaders
- Increasing awareness of the benefits of nuclear science and technology is a significant part of ANS's Strategic Plan
  - The ANS Center for Nuclear Science and Technology Information has developed a new K-12 education program using the Discovery Education curriculum platform, Navigating Nuclear: Energizing Our World
  - The curriculum will reach approximately 30 million students and 1.3 million teachers across the U.S., beginning with middle school this year. The program launches August 15
- The 2018 Utility Achievement Award was presented to Oyster Creek Nuclear Generating Station
  - Oyster Creek is being recognized for providing safe, clean and reliable electricity to Lacey Township and surrounding areas in New Jersey. Oyster Creek started out as the first large-scale commercial nuclear power plant in the country, providing electric power to 600,000 American homes
  - In 2017, the station achieved a 99.2% capacity factor, generated 5.4 million MW hours of carbon-free electricity, safely executed work to maintain excellence in equipment reliability, and protected its workers with the lowest collective radiation exposure in station history at 17.4 Rem. All of these achievements set a record for excellence at the station
  - On February 2, 2018, it was announced that after 49 years of safe and reliable operation, the Oyster Creek Generating Station would permanently shut down this September, a year earlier than planned.
  - Here to accept the award are: Oyster Creek Site Vice President, Tim Moore; Oyster Creek Plant Manager, Mike Gillin; and John Renda, Oyster Creek Work Management Director.

Perspectives of Excellence in Operations (no slides)

Adm Kirk Donald *(Former Director, Navy Nuclear Propulsion Program)*

- How you lead and manage an organization responsible for complex technology where failure is unacceptable
  - Adm. Donald shared story from his interview with Admiral Hyman G. Rickover. Rickover had a method to his madness, which Donald felt was to convey the importance of the shared solemn and grave responsibility (for safe operation in the nuclear navy)
- Donald shared a Rickover Quote: "Responsibility is a unique concept... You may share it with others, but your portion is not diminished. You may delegate it, but it is still with you... If responsibility is rightfully yours, no evasion, or ignorance or passing the blame can shift the burden to someone else. Unless you can point your finger at the man who is responsible when something goes wrong, then you have never had anyone really responsible."
- In every case of systemic issues of performance, there is an issue with responsibility, authority, and accountability… If you get these pieces right, normally success will follow.
- 3 requirements for success (Venn diagram): Technical competence , integrity, stamina. YOU HAVE TO HAVE ALL 3!
  - Technical competence: It's about being an expert in your craft, but also learning and getting better. It makes the difference between a great and good ship
  - Stamina: Not just physical stamina, but mental stamina. It's about "stick-to-it-iveness" and persistence
  - Integrity: It's about brutal honesty and unwillingness to compromise integrity. Can integrity be taught? YES, it's a learned thing that has to be part of your company values. Make sure people know what the standards are and reinforce/update them as part of company culture
- Implications for national security – decline of utilities
- Concern 1: Worries about the nuclear energy market in the US… from a national security perspective
  - Energy resilience, a diverse base of energy providers (for reliability and because we can't predict price fluctuations in wholesale energy markets)
  - Emissions control
  - International standards and partnerships (US is the gold standard for regulation)
  - With the worldwide competition we're facing, we need to have a seat at the table when nuclear matters are discussed
- Concern 2: Demographic concern

    - Impending retirements are a concern, though less now than before because of how the next echelon is currently stepping in
    - The next generation can step in, but proper development for these jobs is required
- Concern 3: Industrial base
    - Critically is important to the success of this industry
    - Viable but fragile
    - Need for collaboration between industry and industrial base is essential for survival of this industry

Pursuit of Excellence through Innovation (not released)

Craig Amadeo *(GM – Programs & Predictive Maintenance Engineering, Delta)*

- Failure is not acceptable in either the nuclear or airline industry
- Innovation helps us meet our goals and beat competitors
- Can't manage what you don't measure… innovate through tracking
    - D0: departure ON TIME vs within 15 minutes of window
    - Maintenance cancellation-free days
    - Maintenance completion factor: how to improve past 99.99%?
- Enabling innovation
    - Leadership buy in to new technologies is essential
    - Predictive maintenance engineering: this group was singularly devoted, not lumped under another division
    - Feedback loops to communicate through multiple levels and demonstrate value
- Predictive Maintenance – let you know a system/component is going to fail before it happens
    - Dipped toes into big data in 2015
    - Leveraged Boeing's physical system monitoring… huge value, quickly implemented within other aircraft (Airbus)
    - Operational Difficulty Index (ODI)
    - Gives competitive advantages and reveals possible safety risks (those are shared)
    - Planned maintenance engineering (PME)
    - Integrated Drive Generator (IDG)
- Case Study: Issues with 737 AC system (STC)
    - Wasn't any data collection, so they installed temperature and pressure sensors
    - Thanks to Data… Discovered one A/C pack system (left and right) wasn't working well enough so the other was working too hard
    - Worked with Boeing on solutions and issue discovery
    - Replaced a valve, pinged the plane and it didn't fix. Then replaced a controller, pinged at altitude and it was FIXED!
    - Data and feedback testing allowed them to find the issues
- Case Study: 777
    - Predictive maintenance procedure let maintenance know this wasn't recreational maintenance. It was replaced even if the test said it was fine
    - Turns out a pump and motor assembly wobble control component had sheared. This took an unscheduled event and made it scheduled
    - Prevented over 1,000 unscheduled maintenance events! Improved performance and operations

Continuing the Pursuit of Excellence = Risk Informed Transformation

Scot Greenlee *(Senior Vice President Engineering and Technical Support, Exelon)*

- Scot brings a passion for risk
- History
    - Since 2010, CDF has basically leveled off (around the time of Fukushima). If we get (back) on the risk bandwagon, we can move that forward again
    - INPO has been a big driver of excellence (improving Capacity factors)
- How much further can we go?
    - CDP: Core damage probability
    - The requirements are just one page, but NRC goals are 1000s of pages
    - We can go a lot further
- What can we do?
    - 1/2: NRC: focus review process on risk and safety significant systems (IE not potable water like they are for some advanced reactors)
    - ROP: regulatory oversight process
    - EP: emergency planning
    - LERF: large early releasee frequency
    - CDF: Core damage frequency
    - 3: Could reduce security to 1/3
    - 4: Have to put PRA methods process back under our control (not need NRC approval to change models)
    - SFCP: surveillance frequency control program
    - 4: Reduce safety significance of monitoring equipment (30% of it is NOT safety related)
    - 5: Value based maintenance is overshadowing 50.69 in terms of value it brings

Q&A

- Rod Adams, Atomic Insights: Why does DOD place so many restrictions on LWR exports?
    - Adm Donald: still some sensitive information around any naval reactor programs… concerns in the international industry for migration of technology to the military front
    - Hoffman: currently working with organizations like DOE to enhance and improve 810 process, has been delegated from the secretary of energy so it can move slightly faster… currently addressing policy issue of 123 agreements as well
- Sean Clark, AMMI Risk Solutions: How are we as an industry going to make sure we capture baby boomer knowledge and pass it along to the next generation?
    - Adm Donald: in shipbuilding, transitioning to digital format helped significantly. It provided an opportunity for welders to use digital tools for training, which improved efficiency and effectiveness. Old fashioned methods are important, but a key element is the ability to use digital tools for knowledge awareness and data analytics for something that is more easily accommodated by younger generation
    - Amadeo: There's a process, but the cultural piece can't be taught through a process. Co-Ops help with this for engineers, and technical schools provide support for technicians. Mentor programs are also important.
    - Greenlee: 3 areas address this:
        - Operator training - great on this
        - Maintenance – now we have electronic work packages for training, which includes demonstration videos of experienced workers
        - Engineering – building packages for engineering teams, also EPRI is starting to include training with their packages

- Angie Howard, Howard - Johnson Associates: How do you share information for digital systems?
  - Admiral: Challenges from reliability and safety concerns… method of knowledge transfer during design process and review
  - Greenlee: We bring it up with the NRC. How can submarines and planes be digital but NPPs aren't? But we ARE in a good place with NRC right now on developing guidelines (that are also informed by these other industries)
  - Amadeo: Technology deployment makes everything more efficient. Technology tools (tablets with procedures that are all tailored to the aircraft automatically) improve useful "touch-time" and mitigates human factor complications
- Yadav Vaibhav, Idaho National Laboratory: What are the challenges if we (utility industry) implement predictive maintenance strategies?
  - Greenlee: We don't have enough data. EPRI has put out a "possible sensor" catalog for each piece of equipment and how their maintenance *could* be shifted to predictive, but sensors haven't been installed, LTE capabilities are catching up to collect and transfer data, and big data tools are being created to analyze this data
  - Amadeo: Delta owns an oil refinery. It gives them a competitive edge, but they have learned that the more complex a system (refinery > plane) needs more data to understand complex interplays (may be as simple as something like a voltage drop, but typically more complex due to interactions)
  - Adm Donald: We are starting to see significant advantages, but the field is ripe for opportunity

Tuesday Plenary: Proceeding in the Face of Uncertainty

This plenary will focus on the areas of uncertainty facing our industry. Specifically, regulatory, policy, economic, and available work for vendors/suppliers.

General Introduction (no slides)

Donald Hoffman *(UNI)*

- Yesterday's opening plenary session focused on continuing the pursuit of excellence, with a focus on operations, innovation, and risk informed transformation.
- Today's plenary session will focus on the challenges and opportunities facing the nuclear industry regarding regulatory and policy issues.
- Tomorrow's closing plenary session will discuss facilitating a way to collectivecontrolling our Destiny and Delivering for Society today to facilitate a way to move forward collectively and individually.

Regulatory: Margaret Doane (Executive Director for Operations US NRC (invited))
Market: Anthony Pugliese *(Chief of Staff, FERC)*

Part I – Industry Priorities (not released)

Bill Pitesa (*Chief Nuclear Officer, NEI*)

- We are all very passionate about our industry but we're facing challenging times – though we also have opportunities.
- Nuclear still provides 20% of our country's electricity. It has significant benefits, including prevention of emissions, close to maximum electricity produced. Nuclear is still the winner with more than half the carbon free electricity from nuclear. It's still a very strong player in energy.
- The nuclear industry also contributes $2.2 billiion in taxes, supports a significant number of jobs, and saves consumers on electricity bills.
- The reality is that we're facing declining electricity prices.
- Nuclear energy used to be cash cow for utilities. It's no longer true today. Pricing is making it difficult for nuclear to stay competitive.
- What does that mean? Plants are closing and announcing early shutdowns purely based on market reasons.
- How we can get more plants to not be in that situation? The solutions are varied. Nuclear is a long-term asset that needs to be viewed in the long-term and not short-term.
- The national strategy is: Preserve, Sustain, Innovate, Thrive
- To preserve nuclear, we need to make sure nuclear is a valued properly. The value goes beyond electricity (carbon free, resilience).
- There is now an urgent conversation on resiliency—initiated by DOE and ongoing at FERC and the regional grid authorities—on how best to recognize and value our nuclear plants as resilient infrastructure vital to the country's national security.
- State of the states: Carbon legislation and other ways to preserve fleets (zero emission credits) have been successful in Illinois, New York and New Jersey,
- Plants have been saved from premature closure (Clinton, Fitzpatrick, Ginna, Millstone 2 & 3, Nine Mile Point 1 & 2, Quad Cities 1 & 2 among them).
- To sustain nuclear, we need to make it as viable as possible, with safety being they key.
- Cost is also a factor, and changes need to be made related to regulatory costs.
- Staffing at NRC is on the decline – NRC had more than 4000 employees in 2010, now 3,094. There is more attrition and they're slower to replace people.
- There are currently five NRC commissioners. It's been a while since we've had five. No more than three can be same party as president.
- We have a friendlier commissioner than we've had in a long time. Working closely to prioritize things correctly and take advantage of the appetite to reduce regulation in a less burdensome way to the industry.
- Also looking to make efficiency improvements, such as the reduction of 19% of total generating costs (costs went up around 2012 and are now coming down).
- NEI has put together a Regulatory Priorities Briefing Book
- NRC Transformation Initiative – we want NRC to look more broadly, transform the ROP program and eliminate white finding
- How do we move forward with innovation? Need to focus on next generation of non light water reactors and other new technologies.
- We need to compete better globally to thrive. Need to be involved in plants being built internationally, such as in Japan – up to 42 will be in operation eventually. Hopeful US will take a stronger lead in building new plants overseas.
- The NRC has two license applicants currently, and there may be a third later this year. There is an opportunity for more utilities going for second license renewals so plants can operate safely up to 80 years.

Part II (no slides)

Anthony Pugliese (*Chief of Staff, Federal Energy Regulatory Commission*)

- It's a very interesting time to be at Federal Energy Regulatory Commission. Five years ago, the FERC was not very well known, now it's in the news seemingly every day.
- There has always been a connection between FERC and nuclear industry. FERC is focused on the aspect of not losing base load power.
- There is a perception that Secretary Rick Perry (and the administration) was trying to bail out the nuclear and coal industries. That is not true. The administration values the aspect of clean energy and national security. They don't want nuclear to go way of dodo bird.
- More nations are looking to gain access to our grid, attacking our way of life.
- Nuclear is resilient and is impervious to cyber attacks, not as vulnerable.
- We can't turn nuclear off and on. We need to be more thoughtful and have a long-term focus.
- We appreciate the conversation that Secretary Perry has started. We're evaluating these issues.
- We need to value resilience in how we create the market. We are continuing to look at this and how we value it. Hope to have an answer in the near future.

- There are five commissioners in FERC and one of those is outgoing. We are waiting for the White House to name a replacement commissioner.
- Energy is now a greater focus in the news, both in the U.S. and internationally.
- FERC is getting more calls on the hill about energy and there is more pressure on congress to get the fifth commissioner named.
- Cyber security is an area the FERC is extremely focused on. TSA oversees pipeline security. TSA doesn't have the resources and subject matter expertise (for this), so they're working with FERC, NRC, CiA, FBI. We need to protect our bulk power systems.

Part III - A Supplier's Perspective - Our Opportunity and the Implications

Bob Coward (*Principal Officer, MPR Associates*)

- Bob will discuss what he's learned over his career and his recent leadership role with ANS.
- Bob was once told the world is going to seek decarbonization – but we'll get there in different ways. It's going to become more and more important to look at our natural resources.
- It means there's a tremendous opportunity for nuclear. Maybe not in 2019, but there is opportunity is on the horizon. Resiliency, energy density, land use, national security, energy security, all work in nuclear's favor. Nothing meets that spec better than nuclear. World is starting to recognize that or will soon. We need to be ready when that time comes.
- Nuclear Future, what does it look like? Doesn't look like what it does today. W need to have a chance to hit it when the ball comes back to us. It's not going to be handed to us. We can't swing and miss. We need to change and adapt, something we're not great at. Need to get better at it.
- Nuclear in the past: Reliable, centralize – we did a great job many years ago. We delivered back then. Different world today. Need to be small, nimble, and adaptable.
- Capitol Hill: They ask, when are you going to deliver? Support for nuclear is going up, but we need to be ready today.
- Our industry is being disrupted, liked what Uber did to taxis.
- The only thing stopping us from capturing the future is us. We have an opportunity to shape the future in a way that's best for us as an industry and people.
- We need to build a bridge to the future, preserve plants and adjust to the market.
    - Anthony (FERC) needs to deliver, fix the markets
    - Bill needs to fix NRC
    - Overcome knowledge transfer challenges
    - Suppliers have a role in all of this
- To innovate, we need leaders untethered to the past.
- We're trying to be too safe, reaching the point of diminishing returns. Only driving up costs by being too safe. Need to tailor to customers, not to engineers because it's so "nifty."
- There's a role for suppliers to contribute, influence and help us move this forward, need to change the culture.
- Example of the book, "Hostages of Each Other" was brought up. Suppliers and customers are entangled, we're hostages of each other, we rise and fall with the tide together.
- We need to be preserving, building, and thriving. Need to do it lockstep together, arm in arm. We need to be better partners. Need to work together.
- Thoughts for utilities:
    - Focus on enabling suppliers – don't let lawyers run your business, don't make it more difficult for your suppliers. Hold them accountable though. Give suppliers a chance and hold them accountable.
    - 10 yrs ago – Limerick generating $1 billion in revenue for Exelon. This year, $500 million in revenue. A new normal. Accept it and build upon it.
- There is plenty of work. Just need to meet that spec.
- Industry needs innovation, there is tremendous opportunity. But we need to earn it.
- This is important for our country and everyone. We need to make the nuclear program successful.

Q&A

- Gene Nelson, Californians for Green Nuclear Power, Inc.: How do you suggest we get help from FERC when local help is unavailable?
    - Pugliese: We welcome your comments. The goal is to hear from all sides. The FERC is looking to intervene when the situation makes it necessary (i.e. when it impacts military or other places that are vulnerable.
- Bob Kalantari, EPM – Why is he (Bob) paying four times more? What does he suggest we/he do? How is the FERC addressing this?
    - Pugliese: In my personal opinion, there are a number of markets that are dysfunctional and need to be evaluated (like Massachusetts). It's very frustrating when states are unwilling to put infrastructure (transmission lines, pipeline) on the ground. He expressed concern about NY Governor Cuomo now lessening support for nuclear because Trump is in favor). Massachusetts had to import natural gas from Russia, that's a concern.
- Rodney Adams, Atomic Insights: How much are we spending to promote the value of nuclear (similar to the gas industry)?
    - Pitesa: We are advertising, but the challenge is funding and who's going to pay for it. 22 operators have a conflict in pushing one technology over others (fuel sources). There is a balancing act of advocating for nuclear without seemingly be too focused for utilities that have other portfolios (renewables, gas, etc.).
- Adams: It seems like nuclear is more vulnerable than stated.
    - Pugliese: Clarified that nuclear is less vulnerable to cyber attacks. They're working with NRC, National Security Council to make them aware of threats.
- Dean Kothmann, Burns & McDonnell: Resiliency is bouncing back after something breaks. What's being done by FERC to try to change mission statements and try to price in and reward reliability.
    - Pugliese: I'm an all of the above guy. Don't want to put all eggs in one basket. Pennsylvania example: They have ton of natural gas. Economically, it's not necessary to keep tapping more natural gas. Goal is to go as cheap as possible and gas is cheap now. They're trying to work with ISOs, etc. to understand resiliency. Need a definition of what that is. Still waiting for security clearances. We need to know what to look out for. We're working on that (one day read-ins). Need to do their best to provide low costs for consumers while being resilient.
- Kothmann: Resiliency is not on their website (PGM) as part of their mission. So they don't value and/or price it.
    - Pugliese: We are focused at ways to get that on the mission statement and to value right attributes and have them included on tariffs.
- Don Hoffman: Nuclear should do at least 24% of world energy source. What is the FERC's purpose if it's not to make the best choices for the people?
    - Pugliese: FERC is working with congress and the White House to look at any legislative changes need to take place to have more control. People need to talk to their state officials. Not enough people on the state level understand the importance of nuclear. California doesn't value nuclear enough. We all need to do a better job of working with our states.

Wednesday Plenary: Controlling our Destiny and Delivering for Society

This plenary will feature a panel discussion on the path forward for our industry.

Vendor: Jay Wileman (President & CEO, GE Hitachi Energy) / Marty Parece (Vice President Design Authority & Licensing, Framatome)
Utility: Brad Adams (Vice President Engineering, Southern Nuclear) / Donald Hoffman (President & CEO, Excel Services Corporation)

General Introduction

Donald Hoffman (*UNI)*

- Monday's plenary discussed how we are striving for continuing excellence and maintaining the current fleet of nuclear plants. On Tuesday, discussed how we need to come together. This morning we're discussing where we go from here. How do we move forward and achieve what we need to? How do we control our destiny and ensure we actually deliver on our commitments and promises.

First Presentation (no slides)

Jay Wileman (*President & CEO, GE Hitachi Energy*)

- This is his first-time speaking at the UWC. Asked the audience when they entered the nuclear industry. Answers were broad, from ranging across several decades and various eras.
- People are at the UWC for various reasons. Some are zealous about nuclear technology, some are here because of concerns about the environment and some here to help power the world.
- The early years of the nuclear industry were very different compared to today. The timeline for the inception of an idea to COD was five years.
- We have to think globally, it's not just about the U.S. nuclear industry. We have to think about China, Japan, Russia, Korea and other countries.
- We're not just at the risk of losing our leadership, we've lost our leadership of doing.
- This decade is a pivot point:
    - #1 We need to keep our nuclear plants running safely.
    - #2 License renewals will provide a bridge to the future.
    - #3 Small modular reactors are the future.
- Costs have to be competitive.
- We need to figure out which horses are in the race when it comes to advanced reactors (gen IV).
- Having an advanced reactor in a plant by 2030 should be the goal. The DOE and NRC need to be involved.
- The industry has been through a lot, but pretty linear. We deed to bend the time curve and have gen IV reactors take us into the future.

Second Presentation (no slides)

Marty Parece (Vice President Design Authority & Licensing, Framatome)

- At Framatome, we have a similar view of the future (compared to Jay's) – where we're going and where we need to be
- We understand price pressures. We need to take a multi-prong approach. We're facing a shutdown of 20 units by 2025, another 10 maybe by 2035.
- We need to respond and find disruptive approaches. We need to make strategic investments at the right time. Need to plan investments and not do things twice.
- We have to think about the vision for a plant, both the physical aspects and economically.
- As we move forward, we need to look at security solutions and other expenses that can be reduced.
- Accident tolerant fuels can help. Metallic fuel has increased peaks and are truly accident tolerant fuels.
- We need to support the deployment of light water reactors and NuScale SMRs. SMRs can fill the gap when not that much energy is needed in various locations.
- Some countries have different solutions than others. In the U.S., gen IV reactors are the solution. They can't just be good though. They have to be perfect.
- We need to shoot for CO2 reduction. Carbon tax will come eventually.
- What else do we need? Need to be cost competitive. Need to deliver more than one product, we need other technologies. Need to give them an inexpensive plant to operate.
- Gen IV should not need emergency safety measures. Need superior safety. That will reduce costs, including maintenance. We also should not have to rely on mass water supplies.
- No requirements for containment translates to cost-effective and carbon free energy.
- We need government help – all new technology has had help. We will fail without government help.
- China has the lead in the gen IV area and they'll maintain it. We need to maintain construction expertise.
- We need innovative and disruptive technology

Third Presentation – Reflections on 40 years in the nuclear business (no slides)

Brad Adams (Vice President Engineering, Southern Nuclear)

- It's important for us to understand what we've learned personally and collectively and apply going forward.
- When he was at the University of Illinois, he didn't know what nuclear engineering was at the time, he just thought it sounded cool.
- In 1979, two key events had a lasting impact on him:
    - China Syndrome, with Jane Fonda, Jack Lemmon and Michael Douglas, came out and was a financial success.
    - The Three Mile Island accident occurred. He learned everything he could about TMI, he was fascinated and learned everything about it.
- People were wondering what he was doing in the field. But he's here today because of these two events, which cemented his love affair with nuclear.
- He started with Commonweatlth Edison, which had 12 plants at the time, most of any utility back then
- The 1986 Chernobyl was another significant event that impacted nuclear. The Soviet Union did not communicate much about the event to the public, which led to negative publicity (may have led to fall of Soviet Union in 1991).
- The world has changed significantly since 1986. TMI and Chernobyl prevented new construction builds and left a bad taste for the public.
- He was worried about his future, did some soul searching, and then the 2001 nuclear renaissance came.
- The Fukushima event changed that. Even with all of the things that happened due to the earthquake and tsunami, people remember the plant issues more than all of the other problems.
- This led to Japan shutting down some plants. Germany shut down plants. The U.S. had 105 plants then now is down to 99.
- Great things have been achieved in nuclear despite the three major events. INPO and NRC were created and other safety measures were put in place.
- He worked for Exelon for 28 years and Southern for 6. He's proud of working in the business for 40 years and proud of the industry. He's bullish on nuclear power. We need to stay positive.

Fourth Presentation – United Nuclear Industry Alliance

Donald Hoffman (*President/CEO, Excel Services Corporation*)

- There are three dimensions of the US nuclear industry: Business, Regulatory, Science & Technology.
- Regarding the business aspect, utilities and suppliers need to support each other. Suppliers need an advocate. We need to support the Supply Chain community.
- The answer can be the United Nuclear Industry (UNI) Alliance, which is intended to create innovative business relationships among its members.

Q&A

- Gene Nelson, Californians for Green Nuclear Power: How are we going to do more public outreach? (to decision-makers)
  - Donald: Nuclear in the States helps to preserve our current fleet in various states. Discussing economic impact (primary jobs and secondary jobs) seems to resonate most at the state level with governors. We need to promote that nuclear is not just a commodity. Getting to the people (not governors and congress people) is the big challenge. Navigating Nuclear will help by educating students. It's never going to be enough, it's a never ending journey. Help us deliver the message.
- Vince Gilbert, Excel Services Corporation: The Operations and Power Division grant program has provided two grants to Nevada; he suggests California submit a grant this year or next.
  - Jay: As native Californian, there's not a simple answer. DOE is doing good things. Need to focus on state level. Economics, maintenance and political poker have caused closures.
  - Marty: Do your neighbors know what you do and what your contributions are? That's the problem, they don't know. People don't know much about closures. What happens to housing, schools, etc. People don't care about the impact; they just want to get rid of nuclear. Go out of your way to explain what you do and its impact to at least five people.
  - Brad: We have a personal obligation. We have to be perfect, we can't afford errors. It comes down to us, need to have and maintain a positive outlook. We need to save our assets.
  - Donald: Meet with people in your state to help inform legislators and decision-makers. You have a responsibility. Be proud of what you do.
  - Gene: We believe we will prevail and we feel it will turn the tide.
- Randy Schmidt, Exelon Generation: What will it take to get a gen IV reactor built in this country?
  - Marty: We have to have a shakedown. Under our regulations, etc. no single company can do it. Companies have to risk a lot of capital without having customers yet. Need a consortium. Multiple technologies are involved. Need to get to the prototype. Need to get over initial hurdle, most likely with the government's help and with a band of companies. Regulations are moving in the right direction. We have been working with the DOE and NRC to write new regulations. Functional containment is a big step, as one example. Need government help with the first prototype so that it can get operating.
  - Jay: 2005 policy went nowhere. Collaboration is key, need the team to go together. Need solid cost estimates. Still have work to do.
  - Marty: Costs rising needs to stop. Need to be pragmatic. Need to be truthful about costs. As an industry we have to be careful about outrageous claims (regarding costs)

- Eric Meyer, Generation Atomic: Do you feel there will be a push for a carbon tax? (Exelon example)
  - Brad: Personal opinion, we need to do a better job selling nuclear as carbon free (gas example). We need more of that going forward. He's for carbon tax, but would like to see us compete without incentives.
  - Donald: We need a better advertising campaign to tell America how good we are. Just need to state what we know and can confirm. That will sell what we do. State the facts and our contributions.

Business and Economic Performance

Session 1: How to Save a Nuclear Plant: A Case Study

Session Organizer: Tim Schlimpert *(MCR)*

The focus of the 2018 UWC is around the analysis of cost drivers in an effort to drive program and process efficiency and effectiveness to reduce operating expenses. The goal here is to ultimately make the current operating fleet more economically competitive and by extension, "save" those plants which are in danger of premature retirement. This session focuses on our industry's success stories in this area from more targeted budgeting, project management and process improvement initiatives to the ultimate ownership transfer of the Fitzpatrick nuclear plant avoiding early closure. Participants will hear from top industry leaders providing applied insights and their critical factors for success.

How to save a nuclear plant: a case study

Tim Hanley (Exelon Corporation)

Session Notes

- A key question to also ask is not how, but also "why" to keep a nuclear plant open. Large capital investment, with long lifetime. Mothballing a Nuclear Plant is also not economical compared to Fossil Fuel power plants.
- Nuclear is the most economical choice for Green Energy. Economically viable is also more than simply breaking even since a company expects some return on investment.
- Independent analysis has shown shutting down a Nuclear Plant is more expensive than keeping the plant open. A plant shutdown is roughly double the cost to customers than keeping a plant open.
- Nuclear power plants provide reactive support to the grid as well as critical inertial frequency response. The larger the plant, the greater the ability to stabilize grid perturbations: an important characteristic that smaller Green Energy technologies do not currently have.

Key Learnings, Recommendations, and/or Best Practices

- Closing a small number of nuclear plants will eliminate the benefits of all of the renewables that have ever been built.

20 Years of Cost Reduction in Commercial Nuclear Power

Tim Schlimpert *(MCR Performance Solutions)*

Session Notes

- The nuclear fleet in the US faces shutdown pressures from many sources. On a routine basis, economic performance is the most controllable aspect of those shutdown pressures.
- Zero base budgeting (ZBB) is a thorough challenge of the budget with a focus on defending justification for the values.
- ZBB experience has shown a 10-15% savings in routine budgets (beyond straight-time labor) even after internal budget initiatives have been implemented.
- Producing robust business cases in project evaluation and prioritization is key to successful capital budget savings. Project evaluation should include robust alternatives.
- Scope control is achieved through a well-defined problem statement. If the scope of the project extends beyond the problem statement, the economic viability traditionally decreases.
- Business case development is dependent on funding thresholds and depends on the company. Example thresholds are $1MM and $5MM.
- Cost reductions often force process improvements.
- Capitalization Strategy needs to include a review of the Unit Retirement Catalog.
- A long-term technology solution is needed to capture Long Range Planning & Budgeting. Often, software is used beyond its intended functions.

Key Learnings, Recommendations, and/or Best Practices

- Life Cycle Management plans help create greater stability in business planning and reduces emergent work.
- Cost and Process are highly interdependent: Cost reduction leads to process improvement and vice-versa.
- Market conditions are not going to go away any time soon.
- There are plenty of opportunities for cost reduction at Nuclear plants. No one strategy will be the answer.

Q&A

Q1. How do you identify all of the assets within a system for Life Cycle Management (LCM) Planning?
A1. Pull from the Master Equipment List and drawings to ensure that all assets are included in the LCM Plan. Also check industry websites for functional equipment groups: INPO ICES data and NRC notices.

Q2. How are Original Equipment Manufacturers (OEMs) used in process improvement or LCM Planning?
A2. Work with OEM more on project evaluation cases for their product

How to "Save" the Current Operating Fleet

Sean Lawrie (Scott Madden)

Session Notes

- Top of the line Natural Gas Combined Cycle (NGCC) plant can operate at 83.9% Capacity Factor over a 5-year period.
- The three big sensitivities for financial evaluation of Nuclear vs. NGCC: 1) carbon tax (favors nuclear), 2) natural gas commodity cost (favors NGCC), and 3) natural gas firm transport cost (favors NGCC).
- NGCC typical ramp rate is 50 MW/minute, something that US Nuclear does not offer.
- There is no economic incentive for RSO (regional service operators) to value resiliency of the technology.
- Flexible operation of nuclear units would enable greater renewable energy use.

Key Learnings, Recommendations, and/or Best Practices

- There is terrific progress being made in cost reductions at Nuclear Plants. However, any continued progress must come from a reduction in labor. This also means process improvements are required.

Q&A

Q1. What experience is there with modifying nuclear unit output for economic reasons?
A1. Exelon uses an advanced nuclear dispatch model to adjust Nuclear unit power output. This has the major benefit of avoiding negative pricing.

Session 2: Defending Equipment Reliability Spending in a Cost Cutting Environment

Session Organizer: Maria Hernandez *(Duke Energy)*

The current climate of economic pressures in nuclear has resulted in a culture of relentless focus on cost cutting - some targeted and data-driven, others widespread and blunt. Regardless of the driving factors this paradigm often results in competing demands from plant engineering, operations, IT, and business operations leaders. Project sponsors focused on preserving plant reliability find themselves in situations with constantly changing budgets and difficult decisions around which key reliability project can be delayed. This session examines how to adequately defend equipment reliability spending in an environment where O&M budgets are strangled and capital is closely guarded, consuming plant assets to the brink. Participants will see real-world examples and learn the tools and techniques to effectively justify spending with limited resources within the context of a broader project portfolio.

Defending ER Spending in a cost Cutting Environment

Joe Donahue (Duke Energy)

Session Notes

- Duke is moving from an engineering-centric to a site-centric approach to equipment reliability. Thus, involving more organizations in the approach. This has resulted in less rework.
- Enhancing monitoring and trending allowed for informed Conditioned-based maintenance. Remote monitoring was also required at fossil sites due to decreased staffing levels.
- License extensions also rely on operational excellence, ensuring that major unnecessary capital improvements are not needed (e.g. reactor vessel replacement).
- Overall Equipment Reliability is a team sport.
- Continuous Online Monitoring programs are cost-effective approaches for early identification of equipment anomalies
- Value based maintenance labor efficiency savings will need to eventually transition to hard labor savings (headcount)

Key Learnings, Recommendations, and/or Best Practices

- There are not a lot of differences between the Nuclear Industry and other Industries. All industries have risks and business constraints. Outside generations and other industries should be consulted for how they manage these same considerations.
- Equipment Reliability consistent with risk and power generation. Zero-tolerance of failure for non-critical, non-safety related equipment is not sustainable economically.

Q&A

Q1. While you wait for Condition-Based Maintenance (CBM), what do you think is key to focus on in the meantime?
A1. Continuous effective maintenance process and trending on the Condition Report level. In addition, assigning owners that don't necessary have to be engineers.

Q2. Did you have any regulatory issues implementing remote monitoring?
A2. No, as long as equipment reliability was commensurate with risk.

Q3. How do you handle CBM from a Business Case perspective?
A3. Executive leadership and strategic vision was more effective than a pure business case approach.

Foundations of Defending and Optimizing Equipment Reliability Spending

Adam Dow *(MCR Performance Solutions)*

Session Notes

- Engineering technical justifications should be combined with business evaluation not only for project approval, but priority amongst a shrinking portfolio.
- A "Nuclear Value Framework" is needed to accurately capture the value of Nuclear projects on an even playing field compared to other technologies within the same company.
- Quantitative failure data is a key component of a proper business case.
- The industry needs to get away from the paradigm of generalizing issues to get project approval (e.g. "obsolescence")
- Labor savings in terms of process efficiency gain should not be confused with hard labor savings. Hard labor savings simply mean that someone is not coming to work tomorrow.
- Regulatory commitments are clearly documented with an associated timetable – to track FTEs and resources to meet those commitments.
- The burden of risk is transferred to the Executive level by having the responsible engineer present multiple fully-developed alternatives (solutions) for Executive selection of the alternative to implement.

Key Learnings, Recommendations, and/or Best Practices

- An effective business justification goes beyond the minimum acceptable economics or scoring metrics (NPV, IRR, etc.)
- Without Executive involvement, the burden of risk is often perceived as "owned" by the responsible engineer. However, this usually results in the least risky solution even though it may not be the most economically justifiable.

Q&A

Q1. For Long-Range Planning (LRP) or Life Cycle Management (LCM), have you found any tools that work well?
A1. There is no simple magic software that does everything needed. Duke has used tools from EPRI, but at the end of the day what matters is the quality of the information that is collected.

Session 3: Is the Nuclear Promise Delivering on Value Based Maintenance? (with Engineering and Equipment Reliability & Maintenance and Work Management)

Session Organizers: Jon Anderson *(ACA)*, Ted Quinn *(Technology Resources)*, Ray Herb *(Southern Nuclear)*

Reduction of Critical Components

Joshua Hinson *(Southern Nuclear)*

Session Notes

- Southern Company Nuclear (SCN) uses a slightly different critical component definition than the one in EB-16-25. Just for more clarification on the definitions for their sites. There was documentation already in place from over the years for critical classification answers. There were 20 questions for critical determination already, so for them it was easier to utilize the past work.
- Question mapping slide – connected the old question answers to the new definitions, in order to apply the new criteria. Did not do a 1-by-1 review in most cases. Only components that could cause a complete loss of safety function were individually reviewed.

Key Learnings, Recommendations, and/or Best Practices

- It is important to baseline what you *mean* and how you interpret the questions. There was a difference between our sites, you can see the reflected in the reduction numbers. Two had the same interpretation and reduced more than the other site with a different interpretation.

Q&A

Q1: Who in the plant owns the non-critical components now?
A1: We have created classifications: non-critical 1 (usually TS/commitment related), non-critical 2 (economic reasons to not let it be Run To Maintenance (RTM)), and RTM. Critical and Non-critical 1 are owned by engineering, Maintenance owns Non-critical 2 and RTM. System Engineers and Component Engineers share the ownership, depending on the particular component.

Q2: You mentioned that EB-16-25 was an enabler to Value Based Maintenance - was the change of more to non-critical just a relook at the template and an opportunity to make changes to the Plant Management (PM) strategy?
A2: Non-critical template was not applied without looking at it, without looking at what unexpected equipment failures. For non-critical you expect some failures, for critical – never. Narrower definition allows more clarity on what is and what is not expected, as far as failures. Don't overreact to all failures.

Duke Energy Equipment Reclassification and Value Based Maintenance Update

Nally Osborne *(Duke Energy)*

Revision 5 to INPO AP-913, Equipment Reliability Process Description, included a notable change that can reduce the number of "Critical" components. Theoretically, downgrading these components to "Important Non-Critical" should allow us to reduce the cost of the Preventive Maintenance (PM) Program (and the Total Cost of Maintenance). This session will present both sides of this initiative: (1) how much did we reduce Critical components and as importantly (2) how much did we reduce the cost of the PM Program and Total Cost of Maintenance.

Session Notes

- Before EB-16-25 Duke had high critical, low critical, non-critical, and RTM as their component classifications. These classifications went to the three groups on the efficiency bulletin.
- Duke had to go at the process brute force, no existing templates to pull from.
- Reclassification of components alone has not saved any money. More detailed analysis is needed to realize PM savings.
- Benefit seen so far is a clear understanding on the components that really are the most important. Some of these components were initial non-critical or non-quantified. We have seen some failures and updated components and been learning through this process.

Q&A

Q3: For non-critical, what basis criteria is used to adjust the preventative maintenance (PM)?
A3: We have a listing for each component of component failures, used to assign costs of each consequence. And then you decide do you live with the failure or the cost of the PM?

Q4: In percentages, how much of the PM work that was done has changed? Have you come closer to life zero? There is an idea that we are over allocating the maintenance. Did we see improvement with the deferrals done?
A4: Don't have the numbers available on the percent reduction on PM work done. With deferrals, there have been some bulk updates.

Q5: Who is most mature in their Value Based Maintenance program?
A5: Primarily the fleets, who have corporate engineers to work through initial bulk.

What is Reclassification and Value Based Maintenance and What do you Expect?

Jon Anderson *(ACA)*

Session Notes

Perspectives on component reclassification:

- From Engineering
  - Site 1: Reclassification was successful, but too early to tell on the savings.
  - Site 2: Reclassification was a success – through VBM can see reduction of FTE needed. Have not reduced people yet, but have a Maintenance attrition model to go along with it. Planning for a 285 reduction by 2020. Have already exceeded where we expected to be on that curve, but there was margin built in. The business people are involved, and we plan to see 24 MM in reductions.
  - Site 3: Accomplished the critical component reduction, and are about 5-6 months into VBM. No removal of human resources yet, but many components were outage related for work window. Saving in that freed up resources, are have seeing small material savings online.
- From Work Management

- Site A: Took the critical component reduction and were able to go after extending PMs and with resources freed up, the FTE were reallocated to work on backlog. Have seen a reduction of 1 MM on material costs.
- As part of DNP effort – EPRI has been helping us see the results of our changes. The clickview program is helpful to get arms around this. What can be missing for the business people is the granular information for metrics that they like to use.
- Important to ensure that corrective Work Orders (WO) are only fixing things that are broken, not for touch ups. They can clutter up the population. Cracked superficial cover, chipping paint, etc. should not be in the corrective population.
- If anything looks to be too easy – it is probably wrong.

Q&A
Q6: If I have an unplanned LCO entry is that okay? How many are okay? How many MRule risk significant failures can I have in a cycle?
A6: MRule allows for some failures associated for that function.

Q7: The systemic issue that we are trying to solve is that with all the downgrades, we cannot let them have failures. Have our organizations bought into the fact that there will be more failures?
A7: Organizations will need to face the fact that they cannot have it both ways. Either some failures are expected or more funds for maintenance are required.

Q8: Is the problem with the preventative maintenance (PM) program the costs? How many times has your site redone it or tried to reduce PM cost?
A8: If we reduce PMs but cost for reactive work goes up, then we are winning the battle but losing the war.

Q9: We have seen many flavors of the PM program over the years; do we still have the metrics as Business/ Work Management/Maintenance/Engineering to know that it is working now? We all have Equipment Reliability Index (ERI), which has made us dive the deferral rate to zero.

Q10. What is a benefit of reclassification?
A10. Non-Critical reclassification does not count against the ERI.

Session 4: The Nuclear Value Framework and Project Life Cycle

Session Organizer: Maria Hernandez *(Duke Energy)*

The Nuclear Value Framework can be defined as establishing a model or set of inputs in order to quantify both the clear costs of nuclear projects as well as the more abstract, less tangible costs like regulatory burden and safety among others. Establishing a robust framework allows for strong business cases with strong quantitative and qualitative justification, thoughtful alternatives and rigorously defended assumptions. Nuclear is unique and issues can arise when attempting to optimize portfolios across different businesses and fuel types. Participants will be exposed to these fundamental tools in order to direct funding and resources to projects with the most value while simultaneously understanding investment risk profiles and how these (and their financial consequences) change over time.

Value-Based Capital Portfolio Decision Making

Alex Payne (Copperleaf)

Session Notes

- AIPM – Asset Investment Planning & Management
- Copperleaf is the company that produces the software: C55.
- The C55 Value Framework brings a consistent view of value from different entities within an organization
- Decision Making Maturity slide – Maturity increases from the bottom to the top in the slide
- Scoring allows for multiple alternatives to be considered by the portfolio optimizer.
- The software looks at both in-flight projects and potential future projects
- Creating a Value Framework – determine the strategic objectives of the organization. The software is fully configurable.
- Value is calculated by the combination of a consequence level and the probability of that consequence occurring (i.e. “risk”).
- Not every project needs to score against all value measures. Only the value measures that apply are needed.
- Value-Based Optimization slide – Prioritization = cut-line method; Optimization = shift investments in time
- Optimization within the tool can be manually overridden to slot projects
- Avoided risk is the risk “benefit” of implementing the project
- Risk changes with time and is captured within the tool
- Optimization Scenarios help an organization react quickly to changing business needs (e.g. emergent work)

Integrating the Reactor Oversight Process with Value Frameworks

Kevin Dutton *(TVA) and* John Alfultis *(TVA)*

Session Notes

- The historical approach for budget development was repeating previous year’s numbers
- Health Threat Manager and Long Term Asset Manager (LTAM) had been used at TVA for years, but these systems no longer fit enterprise needs
- Long Range Planning (LRP) needed to improve to better understand both short-term and long-term risks
- Copperleaf C55 was the platform chosen to create both short and long range investment plans
- C55 had been in use with the Power Operations (Non-Nuclear) group at TVA for two years prior to the TVA-wide deployment initiative.
- This was used to determine a GAP in terms of what makes a project important to the *company* and not just the plant. Thus, more robust justification was needed.
- During Value Framework development, the question was asked how regulatory oversight would be valued in the framework. TVA’s answer was to code the NRC Regulatory Oversight Process (ROP) and consequences directly into C55 as a Value Measure.
- This past year 5% of capital budgets from each Business Unit was put in a fund for competition (ECF).
- During the ECF, Nuclear was able to compare valuations between Fossil plants and Nuclear plants for similar equipment.
- All Business Units came together to develop thumb-rules to help consistently value score projects
- Nuclear was awarded $21M out of $38M for ECF.

Key Learnings, Recommendations, and/or Best Practices

- The use of C55 and their updated business process removed “emotion” from project selection
- The entire process led to better business cases and showing project value to the company

Q&A

Q1. When using new value model for first time did you have a consistent group valuing projects or use individual requestors?
A1. A central group of people valued the projects and will value the projects going forward for consistency.

Q2. Did you have a gut-check after the results came back?
A2. Yes. Multiple checks and balances were used to ensure the results were correct. This also included various sites involvement.

Q3. Did you value all alternatives?
A3. Not for the ECF this past year. However, going forward TVA will be.

Q4. How did you align the value framework across the business units?
A4. Each business unit (BU) developed their own value models initially. Then the BUs all came together to decide the final value model framework. During this time the business units challenged each other until consensus was reached. A governance team will be used going forward for any changes to the value framework.

Accident Tolerant Fuel Business Case

Bill Williams (Southern Nuclear)

Session Notes

- ATF – Accident Tolerant Fuel
- Fuel cost penalties were estimated at up to 20% thus savings would need to come from O&M reductions
- They looked at what changes could be made at the plant if the fuel is shown to have adequate performance
- They looked at being able to apply 50.69 criteria if the fuel could survive 8 hours without cooling
- Current ATF performance shows survival for up to 4 hours
- Fuel burnup is limited based on fuel performance for a large break LOCA condition – If the large break LOCA condition was removed, the fuel burnup could be increased.
- A reduction of the Emergency Planning Zones is no longer being considered based on less performance of ATF than expected
- Over 60 items were considered for the economic and safety benefits

Key Learnings, Recommendations, and/or Best Practices

- For complex business cases it is imperative to have an iterative process to evaluate ATF

Session 5: Blockchain and Energy - Let’s Learn Together! (with Technology and Innovation)

Session Organizers: Tim Crook *(Transatomic Power Corporation)*, Adam Dow *(MCR), Vincent Williams (Southern Nuclear)*

Blockchain, the foundation for Bitcoin and cryptocurrencies, has burst into the technology and innovative process headlines! This distributed ledger technology has the potential to touch many aspects of the energy market from power generation to transmission, distribution and consumption. Typical applications involve legacy institutions with high transaction costs, market process inefficiencies, and decentralizing the ownership of assets from the tangible (power plants) to the intangible (zero emission credits). Recently, PG&E and Ameren (both nuclear utilities) have started pilot projects around blockchain technology with typical initiatives targeting cybersecurity, grid power calculations, export controls, and market transactions (e.g. Zero Emissions Credits). As blockchain development accelerates while simultaneously encountering regulatory and technology hurdles, this joint session seeks to provide an overview of applications in energy to participants in order to stay informed and push an industry reticent to change out of its comfort zone. Let’s learn together!

Introduction to Blockchain With Focus on Energy

Tony Giroti *(Energy Blockchain Consortium)*

- Blockchain started because of a lack of trust with the finance market
- Blockchain allows you to encode trust into the machine
- Bitcoin was created as a finite resource with the same rarity of Gold
- Any commodity or asset can be tracked through blockchain
- Distributed computing platform with de-centralized control: Control no longer lies with a single entity
- SmartContract is the business logic and should be concise/simple
- A “Block” has 4 components: data, timestamp, hash, link to previous hash
- Creating a single block is an expense operation

Clean Energy Blockchain Network

Mark Johnson *(Clean Energy Blockchain Network)*

- EV – Electric Vehicle
- LCFS – Low Carbon Fuel Standard.
- Trading of clean energy credits via blockchain is a possibility
- There are some inherent areas where Nuclear won’t work, but supply chain and security are potentials

Key Learnings / Takeaways

- Blockchain allows you to encode trust into transactions
- Bottom line tech is new and not fully developed. The Utility will have to be willing to step in and "dip their toe in water" prior to the tech being fully developed to be able to "control their own destiny" going forward.

Q&A / Discussion

Discussion: Block chaining QA from supply chain for equipment in warehouse; tracking U-235 from cradle to grave thru IEA.

Q1. Amount of digital data doubles every year. What is scale of data growth with block chain data sets?
A1. Decentralized data storage will increase

Q2. What are we going to do about the energy consumed by blockchain?
A2. Figure a way to use clean energy to power datamining. Other methods, PoS/PoA, can be less energy intensive.

Q3. Can you use alternative methods without sacrificing security?
A3. Scattering data helps it to be more secure, and blockchain is inherently encrypted

Q4. What if data is centralized (like China), will it compromise security?
A4. If 51% of chain is mined by one actor the chain can be hijacked. (This is very unlikely)
A4. (Continued) using POA/POS trusted actors could eliminate the 51% risks could be avoided.

Q5. When a solution looks like a blockchain solution but isn't, where we are seeing the value is in a consortium vs. a private blockchain.
A5. Like-minded people can get together and make a consortium work. Good Idea.
A5. Don't force a block chain solution on something that can be solved with an excel spreadsheet.

Q6. (Discussion) Data storage, only thing being stored on the blockchain is the transactional data. All other data is stored elsewhere.
Vulnerabilities : wallet, same as losing your wallet in real life. Poorly vetted bad smart contract. Ensure contract vetted well.

Q7. What should utilities of future be doing now to ensure proper application of this tech?
A7. Exelon is working on "Utility of future" group, 2-way transmission, wholesaling renewables while bypassing net-metering, lot of opportunities for utility to participate. Early adopters will be better off in the long run.

Session 6: Let's Get Down to Business (with Executive and Leadership)

Session Organizer: Wayne Kinnisson *(Texas A&M University)*

In this highly-competitive energy market, it is imperative that nuclear technical leaders become proficient in running a large business in addition to having a strong understanding of their technology. This session will feature a lively and interactive panel discussion featuring three well known and respected senior nuclear power plant executives, who will give examples of projects where business acumen (or lack thereof) in conjunction with a strong technical understanding allowed them to pull a success out of the mouth of defeat (or vice versa). Methods for improving this commercial knowledge will be discussed, including the program which is being started up at Texas A&M University to help technical experts start down the path towards being future industry leaders with the nuclear business knowledge and leadership skills that are required for the task.

The Business of Engineering

Matt Sunseri (Zeus Enterprises LLC)

Session Notes

- Matt Sunseri has 34 years' experience in Nuclear Industry.
- He has experience primary in PWR, business with regulatory.
- Due to this nexus between technology and society there is the need to establish what "good of humanity" looks like
- Practice of engineering is the about the application of physical and chemical engineering science for products.
- In early days, the operation of power plant is different. Not many business pressures. The money is mainly spent for improving operation reliability and reducing costs. Money coming for plant operations.
- With the market improvement, the operation of power plant becomes market-driven. These business parameters (capital investment, operation maintenance cost, etc.) drive the plan engineering process.
- The development of three cycle plan is driven by system health purpose.
- Few companies that meet the commitment for reducing cost with the technical adjustment. But Zeus achieved the goal with the implementation of the three-cycle plan.
- In early 80s, the Uranium inventory at a site (new build) was excessive due to the project delay. Engineers helped to solve this problem and release the financial pressure by selling the 40 metric tons of Uranium inventory to another country.

Key Learnings, Recommendations, and/or Best Practices

- To be flexible to changing financial concerns, a good understanding of the baseline risk is needed.
- Give engineers an understanding of financial techniques

Key Issues for US Companies Conducting International Nuclear Business

Bill Woodward

Session Notes

- Bill Woodward has 42 years of experience in nuclear industry.
- This presentation focuses on providing thoughts on existed challenges for moving from U.S. market to international markets.
- The existed challenges can be summarized as follows:
  1.U.S. export controls. It is complex because it involves four government departments which includes department overseas. Also, it takes time to get approvals for selling to international customer.
  2.Foreign regulations. Take times as well for approval.
  3.Certification and license. Like ASME standard, other countries require certification and different standards. You might to do things in metric
  4.Buy materials /manufacture in the destination country. It is difficult to find Qualified and trusted partners. They should follow the requirement/QA. The supply chain is also limited.
  5.Nuclear reliability indemnification. Probability of accident is low but it does happen. Overseas condition is different from U.S.

6.Protection of intellectual property
7.Local law.
8.Faced issues with selling against government owned companies selling government-to-Government. It is difficult to deal with this problem

- Material specifications can be different in other countries
- Local content – some part of the manufacturing/materials may need to be within the country

Key Learnings, Recommendations, and/or Best Practices

- For the nuclear industry to continue to thrive, U.S. companies will have to rely on doing more business outside of the U.S.

Q&A

Q1. Have tariffs affected your business?
A1. Too early to tell

What We Didn't Learn About Leadership at Engineering School

Everett Perkins (Certrec Corporation)

Session Notes

- Everett Perkins has 30 years' experience in nuclear management. He tells stories of what leadership is based on his own experiences which are not learned when he was school at Rensselaer Polytechnic Institute(RPI).
- His father owned hotels, motels, and restaurants. He knows restaurant business. It is challenging for margin. His father told him the restaurant can be yours. But the speaker refused the offer because it is a very demanding business. The speaker finally went to nuclear engineering business which is also demanding.
- They are many competitors such as solar and natural gas plant.
- The reduction of operation case is all about leadership.
- Nuclear is special and unique. For example, the decay heat presents potential risks after shut down and it requires people and special designs to take care of that, but it does not mean we have to be victims of the special aspects.
- Leadership is about to get right result in a right way.
- Nuclear plant is highly detail oriented. Tend to be detail-centric. Leadership provides quantity and quality of value-added work product.
- Leaders can motivate people. Leaders should be more strategic and less technical. Leaders should rally team together to achieve the results.
- In early 2000's, major nuclear fleets had big challenges. This is solved by hiring new senior executive with good leadership. The analysis was focused on what was done and why. Some basic principles quickly emerged.
- 6-P's:
    1. Strategic leader paint the pictures of successes and it can be understood by people. The pictures should be practical and tangible.
    2. Leaders cannot do things alone. They should rally team and have track recorded people.
    3. Work with performance. Seniors should participate the development of the plan.
    4. The leaders should be persuasive. They can persuade the team and seniors to implement the plans.
    5. Performance metrics that really count. Publish them and update them regularly
    6. Pay for performance. Organization rally together and you should inspire them with good compensation.
- The Bottom is all about results.

Key Learnings, Recommendations, and/or Best Practices

- A good leader is one that gets that right results in the right way
- Organizational Performance Strategy: 6 – P's
    - Paint the picture of success – in terms that are easily understandable
    - Performers – surround yourself with those that have a track record of getting results
    - Plan – work with performers to develop plan
    - Persuasive – persuade the leadership team (performers) to implement the plan to achieve the picture of success
    - Performance Metrics – Come up with up to 10, publish them, and keep them updated
    - Pay for performance – Reward the team for being successful

Nuclear Management Program at Texas A&M University

Wayne Kinnisson *(Texas A&M University)*

Session Notes

- Program intended for engineers already with 3-5 years industry experience
- Will have industry experts help develop leadership lessons
- Nuclear management program is being developed. Reason for doing this is to help to prepare the next generation for nuclear industry leadership.
- The nuclear management degree program is all online course.
- The nuclear management degree program only requires students to be on campus at the beginning of each year for one week. It is required for the purposes of meeting colleagues and performing laboratory experiments. It helps students to work as teams even its online course.
- One factor is that only 5% of those in the nuclear industry are nuclear engineers. This program helps to improve that percentage.
- There will be 16 credits focused on technical courses and 14 credits for core management courses.
- The instructors are from industries and governments who have already demonstrated their leadership.
- The program prepares students to have a better understating on the business side for nuclear engineering.
- More details can be found in slides and the official website (https://engineering.tamu.edu/nuclear/index.html)

Session 7: What Others are Doing to Improve Work Management and Maintenance That Are Out of the Box for Us (with Engineering and Equipment Reliability & Maintenance and Work Management)

Session Organizer: Jon Anderson *(ACA)*

In this session other industries that are "ahead" of the domestic nuclear industry when it comes to how they manage their assets, including monitoring component performance, work management and maintenance. Some of these organizations include the use of continuous online monitoring and automatically generating work orders based on need. Participants will take away "out of the box" ideas on how other for-profit companies are more efficiently managing their resources.

What Others are Doing to Improve Work Management and Maintenance That Are Out of the Box for Us

Sorin Marinesco (Southern Nuclear)

Session Notes

- Multiple equipment reliability (ER) initiatives have been developed throughout the years (e.g. ERI). At the end of the day we realized that we had too much equipment reliability work without the necessary resources to accomplish everything.
- OPG has integrated Asset Management with 3 key areas: Equipment Reliability, Integrated Life Cycle Management (LCM), and Monitoring & Diagnostic Centre
- The deployed Asset Management program balances PMs, life cycle planning to assess risks of the equipment, and continuous online monitoring of the equipment to predict component failures.
- OPG utilizes the Asset Management functions of Copperleaf to optimize the LCM plans. It balances equipment spending and risks through both short and long term planning.
- With Copperleaf, Work Management and Maintenance can view the costs of their assets through the end of life
- The expensive portion of remote monitoring is the communication infrastructure to handle all the data coming from sensors. There are many options for deploying such infrastructure.
- Today over 2,000 parameters are monitored at 2 nuclear stations
- All generating stations (nuclear, hydro, etc) paid to have their units monitored through a central M&D center
- Sensor data can potentially extend PMs frequencies.
- Criticality changes through value-based maintenance, helped set the priority of equipment to monitor
- Adding sensors to equipment can also reduce the risk of needing replacement vs refurbishment
- APR – Advanced Pattern Recognition
- Trust between the M&D center and the station is very important.
- At OPG, through use of an APR model, routine Loop Calibrations are no longer needed.
- The M&D center works with the Work Control groups
- PM reductions are primary focus
- Maintaining the business case for remote monitoring is vital for success

Q&A

Q1. Any unique design challenges for safety related equipment?
A1. The challenge is to have a standard design for sensor packages for standard equipment. If the monitoring is non-intrusive, it's easier to install on safety related equiptment. Custom designs should be minimized to ensure successful standardization

Out of the Box Work Management – Lead, Don't Follow!

Jon Anderson *(ACA)*

Session Notes

- Endeavor is a software company that has partnered with ACA to integrate data analytics (remote, continuous online monitoring) with Work Management
- Out of the box thinking #1 – equipment data → data analytics → generate Work Orders automatically within the system
- NxA (company name)
- FEG – Functional Equipment Group
- Optimizing a component PM goes against optimizing Work Management (too many PM frequencies)

Q&A / Discussion

Discussion - We did this at Browns Ferry 2014. Aligned all outage PMs with Outage frequency, and aligned trains to specific outages (3 trains)

Q1. From a TVA perspective, is there a button to push to give you all FEG frequencies?
A1. I haven't run the report yet at TVA, but we do have one.

Q2. I tried matching unit to unit at one site in CMMS and it was not easy, does TVA have a system to compare unit to unit simply to look for Alignment? A2. We use excel and access with data from reporting services.

Q3: What is the power source for the sensors?
A: Depends. Primarily, batteries. When batteries are used obviously Maintenance will ask how often do you replace them? Will that be a tradeoff of work? In most cases, no. The battery is only used when the sensor is transmitting data. It's not used constantly since you are just getting a trend. It doesn't have to constantly transmit looking for failure, those are already taken care of by the information sent to the Control Room. Obviously setting the collection frequency takes intelligence.

When you go back at look at the frequencies, thinking that you are getting all you can out of FEG, you might be surprised that they have all gotten off.
Engineers extending PMs, or responding to a CR they may have been changing them without thinking about the FEG

Don't just push out PMs, revise frequencies to match FEGs.

Check consistency of PM frequencies across units and trains. consistency.

Q4: So at corporate, we tried to do a matching function to match unit PMs, and found miss matches. Sometimes the equipment wasn't named the same though. Is there a way to easily compare?
A4: All exported to an excel spreadsheet, download the data from Maximo. And then compare.

Engineering and Equipment Reliability

Session 1: Digital I&C Upgrade Benefits and Licensing Challenges (with Regulatory Relations)

Session Organizer: Ray Herb *(Southern Nuclear)*

The utilization of digital instrumentation and control (DI&C) technology is critically important to the sustainability of the current operating fleet and the next generation of reactors. Digital technology can increase safety, reliability, and efficiency while addressing analog component obsolescence. Come hear our panel discuss the latest developments in DI&C and recent efforts by NRC to address licensing challenges. See how your plant can use the latest in DI&C guidance and improved regulatory processes to upgrade your plant and reap the benefits of DI&C technology.

Digital I&C, the NRC Digital Action Plan and Licensing Challenges

Eric Benner *(US NRC)*

Session Notes

- NRC realized that just a product was not enough, a support system is needed. Have a new sort of "Phone-a-friend program" When working on a digital mod in 50.59 space, reach out the NRC. With that heads up, they will prepare the region and the inspectors with Just in Time Training on their position.
- Progress on Appendix D guidance was on hold for a while but focus has been put on it again. Inspect by end of 2018 to have interim endorsement published, not going with a full Reg Guide yet.
- Commissioners have not yet voted on recommendations from the NRC transformation team. The recommendations developed and action suggested are in a holding pattern until this vote occurs.
- Staff looked at policy to see if it was impeding, policy was okay but the implementation was hindrance in the process. BTP 7-19 discusses this.

Q&A / Discussion

Q1: Sal Gabin, Duke Engergy – Do we have alignment on testability boundaries, if so where are we?
Is there a distinct boundary between the when you need to be in 50.59 space vs LAR space? Is there clear guidance on which process to use? Is redundancy to preclude common failure, still a requirement?

A1: Branch Technical Position 7-19 speaks to the testability boundaries. Risk allows you to credit Operating Experience, real world data on the component. If you have a Safety Related component, that digital component is well vetted, can potentially implement under 50.59. Obviously, you start with 50.59, then you may realize that you need to go to license amendment.

Q2: When are, and where are the workshops? Do they mostly focus on design or licensing?
A2: **ADD LINK**, The meetings have varying sizes, registration can be found on NEI website. The goal is to have a forum to get practitioners to get OEM, Industry and the Regulator so everyone has the same understanding and interpretation. So it's both design and licensing.

Q3: Terrapower – Very impressed to see the integration of NRC/NEI/industry all working together. What is the network development role? To get the data from the station out, how do you position in reg space? What's the qualification process for monitoring software?

A3: Network development – at Exelon we have the network divided into two pieces. The half with plant level sensors, are there for trending and monitoring. These are not inputs to operational decision making. These aren't for control room indication. Imputing sensors gives us huge amounts of data, and must draw a line between the two areas for cyber security. Software qualification – it exists in analytical environment, not an input to the control room, not providing operation information, keeping this distinction is important.

The existing digital mod guidance from the NRC covers a large range. It became clear that one document cannot cover the full range of what we are looking at for these mods. As the Regulator, we are focused on the top end high risk/importance things, whereas the Utilities were more concerned with the low level, simple things to update and go digital. These don't require the same way of looking at them.

Q4: Ray Herb, Southern Nuclear - MP4B has 2 initiatives, will it take 603 out of reg?
A4: We are not eliminating 603. NRC's concern with it being in reg is that any alternative considered are compared to standard in the reg, not the GDC. Thought of NRC transformation team is that it would be fine from some stuff to move from in the regs, back to the reg guide enforcement space.

Q5: Is there a plan to do any more work on operating plant's GDCs (General Design Criteria)? Add more detail, change any?
A5: Not aware of any plans to, but GDCs have been reviewed for advanced designs. Of those that were, there were no radical changes.

Q6: John, Entergy – Have any suggestions or can give any guidance to give to the I&C working group at EPRI?
A6: Improve integration across EPRI – coordinate plant mods, sensor tech, analytics, work together to solve these challenges The sum of the parts is the whole only if they can all fit together. This needs to be attacked like license renewal – coordinated efforts made that happen.

Q7: Bill, Rolls Royce – Can we reconcile the IEC and IEEE standards, are we in the US behind the times compared to others internationally?
A7: I believe we have participants in the standard development orgs, dual logo standard brings orgs together.

Regulatory perspective is that we are not wedded to a standard. However once one is in use that sort of becomes the go-to, this could be viewed as we only like one. We are open minded to looking at other standards, if it provides the same standards for safety. NRC doesn't have unlimited resources obviously, so when industry is aligned, that makes our job more streamlined.

Working group 6 has interest in IEC standards, and more dual logo standards. Lot of activity to standards between the two, condition monitoring standard was developed together. Other standards could be standardized globally. Coping with common cause - IEC 6240, IEEE has asked to be involved. Past experience has been there is a hard time getting utilities involved in the development. This is unfortunate when the prime users aren't engaged. This makes it difficult to propagate the US standards internationally. When globally a standard is adopted, all the vendors have to comply.

Word of advice on moving forward with digital mods – don't fear the inspectors. Use the "Phone-a-friend" We have a communications plans, have started having preliminary discussions at the regions. Let's talk if you have this inspection coming up, to make sure you are well versed on the NRC position. And if your site is having inspection and questions are out of bounds, beyond the Regulatory position, please tell that to the region– or to any of the people RIS. It will not be viewed as a negative if you question. We are attempting to totally impart the information beforehand; we expect to find additional questions as this is worked through. Success for the NRC, is having the industry implementing the mods.

Q8: Ken Lowry, Southern Nuclear: Thoughts on coordination in the industry on pilot project? Where there is one digital mod under 50.59 and as LAR to set a precedence on how they are done?
A8: Workshops and table tops address this in their construction. Plans to do further workshops on the ISG-06 response document, we don't know where that will land yet – maybe either NEI or INPO. Information sharing will be key for the 50.59 process, especially. First adopters of digital mods will be those stakeholders that were involved in the involved in the risk piece. As digital mods get done, if they were shared that would be helpful, the NRC is looking at ways to share information between inspections on mods, to build case studies on different types.

If you are planning to do a digital mod, speak up and talk to NEI, who has homes of building an inventory of mods. Want the full range of digital mods, at different levels. With the upcoming standardized digital engineering document, ENG -008, there will be an industry standard process for all things digital. This opens up the opportunity for everyone to operate with a common playbook, to share info between OEM, utilities, for NRC to have a common thing to look at. Workshops we are putting together will have worked examples. Putting together ISG-06 resource manual to have whys and what's for this process covered.

Q9: Jack Grobe, Exelon – What happens when the first rev of the software comes out? What happens when vendor has a revision, and how does that fit in to this process?
A9: If it's a cyber security vulnerability it will need to be reviewed. But the question to ask is, is this rev impacting something that was stripped out? With the mods we have looked at, we have not seen that many revs that need to be added. Especially in light of all the testing that is done you need to be careful, sometimes updating with the rev can invalidate testing. Upgrades tend to be lengthy. For approved platforms, on high risk systems, the bulk of the software will rarely change. You're got to remember that it's designed for the application. When moving through the design process, the software choice is taken into account. When revs come up, realized how much are these attributes locked down in licensing space? Is the rev impacting them? Often times, Reg approval will be done before complete testing is done.

Important to remember – there are different layers to software, but the core doesn't change. Small incremental changes will occur with the software, but the control does not change. The HMI can get updated, small IT stuff will change. But we have to ask, is it something that warrants being upgraded? Do you care about making this change?

Q: Larry Cunningham, some place – Looking down the road a bit - Mapping out future economizing, we talking at all about decision learning? When you map a system, will it be the same thought process to make a decision? In lieu of MP4B, is that something you are considering – AI, data mapping to deal with common mode failures, or one offs?
A: No reg component. Currently we are trying to be careful about not trying to solve the world problems all at once, and not open it up to things beyond the digital mods. Not looking at how the licensees use data they can potentially collect with digital mods. Right now the first step is still the infrastructure.

NEI Digital I&C Update

Christopher Earls *(NEI)*

- Important for industry involvement in developing these guidelines.
- Refocused efforts on Appendix D for 50.59 digital mods, expect guidelines to be out by the end of the year
- Schedule – some are delayed due to reprioritization of efforts

Sustainability Through Modernization

John Connelly (Exelon Corporation)

- Our plants are maintaining legacy systems primarily, not utilizing the new technology.
- New competition has entered the market – natural gas can be a baseload due to cheap fuel source
- Putting infrastructure in place provides the gateway for future endeavors. We don't yet know what we can do in the future with the digital mods we are putting in now. For example, you cell phone, there is a new job it can do every day.
- New EPRI program to integrate digital technologies coming soon
- Looking to the aerospace industry as an example – have have increased technology use and reduce humans and equipment required to do the same job, in a more reliable way.

Session 2: Advanced Reactor Designs, Accident Tolerant Fuels, and Licensing Challenges (with Regulatory Relations)

Session Organizer: Bob Coward *(MPR)*

In the near term, Accident Tolerant Fuels will transform our current fleet improving safety, efficiency and cost effectiveness of our operating reactors. In the longer term, the next generation of reactors are being developed today. Come hear the panel discuss new reactor technology such as advanced reactor designs and accident tolerant fuels. You will hear about their benefits and unique licensing challenges. Hear how the industry and the NRC are working together to streamline the regulatory processes for timely licensing of these new and safer technologies. This is the future of nuclear power, these technologies will change the face of nuclear power as we know it making safe and carbon zero nuclear power a viable and necessary component of a carbon neutral society.

Adapting to New Technologies

Brian Hollian *(US NRC)*

- New reactors is going to combine with NRR in an attempt to reduce overhead
  - NRC staff has reduced from ~4000 to ~3100
- Nuscale design review is probably the biggest current piece of work for new reactors.
- The big question for the NRC in regard to Vogtle is can you actually review all of the ITAACs as they come in?
- Is the NRC and their regulations adaptable for the very [Gen IV] reactors?
  - Pushing on a technical, does-based, consequence-base system for site boundary limits
  - Can you look at spanning down security?
- Another issue is that of containment vs. confinement
  - Can you look at other methods of defense in depth?
- Starting several RICs ago, the NRC was asked why there's so many different paths for putting in LTAs
  - 50.59 evaluation, LAR, 50.46 exemption, etc.
  - The NRC has now offered guidance that a 50.59 evaluation is sufficient

Accident Tolerant Fuel Development and Licensing

Jack Grobe *(Exelon Corporation)*

- This will be a primer on accident tolerant fuels for those of you who aren't very familiar
- Accident tolerant fuels have an opportunity to reduce operating costs of plants, which is currently a hot topic
- Three of the ATF vendors are doing variations on current design – pellets with cladding
- Enfission (Lightbridge and Framatome) have a totally different design
    - This is the "twizzler" of fuel
    - Twisted cruciform of solid uranium metal
    - This is in operation today in Russian icebreakers
- NSAIC chartered a working group (Accident Tolerant Fuel Working Group or ATFWG)
    - There are three task forces and an EPRI collaboration effort
- These fuels are different
    - If you talk about putting a chrome coated fuel in a chrome coated cladding you can use similar to today's regulatory infrastructure
    - If you talk about silicon carbide fuels or claddings, you need a new type of regulation
- Southern was very successful under 50.59 to put some ATF LTAs (Lead Test Assemblies) into Hatch
    - Byron submitted an LAR successfully to put ATF LTAs into Byron in the spring

Safety Benefits of Accident Tolerant Fuel

John Williams *(Southern Nuclear)*

- There are two licensing aspects of ATF
    - The first is the licensing of the fuel itself
    - The second part is the margin recovery one the fuel is deployed
    - We know that CDF will decrease by 10-15% after ATF is deployed without changing anything else
- Southern Company is performing a cost-benefit analysis on the deployment of ATF to see what other benefits can be gleaned from ATF
- Southern believes there are far more worthwhile options out there to pursue related to ATF than risk-related options

NuScale Power Review Lessons-Learned

Tom Bergman *(NuScale)*

- There's 6 phases to a Design Certification Review
    - Phase one is the bulk of the paperwork and RAIs, which NuScale completed ahead of schedule
    - NuScale has received far fewer questions than previous DC submittals
        - 1485 vs. 5-6k
- NuScale is always striving to innovate
    - They angle to solve problems by simplification, not addition
- Over 3000 pages of NuScale's 12000 page application were on Human Factors
- Highest frequency event that leads to core damage is 1E-10, which is not credible
    - This breaks certain regulations that assume core damage such as DBE and BDBE
- The largest challenges left are areas where the NRC is requiring tests when tests weren't previously planned

Advanced Reactor Design and Licensing Methods

Greg Krueger *(NEI)*

- If we step back from the LWR experience, we find we had a good regulatory system, but we added more and more
    - We added ATWS, we added FLEX, and we added other barriers that prevented us from other things
- If we make things passive, we don't need certain barriers anymore for example
- The footprint of nuclear is very small, especially given its power density
- If you converted all of the nuclear power in the US and used solar instead, you would need to cover a space the size of North Carolina just to generate what nuclear can today
- Just looking back at LWRs, DBLOCA has negative risk consequences
    - You have to slam closed isolation valves and power up diesels in seconds just because of this single event
- Diversity trumps redundancy by far

Q&A

Q1: Rod Adams- should we have anticipated Halden closing down? Was it not owned by a private organization that saw large losses, which helped shut it down?
A1: We probably should have. Norway doesn't have a single nuclear power plant, but they've been operating this research reactor for over 50 years. We could have seen this coming. They had a 5" isolation valve in the primary system that was leaking, and the government decided it wasn't worth the effort to fix and bring back. Yes, the private organization's losses were also one of a number of reasons that the Norwegian government decided to shut the plant down. A major benefit of Halden is the HF I&C

Q2: For Tom Bergman- I want to ask about commercialization. A typical rule of thumb is 3500-4000 dollars for installed kW, but the AP1000 deployments are going to be something in excess of $8k. Can the new designs beat that number of installed kW?
A2: Yes, NuScale believes they can beat these numbers, otherwise what is the point? UAmps is continuing to pursue the plant. The NuScale ECCS system is 5 valves, not 5 trains. There's far fewer components, which drives down cost and schedule. The NRC is a skeptic, but your potential customer is usually an even bigger skeptic, so we're constantly challenged on the validity of our cost estimate.

Q3: Has the political impasse on finding a final disposition route become a burden for advanced reactor technologies to be developed? Is there anything the industry can do to help?
A3: UAmps is publicly owned, so we get similar questions in NuScale. We have a 60 year rated ISFSI that was added to the original NuScale design. If some of these advanced reactor designs come online we can even reduce this waste. The fact of the matter is that there really just isn't that much waste. Nuclear reactors don't generate nearly the waste the public thinks they do, and dry cask storage along with wet pool storage can really handle this easily. It's a very convenient excuse for people against nuclear power, but for any policy-makers looking to have honest discussions it isn't an issue.

Q4: My question is about Enfission. The claims I've seen on their website are that the fuel allows for potentially higher power output from a typical LWR, is that something the industry is actually interested in? It seems like something of an after thought. They still use Zirc, but they cool it a lot more.
A4: Power up-rates would be interesting for some utilities. Utilities are usually limited by PCT during LBLOCAs, and perhaps this could help some utilities, but some other utilities may also be able to increase their operating cycle time. Enfission has not taken any DOE money to participate in the ATF development effort in the US. That doesn't mean they're not a player in the game, it just means they didn't want to take any money and proceed on their own. BDB performance doesn't meet the performance criteria that the DOE set forth, but in other aspects like AOOs they're even better than current fuels.

Q5: Is there any regulatory concern about using metallic fuel?
A5: The NRC uses a PIRT methodology to help the agency and the industry to get the gurus in each area of technical expertise to figure out what needs to be done to license the fuel. One of the challenges is that we'll have to establish new licensing criteria, but that can be done, presumably.

Q6: Mr. Krueger, at the end you said diversity is much, much better than redundancy. Can you clarify what you mean? Application diversity, performance diversity, equipment diversity, etc.
A6: That was more pointed towards equipment diversity.

Session 3: Is the Nuclear Promise Delivering on Value Based Maintenance? (see Business and Economic Performance)

Session 4: Realizing the Promise of 50.69 Risk Informed Component Categorization (with Risk Management)

Session Organizer: Shannon Rafferty-Czincila *(Exelon Corporation)*

In support of implementing the "Nuclear Promise" this track consists of sessions focused on 50.69 progress and lessons learned. This includes how the industry has been collaborating in order to gain alignment and resolve challenges, an understanding of the insights gained during the licensing process and expectations after implementation. In addition, the session will highlight real examples of how 50.69 provides a return on its investment. A panel discussion will provide the audience the opportunity to ask industry experts questions regarding their experiences with 50.69 over the past year. This session will be combined with other tracks to provide a broad based, multi-discipline understanding of the topics being discussed.

50.69 Joint PWROG/BWROG Working Group Committee

Heather Szews (Duke Energy)

- Goal of the working group is for all submissions of LARs to be similar in order to speed up the review process for the NRC.
- There are differences in the length of time that the NRC reviewing, but that mostly depends on the amount of models that are being submitted for review
- Project when receive SEs, so when we know deliverables need to be ready for use.
- The group is tracking when they expect LAR submittals. There is a large wave in 4Q18 is still our projection. Plants that didn't have a PRA for seismic, now have solutions with EPRI helping plants get there. That is what is driving the large number all at once.
- Every LAR that has been submitted so far, has been audited. The working group has looked at what RAIs are coming from the NRC to see if there are commonalities. So far, there have been 6 common/generic RAIs. The working group is updating the template to have the licensees answer these questions with the templates, that way they are addressed ahead of time, uniformly.
- Looking at software, asked the question if all licensees needed to use the same platform In the end, determined the software itself didn't matter, the format of the information presented to the NRC was the important part. This provides consistency in the inspections and audits.
- The owner's group doesn't believe that writing alternative treatments belongs in code cases, but in the inspection manual. They are taking the stance that it is not appropriate, and beyond the scope of the rule.
- Change management is ongoing process and one of the most important pieces of this change – reminding and reinforcing with people that we are using our existing processes to accomplish this.

50.69 RAI and Audit Lessons Learned

Shannon Rafferty-Czincila *(Exelon Corporation),* Bryan Thiele *(APS)*

- Limerick OE - NRC initially was uneasy about the categorization process and had lots of questions about it. Found that the main concern after talking to them, it was important for them to see we were in line with NEI 00-04. Limerick developed a presentation to give to the inspectors in order to explain this. They are willing to share their presentation to other sites. This presentation has been requested at the other sites in their fleet.
- Exelon did not start from scratch when developing their 50.69 procedures, they used Vogtle's procedures as a starting point. A generic version of these are now available on the NEI website, don't start from scratch.
- Peer review needs to be in license condition in a table format. The NRC wants to see that before entering the 50.69 process.
- Uncertainties need to have sensitivity studies to show how they are impacting.
- The draft questions from the NRC come in only the week before they arrive, in some cases they have only sent them the Friday before the Monday they arrive (they did this with APS). So heads up if you haven't received them at the beginning of the week, you might have to be working that weekend. After the audit, only 2 extra RAIs were added for APS, so not too many surprises there.
- Walking through the software with the NRC was helpful, to explain to them how it works. APS showed them how multiple Equipment Out of Service impacts the model.
- APS found it was extremely beneficial to have the vendor come out for the audit. The people that developed the PRA model gave a presentation with a description of their methodology to the NRC. This greatly helped curb the questions the NRC had.
- In the APS exit, it overall was positive. The NRC left confident in the model, things seemed reasonable and categorized in the right bucket.
- Needed to capture the basis on update vs upgrade for each closure. NRC was very interested in this.
- One surprised by the level of review of the NRC, the peer review does not really reduce the level of review they do.
- APS was initially told that it would take 800 hours for review, after the RAIs were finalized that number went up to 2000 hours. So the costs went up 500k. So the budget has had to expand to accommodate.

50.69 Risk Informed Engineering Programs missing presentation

Gerry Kindred *(TVA)*

- Slides sufficiently captured presentation

Realizing Savings from 50.69

Dan Monahon (Southern Nuclear) and Adam Coker (Southern Nuclear)

Session Notes

- Example of cost benefit of 50.69: Drain valve, Safety Related - costs 20k. When it needed to be replaces, a planner asked if it could be categorized and an equivalent valve used. Turns out, it could, and the valve that it was replaced with (that was already in the warehouse) costs $1500. Just the tip of the iceberg as far as the savings that can be realized from 50.69.
- If you can find the big ticket items to go after and categorize, you can find immediate returns.
- As a result of categorization, Vogtle reduced their outage budget by 500k. These are real savings you can see.
- Got approval of the LAR in December 2014, but most of the progress has been made in the last 6 months. In order to make this process work, we looked at our processes, and realized they were unnecessarily difficult. We had essentially created an ISI/IST lite out of a lot of things. We first went to the working group, to make sure our vision was in line with the industry since they have already worked to streamline much of this and used the recommendations. We then focus resources on what's important., rewrote procedures, realizing if we make the process so hard to use, it won't be used at all.
- This initiative has birthed from operations. Ops has a different perspective from conducting the surveillances. They have a different understanding of the equipment than engineering, and see the big picture. When determining the alternative treatment, input from engineering and maintenance is taken into account, but at the end of the day, the person with the license is signing their name on the line saying that the new testing period it adequate to ensure safety and performance.
- To begin, Ops sat down with the engineering program owners of ISI, IST, Appendix J to really learn the system. Once Ops understood how the programs work, they could rewrite the process to streamline. This part is really important, you can't fix what you don't understand.
- Caution: de-scoping doesn't exempt you from TS/GL programs. Some equipment can be 50.69 categorized, but would still be called out elsewhere. May need to continue some testing to meet those commitments. There is also the potential that they may be things 50.69 that lets you exempt.
- As you go along, make sure in the approval process go ahead and document cost savings. This is how you develop the business case for the work that goes into the categorization.
- Program owners may be resistant to change; you have to get them to understand that we are not being less safe. The NRC has approved this process. Ops has a different perspective than engineering, they are the ones testing the same things week after week, quarter after quarter.

Q&A / Discussion

Comment: Study was done and a year ago by NEI with comparisons of plants, looking at methods with respect to fire treatment and how many components were brought into scope depending on how fire protection was treated. Vogtle said only a handful of equipment is impacted by the seismic safe shutdown list.

Q2: Was in the room when decision making was done for using the Appendix R list. This list already exists; all the structure exists around that list. The number of hours for review list of something that is already approved, seems odd when you could just do a fire PRA. How can that take more review hours for the NRC?
A2: I asked that of the NRC, and the feedback was that since it's a deviation from NEI 00-04 it takes more time, because deviations are always need more time. The review hours are what they are, unfortunately.

All the plants submitting LARs for 50.69 that similar to Vogtle are in. The ones that are coming after will have deviations from that site, and that's important to realize. The point of the pilot is not a model to strictly follow, it was to prove the process works.

Q3: As we go forward with license extension, we are coming up on EQ PMs we have pushed off. Where do you see 50.69 falling in to deal with these?
A3: From PRA, wouldn't see a difference necessarily. From a risk perspective if it's low it will remain low. Those are for Equipment Reliability. We haven't gotten deep in the EQ program yet, but eventually elimination may be possible.

Comment on EQ – sites that are going for license renewal; EQ PMs need to have a technical evaluation in order to extend them. But maybe it's time to revisit EQ. There's big money in the EQ. What's the accident EQ qualification is based on? Shouldn't the risk shift to a higher probability accident?

EQ has not been shown to be safety significant. Full treatment needs to be revisited. There is a lot of fear around alternative treatment process.

Talking about license renewal – there has to be a culture change. This also has to be a culture change in how we approach alternative treatment. If you sit down face to face with planner, procurement, engineers, explain what you expect and reinforce makes a big difference.

That coupled with it says here in your process, that releases them. Look at all the risk 3 components we are working this outage, and what can we do with them?

Q4: Why did the planner ask the question? From training? Did you talk to him?
A4: Basic review process makes him review all the special indicators one that it had been tagged was 50.69, and he didn't know what it was so he asked. We have since educated all of them. Our change management didn't have that training in our plan. CM can be good, but it has to be implemented.

Q5: Capturing the savings can be difficult to do, it's easy to get craft hours and material. Could you quantify the amount saved when Ops didn't have to tag out for work, there was no engineering evaluation, no records doc review? Have you been able to capture this? What about documenting in the PRA the improvement with the equipment not being tagged out, increasing availability?
A5: For "efficiency gains" we allocate $55/hour as an overall set rate. Capturing the gains is important to thrust forward

The 50.69 Working group is developing a standard set of alternative treatment cost gains so that we can measure it the savings the same. And all can be captured. So senior leaders can compare sites, since all the CNO talk and compare.

Q6: You mentioned that you heard from you Project Manager for submittal that there was a last minute addition, can you elaborate on that?
A6: Needed more specificity around a process SPRA vs SMA list. It's a generic request now. If you don't have the wording of his to respond, reach out the Exelon.

Q7: What criteria do you use to categorize?
A7: Vogtle – a list was put together to determine the percentage of Safety Related components in the system. Looked at what was modeled in PRA vs not. One good thing to go over is that is obsolete, see where you can do an alternative treatment for them. Other areas - Is it causing me high dose to go work with marginal returns? Not a lot of cost saving benefit – but other savings available. Ops knows all the ISI and ISTs that the site does. They try to marry to the systems to the criteria.

Look at projects list for updates to you are doing in the next 5 years. Look at what you can categorize into Risk 3, there is a potential for savings when purchasing equipment.

Session 5: Sustaining High Equipment Reliability

Session Organizer: Ray Newmaster *(Exelon Corporation)*

In this session panel members will discuss what is being done in their organizations to maintain the "Right Equipment Reliability" at "The Right Cost" in support of "Delivering the Nuclear Promise" for the Long Term Asset Management for plants now operating for 60 years and some being extended to 80 years of operation. This session is meant to prompt an audience interaction of questions and discussion on the topic of Long Term Asset Management.

Long-Term Asset Management Strategies

Ray Newmaster *(Exelon Corporation)*

- The Exelon finance people are deeply involved in the LTAM process.
- Our process takes it through corporate Plant Health Committee, then it goes to site PHC where is gets approved it as well
- Referencing the slide - candidate for going into the LTAM must have one of the criteria listed, not all are required.
- The LTAMs are living documents and are reviewed yearly. Or updated as new industry issues arise.
- Some strategies are straight forward – I&C related equipment's may have 15-16 different components under the one umbrella.

Tools for Sustaining High Equipment Reliability - EPRI ILCM Software Duke Energy

Gary Wald *(Duke Energy)*

- Joint product with site engineering and corporate engineering, for the Long Range Plan (LRP), by the site engineering takes it to Plant Health Committee (PHC). Initially nervous about using any single curve and ran Wyble curves with the Life Cycle Management (LCM) and had good agreement.
- EPRI ILCM models provide a technical basis for decisions and PM schedules.
- LRP tool C55 does a good job of laying out the spending plan for large numbers of investments. Complaint was that there too qualitative. Unless everyone used the same method, it's hard the compare. There are about 14 pieces of major equipment. C55 looks at large projects, starting smaller for the beginning. Marrying of the qualitative and quantitative.

OPG-Monitoring and Diagnostics Center

Sorin Marinescu *(Ontario Power)*

- Another example where they benchmarked the US example. Have to change to get more efficient. Took the best practices and considered them part of the program. Worked with Duke to develop this program. Not that we have the LCAM.
- We have changed criticality, how many times? PM program is too robust, then not enough, we go back and forth. We have been digging around the issue and then went after Equipment Reliability Index (ERI). It has been changed so many times. This is common, be part of the problem and the solution.
- OPG conclusion: don't understand the condition of the equipment, without this we can't make good decisions about PMs. This is why they decided to focus on the condition monitoring.
- Even if you have a non-crit component, you still have to replace at some point.
- Fleet-wide monitoring slide: Grey – developed models for these areas. Started with these to show a proof of concept.
- ER optimization – changing PM since we now have a look into the equipment.
- Created 2000 advance monitoring models so far.
- We are at the point showing of that this works, no major financial saving realized yet but see the potential.
- Have a dedicated PM review team, using the data gathered, reduce and adjust the PMs.

Q&A

Q1. The LAF models make sense LOR model make me nervous, may be the opinion of engineers. They don't want to trust a number more than it's worth.
A1. Short answer – can't go with one model. There is more to the LOR model than it appears, it's a questionnaire and what it does is solicits options of experienced engineers, pools between 5-6 different people. Goes into experiences, then goes through a theorem. What I am looking for is convergence. Went through the project with the LRP model, sent back and ran it through LCM process. What did we have before? Engineer hand waving about the importance of the thing. Having an argument armed with data lets you point to something. LCM is not a perfect science, it's definitely more probabilistic. We expect 60-70% of critical components for this to be applied on.

Q2. Has this been applied to switchyard health?
A2. Large Main Transformer, EPRI transformed templates. There will come a time when that is used more. Across utilities we know a lot about transformers, they are big cost, big risk item. For us, they are candidates for strategic sourcing.

Q3. With qualitative data, their experience maybe be limited to their data. The OEM has the potential to have a lot of data accessible, that could be provided to you. The engineers that may be working on multiple things, there is a lot of data that might not be in the EPRI database.
A3. Would they OEM be willing to share that data? To the point of the turnover of engineers, for that reason that is why we don't want a LoR from a single engineer. Don't want to oversell the LoR, engineers believe in it, captures their perspective. But would not go up against a vendor saying something is don't. Assessment Investment template for OPG – the operating experience must be validated with industry and the OEM. Part of the normal evaluation for engineers, and as part of the list, have to ask the OEM. There are some times where the OEM has been asked to review a whole component group. Focus on the large, high valve groups. We have a good idea of consequence, but not probability. Set ranges and do Monte Carlo to see how likely it is that we are right.

Q4. If you predict something will fail, you have to get work in the schedule, if there a problem getting the work in?
A4. One of the first PMs we went after was loop calibrations. We created Conditioning Monitoring WOs that were setting there planned, that have an agreement with maintenance that it will be worked within a certain time frame. The engineers have to have materials lined up to make sure it can be executed.

Q5. Lots of excitement about Condition Based Monitoring, but there is still trepidation, what if we overreact when we see something if we are always monitoring?
A5. It's culture change at first you don't need money wins, need high valve wins. The craft and the engineers that they don't need to calibrate but let them go calibrate and then they see it doesn't need to be done.
We have I pilot on the intelligent monitoring. Engineering have a nervous on changing PMs, they are seeing early catches in the pilot program. All though it was initially slow growingly they are starting to grow trust. Authorized operator is a part of the team, and maintenance and grow with the process.
We have to start teaching engineers how to deal with risk, we are used to replacing equipment based on age. Now we need to move on the risk. Got into the algorithms and surprised that it was Monte Carlo runs on them. It's becoming more built in, dealing with risk is the order of the day

Session 6: Extracting and Applying the Insights from Fire PRA Models (with Risk Management)

Session Organizers: Gene Kelly *(Exelon),* Ed Simbles *(Jensen Hughes)*

Many plants have fire PRA models in varied stages of evolution. Some are new and being finished; others are under review. Yet others are signed-off models of record, but undergoing additional refinement, and NFPA-805 plants have gotten there sooner. Such models are complex, which brings a whole new set of challenges. Given this considerable investment in fire modeling, we would expect the models to be useful with credible results. These models are "telling" us something, suggesting additional plant changes (procedures, modifications, transient controls) for a variety of reasons and benefits. This begs the question of what new insights are we gaining, other than large metrics and questions of realism? Where are the true risks due to fire at our plants … and what are we doing about it?

Fire PRA Informed Risk Reduction

Greg Zucal (*Jensen Hughes*)

- Eliminate human interface for this action to occur. The design of the value, if modified, could put you in a much better place was recognized.
- How much to fire response can be procedure in other areas, how can we use that to help us?
- Many times we are trying to reduce operator actions, but in key places it might be valuable to duplicated it in another area.
- Your knowledge of the model and your model in the plant you can understand why a particular power supply is important. Failures that are relative are behind the cut set. Experience illuminates the important piece. How do we gain insights when things are hidden?
- Working on teaming with EPRI to bring the software to the whole industry.

Fire PRA models - what are they telling us?

Gene Kelly *(Exelon)* & Ed Simbles *(Jensen Hughes)*

- Reality is that there is still risk to fire, not something that we can just ignore at an operating plant. Sometimes hard to believe risk can be driven by fire, but it does.
- There is a portion of this we can control and get some credit in the model. Look at the OE and the opex and what kind of fires these are, small equipment and might be treating these greater than they are
- If cabinet fires are where most of the risk, what can we do about it? Very complex in the model PRA. Tend to be really conservative about how we treat them. OE does not reflect how we are treating them in the model. There is an insight to the model, we can identify which cabinet that drives the big risk bus, or this cable in this tray. You can get a lot on specificity on where the real like is located with these.
- Challenge – when you build the average model you can only get to certain things, but say you have significant equipment out of service. And all of a sudden all those tent pole shift, and what didn't matter in the average model, can kill you now. Trying to get ideas to look at the model differently to, starting to find some simple remedies.
- Unnecessary conservatism can be added in each step and it just builds. This can affect bottom line results. Adding conservatism to cover uncertainty doesn't do any good.

FPE Challenges - Now that we have a Fire PRA

Tom Cheslak *(Duke Energy)*

- PRA updates – Duke is doing a 3-year updates.
- Changing to a new code year, brought on a lot of changes, had to write a test procedure to start tripping fire dampers at Oconee. Because of the code of record changed years.
- There have been green NCVs for pre-fire plans not being up to date to the minute when the NRC goes out to do walkdowns.
- Have open caged area, under apex R, not worried about how much is in there. This changes under Fire PRA, had to remove the transients in there so it wouldn't present a target. Implemented housekeeping procs, to look at how long the thing will be there.
- Well-sealed, robustly secured cabinets as per NUREG 68-50 are being interpreted literally. Finding small openings in the top of the cabinet, and being challenged based on the NUREG definition. Lots of issues in triennial inspection defending it.
- So far, triennials are not concentrating on the monitoring piece yet.
- For the TRMs on pen seals, go do destructive testing. See what the depth of the cracks are. If using equipment and doing a 10% during the outage, may miss some.
- Done benchmarking that we have FP features that are not HSS or LSS, how to do get work control to get those fixed? Need those impairments fixed so we aren't just sitting with those.
- Put procs in place for the RE when doing mods to direct them to think about when doing mods and how they can effect the PRA.

Q&A

Q1: For Fire SDP, who is contact?
A1: Reg Assurance, if a major issue, licensing has a procedure to put a multiple disciplinary team in place. We start with the risk engineers, try not to bother the PRA owner unless it's a big issue. Initial plans will be handled by the sites.

Q2: Misconception is use of FLEX in fire PRA, the amount of impact should be looked at with a grain of salt – very site specific. Know what's in fire, seismic, internal. The as-built-as-operated plant, need to have that in the model. The third question is are you crediting FLEX? We should have it in our modes. When you are in a SDP, you say how about if you have a plant where a diesel is not available that changes the whole model? That's where FLEX is essential.
A2: NRC is working with Southern, FLEX is in our SPAR.

Q3: Fire watches, do we get credit?
A3: The number is not as important as the compensatory measures you add in. what saves the day it to get no credit for pre-staging, gave the warm fuzzies. Qualitative measures are important. You get more credit and more threshold if you have comp measures.

Session 7: What Others are Doing to Improve Work Management and Maintenance That Are Out of the Box for Us (see Business and Economic Performance)

Executive and Leadership

Session 1: Challenging Traditional Paradigms of Reload Analysis Methodology

Session Organizer: Steven Freel *(Studsvik Scandpower)*

As the US industry has worked to reduce cost in plant operations through Delivering the Nuclear Promise, one area in fuel management has remained generally untouched. Reload methodologies used today were created 50 years ago and depended greatly on bounding analyses. Due to the large cost and effort, licensed reload methodologies have not changed in recent decades. With modern computing power, databases, and automation, the traditional paradigm of reload methodology can be challenged to provide cycle-specific safety analyses. This panel will combine utility and independent consulting expertise to describe the integration of safety analyses, neutronics, and PRA into one process to support financial, cost, and risk savings on fuel cycle reloads. With the combination of new Accident Tolerant Fuels and changes in the US nuclear fuel supply market, speed and flexibility will ensure utilities are ready for tomorrow's fuel market.

Independent Safety Analysis: Recognizing Opportunity

Keith Drudy *(Southern Nuclear)*

- See the problem from a sales pitch perspective. Be there to change the way to do business.
- To improve the safety analysis, consider the aspects includes the better understanding of plants' design, addressing the operational problems, improving the efficiency of fuel supply.
- Strategies have been proposed for a long time to addresses these problems. But there are still tremendous opportunities there, since the methodologies still have large room for improvement.
- Challenge – do more work and how to improve the existing ones. Make right changes to can result in a better operation.
- Ability to do big data analysis on safety analysis can help to improve in multiple ways.
- The barrier for changing the current methodologies come lies in several aspects which includes initial investment, long-term commitment, competition etc.
- Maintain and manage the response and how to share them are vital in safety analysis.
- Southern Nuclear is trying to address and advance the safety analysis in various ways. A wide spectrum of solutions are provided for status quo and revolutionary changes. Both the short- and long-term goals are considered.

Challenging Traditional Paradigms: Reload Analysis Methodology

Steven Freel *(Studsvik Scandpower)*, Cesare Frepoli *(Fpoli Solutions)*

- Change is hard due to the resistance from regulation committee.
- Reduce risk and cost is the main purpose of advancing the reload analysis.
- We need more transparency about how and why these regulations on reload are implemented.
- Change for reload methodology can only be successfully if we can develop a monetary value for the adoption of vendor independent reload methodology.
- A more generic reload design methodology can have more benefits compared to the traditional method in terms of save time and bring more margins. It can provide support for ATF fuels and provide more operational flexibility.
- Operation is an important factor for reducing cost.
- The technology has experienced large improvement but the physics still remain the same as the past 40 years.
- To reduce cost, the following aspects should be considered: cheaper reloads, fuel supply security, more competitive fuel market and operation margins
- FPoliSolutions have expertise in field of nuclear reactor safety analysis, fuel performance and developing software for data management and analysis.
- Changes always has large cost. Dedicated team have been organized to do the V&V and for data analysis. More focus in fuel product is on the performance aspect.
- Automation help to reduce cost and improve efficiency.
- Effort to adopt the modern data and content management. The team members can speak multiple languages with different background to rethink the solution of complex multidisciplinary problems.
- Commoditization not possible without vendor independent LOCA tools and methodologies.
- Reduce the analytical tools helps to reduce complexity while enhance the fidelity in streamlining the chapter 15. The detailed strategies include using a single system response code and a single thermo-mechanical for both steady-state and transient response of fuel products under accident conditions.
- FPoliSolutions are current developing a data management and application platform with more transparency and reliability. This project receives DOE sponsorship.

Personal Perspectives on Cycle Specific Safety Analysis

Joshua Kaizer *(US NRC)*

- There is a need to convince people that computer code simulations can be trusted when presenting them for the public to review and understand. A large effort is needed to solve this concern.
- Many efforts have been done before computer revolution. We should utilize the current stage computer power for reload analysis to save time and cost.
- Discuss the difference between single and continuous simulation. Analyze the given specific conditions is not very helpful. Generic solutions for a group of situations will be more desired.
- The review has a high bar for approval even though it provides greater regulatory in terms of continuous review. One should choose the methodologies based on the its benefits to the community.

Challenging Traditional Paradigms of Reload Analysis Methodology

Jim Tusar *(Exelon Corporation)*

- Breaking paradigms have been approved successful in academia. It helps to reduce fuel costs by improve reload. It can improve economic viability of nuclear power.
- Exelon's in the neighborhood of billion dollars for fuel capital expenditure.
- Exelon has 6 business imperatives.
    - Innovation is one of the most important.
    - Innovations can break the old rules
- Exelon has a procedure for innovation. The core of innovation is uniqueness and positive business impact.
- Exelon is the first company to adopt GE TRACG LOCA methodology

    - It increases the MAPLHGR limits and result in a efficiently core design.
- Thermal limit biases (> 12%) exist in-between on-line and off-line limits of the 3D core simulator code.
    - Bias is not expected when designing the core. The solution is to using advanced data analytics to understand and decrease the difference. Has been Working with musigma(data science company) for 1.5 years.
- Other orthodox breakers include use of plant-specific measured scram times in safety analyses as opposed to traditional conservative tech spec values. It decreases OLMCPR at Nine Mile Point Unit 2 by 0.1. It decreased reload batch size and fuel costs by $3M.

Key learnings, Recommendations, and/or Best Practices

- Vendor looking at creating solutions rather than selling products. Work with others - work together to solve problems.
- Take advantage of coming up new technologies can make the industry better.
- Innovation and breaking the old paradigms can benefit the industry in various ways.

Q&A

Q1: Sean Clark: What aspects would you provide for companies for supply chain improvement?
A1: Keith Drudy: Look at business perspective. Not all changes are good on business cases. The innovation should be encouraged.

Q2:John: What does NRC transformation changes for code development and V&V?
A2: Joshua: Not a lot good documentations addressing this problem. Problem still lies in how to credit the analysis and how to make those steps more transparent. There are experts address and response to the code development and V&V issues.

Session 2: Passing the Torch - Bridging the "Baby Boomer/Millennial" Communications Gap

Session Organizers: Tom Vehec, Rich Werdann *(ReNuke Services)*

One of the greatest challenges facing the nuclear industry is aging; specifically, the aging of facilities and infrastructure and the aging of a highly experienced workforce. The loss from retirement and attrition of talent and expertise developed over the last thirty years poses a difficult problem, one never before encountered by the nuclear industry. This is even more daunting considering the need to attract, accelerate the technical and professional development of, and retain a new generation of workers consisting of millennials who have a set of values and work cultures vastly different from the current workforce predominantly made up of "Baby Boomers."
Key objectives for success are twofold:

1. How to attract and retain a new generation workforce into an industry whose very commercial viability is being questioned.
2. How to effectively communicate and transfer the knowledge and experience of an aging generation of professionals to a new generation of millennials to ensure the long-term viability of the nuclear industry.

Come interact with our panel to explore this topic from multiple perspectives; a view of the challenges that current millennials face today; insights about the millennial culture; behaviors, myths and motivation; and lastly, approaches for ensuring effective communication to bridge the gaps and meet the needs of both sides of this critical issue.

Overview of the Challenges from a baby boomer/millennial's perspective

Rich Werdann (ReNuke)

- Baby boomers learning differently from the millennials.
- An interesting video titled as: millennials in the workplace training video (https://www.youtube.com/watch?v=Sz0o9clVQu8) is played by the speakers. It should the habit and the ways of thinking are much different between two generations.
- Baby boomer works 60-80 hours. Nowadays, millennials work for the bosses not necessarily for company. How to train the millennials is an important question which should be revisited. If trying to teach millenials the same way as for baby boomers, it will not be effective.
- Job Market for Baby Boomers vs. Millenials
    - Baby Boomers
        - Not bright following TMI, but jobs were still available
        - Getting multiple job offers
    - Millenials
        - Competition among different industries are more intense
- Baby boomers and millennials think differently
    - The baby boomers learn new technology to keep up with the younger generation
- How we can attract more millennials to industry?
    - Salary is competitive.
    - More promotion opportunities as more baby boomers are retiring.
    - Baby boomers can get more experiences and practice opportunities.
    - It is not just about money but adding values for company

Jacob McCrory (Entergy)

- The speaker is a millennial nuclear professional with 7 years' experience with an aerospace engineering background
- Industry is reluctant to adopt new technologies.
    - Follow the procedures which were developed 30 years ago.
    - No chances to apply his knowledge.
- Money is better other fields. Potential promotion chances in nuclear industry keep the speaker staying here, since more baby boomers are retiring.
- It would be important to systematically passing the knowledge to millennials for transition.

Suzanne Jaworoski(DOE)

- She is a baby boomer as marketing, energy and government professional with more than 20 years' experience.
- Reliable source of energy improves quality of life
    - June 29th 2017, in a review conference, Trump asked "How do we make nuclear cool again? We need an education program. Find why it is interesting and important to society that we cannot abandon nuclear."
    - Nuclear power has no emission. It is important to national security.
- There's not a scientific problem. There is a market or communication problems on advertising the nuclear power.

    - Government page, social medias such as: YouTube, Facebook are used to let young understand the valuable and importance of nuclear for their future.
    - Knowledge education program is really important.
    - Belief millennials will be able come to their conclusion.
- Emissions free energy saving our planet
- Make the industry simpler, not more complicated.
- Future is bright for industry.
    - Young smart, dedicated people are coming to this industry.

Jim Little (NEP)

- The speaker is a baby boomer but identifies as a millennial. He is a nuclear professional with more than 45 years of experience.
- Nuclear plant performance is never being better, with more than 70% efficiency.
- The existing issues include
    - Increasing number of competing sources of power
    - Increasing cost with nuclear power plant aging(renewing license, spent fuel dispose etc).
- The speaker has retired twice. There is a big challenge to continue and transfer the knowledge is a big challenge
- Survey shows 43% of millennials stay in same company in two years
    - Need more flexibility to use people from different background
    - Free up time for innovation and being creative
    - Try new technology to do the cool stuff
- Technologies can improve the operation safety. Google bought solution engines for $2 million
- Tradition is in the way. We should put them aside
- It pays to think like a millennial

Key learnings, Recommendations, and/or Best Practices

- If baby boomers do not change their perspective, the next generation for the nuclear industry may be lost.
- The discussion of this topic will exist in the future. The transition from baby boomer to millennials requires the long-term rather than short-term efforts of the whole nuclear industry.

Q&A

Q1: Education are required for the CEOs and whole industry. A lot of changes are required, for example, the knowledge base transfer, educating millennials, etc. We should urge the baby boomer generation to push upward and outward. There has to be a complete change of culture and ways. Any perspectives on these?
A1: I have already seen changes in the industry. With my own experience, the things like working at home are gradually accepted by management and those leaders in mid 30s.

Q2: I am sad and about to leave the company due to the decommissioning. The relationship between baby boomer and millennials are breaking down. Any solutions?
A2: The millennials are more social people compared to the baby boomers. We are inviting the millennials to visit nuclear plant on site, creating social systems for millennials and baby boomers; help the millennials to find their own coaches. These will help to bridge the gap.

Q3: Currently, most millennials are to adopt the culture and to work in the existed nuclear plant. Millennials cares more about climate change and need to find purposes. I think the community and industry doesn't help and provide enough sources.
A3: Suzanne: Nuclear is not only about electricity. We need to learn how to bring people together. See the problems in world and find solutions. We need motivation but also execution, leadership to address the existed problems.

Q4: Shann: There are more diversity in term of experience for millennials. The utility side do not keep up with these.
A4: Rich: These problems are difficult to deal with. Need long-term effort to help this transition.

Session 3: DNP Initiative Status for the Industry and CAP-002 Lessons Learned (with Performance Improvement)

Session Organizers: Fred Lake *(WD Associates)*, Reiko Perleberg *(Southern Nuclear)*

Learn where we are going next in the land of DNP and the lessons learned from the PI DNP initiatives. You will have an opportunity to ask the industry what they have learned and how the CAP02 industry implementation is taking hold.

Insights on Performance Improvement

Chuck Kharrl *(Palo Verde)*

Session Notes

- Staffing has gone down in the last 7 years and hired 1500 new people at Palo Verde. About 160 people leave yearly, which could result in challenges due to knowledge transfer. However, performance has improved.
- Problem identification (PI1) is a problem across the industry.
- Experience levels for leaders is going down due to attrition of longer-tenured employees.
- Humans are not wired to look at problems broadly / cross-functionally. Humans tend to act when there are alarming facts or consequences, but in nuclear we can't do that.
- We need to look at data differently. We need to evolve how we analyze metrics.
- Palo Verde created Data Integration and Network Analysis (DIANA) for OR.
- Fundamental problem: interface with line organization; the line is quick to dismiss as irrelevant or not significant enough.
- DIANA is much faster than humans analysts and improves data quality.
- Common = causation. Every infraction; humans can find easy common threads.
- At the end of day, DIANA helps plant performance:
    - We live in the world of low level issues
    - DIANA identifies uncommon relationships that humans can't see.

    - DIANA helps figure out how to trend seemingly insignificant events and predict events.
- Human bias: We can't help it. It shapes your thinking on raw data.
- Causation vs. Correlation:
    - Humans need to see causation; need to see cause and effect or we will dismiss it as unrelated.
    - With DIANA, you can see unrelated facts through correlation.
- We live in world of descriptive or analytic data
- We can describe what happened
- Get into CAP determining why it happened
- Try to achieve is predictive analytics; can we learn enough to determine what happened and change / alter its course.
- Over 1000 PO&C codes but humans favor 40-50. DIANA started as a recommender tool, and when we disagreed DIANA "learned" and got better. Now DIANA is more than a recommender tool – you can almost take its output "to the bank."
- Speaker didn't like DIANA at first, but later realized he was wrong. He didn't believe machine could replace humans; believed wisdom was required.
- Value of Advanced Analytics to DNP:
    - Quickly and efficiently identify central elements to class of issues (Includes events, CRs and observations, Does in minutes what takes a team of humans many days)
    - Points OR Analysts toward the "things" that should be investigated further (Informal influencers may have better information on causes of issues, Informs where corrective actions may be most effective)
    - Improves performance of less experienced employees (Work Control SROs, OR Analysts)

Key Learnings, Recommendations, and/or Best Practices

- Intelligence is about data, wisdom comes from the human, both have a role in achieving an accurate perspective of performance.

Delivering the Nuclear Promise, CAP-002 Implementation Experience

Marcia Lesniak *(Exelon),* Kevin Rackley (TVA), Sharon Peavyhouse (Duke), Jim Schleser (Dominion Energy)

Marcia Lesniak (Exelon Corporation)

- Status: 70%
- Changes implemented:
    - Level of effort for investigation / action development based on Risk and Uncertainty Matrix
    - Current Training Analysis template requires enhancements to align with initiative
    - "Off ramp" links provided for IT help desk, Facility Requests, Training Requests, Observation System, HR software
- Changes not implemented:
    - CARC definition (addressed in governance)
    - CAQ and SCAQ definitions (kept alignment with NQA.1)
    - NEI 16-07 Level of Effort Checklist for Equipment/HU/OR
    - Additional level of refinement for CAQ/CARC vs NCAP (INPO AFIs, OSHA Recordables)
- Site reaction: Mostly positive
- Benefits noted to data:
    - 50% reduction in the number of ACE-like investigations
    - Decrease in number of actions created from investigations
    - Less frequent MRC meetings
    - More than 85% of IRs are closed at screening.
- Lessons learned:
    - NCAP IRs initiated and are important to the station receive the appropriate management attention and oversight.
    - Reinforcement by Department Heads/SLT needed
    - Robust oversight of screening committee for CAP vs. non-CAP is required
    - In-depth knowledge of the Utility QA Program and associated regulations and standards required

Kevin Rackley *(TVA)*

- Status: 95%
- Changes implemented
    - Corrective Action Program Scope (CAQ, SCAQ, CARC)
    - Level of effort for action development based on Risk and Uncertainty
    - "ala carte" type Level of Effort Checklist used to charter the evaluation tools applied, documentation and management oversight required for less significant evaluations
- Changes not implemented:
    - Breaking linkage of root cause evaluation to SCAQ
    - CARC definition (addressed via program scope statement)
    - CAQ and SCAQ definitions (kept alignment with N45.2 QA Program)
- Site reaction: Positive and embrace the implementation
- Benefits noted to data:
    - Successful PI&Rs (no program-related findings) following program changes
    - Analysis time substantially decreased for non-root cause evaluations
    - ~70% reduction in the number of Level 2 evaluations (aka ACEs)
    - Less frequent MRCs with broader PI/OR focus
    - 80% of CRs screened as non-CAP
    - Improvement in the % of CRs that are "closed at screening"
    - CR generation rate has remained stable
- Lessons learned:
    - Non-CAP CRs "matter" when addressing issues with business risk
    - Hard to curb management "appetite" for volume and oversight in less significant evaluation products
    - Robust oversight of screening for CAP vs. non-CAP is required
    - In-depth knowledge of the station/utility QA Program and associated regulations and standards is a must when making program changes
    - Full utilization of the NEI 16-07 program flexibility is not realistic with current NRC Inspection Manual expectations (71152 and 95001)

Sharon Peaveyhouse *(Duke Energy)*

- Status: 95% as of 2/1/18
- Changes implemented:
  - Condition Reports screened based on consequence and cause uncertainty.
  - Lower level cause evaluations (ACE,QCE) replaced with NEI 16-07 checklists.
  - Flexible Cause Evaluation implemented if multiple checklists or aggregate analysis is required.
  - Decreased investigation time (15 hrs./QCE – 3 hrs./Checklist)
  - Level of effort required is based on the consequence and type of event
  - Streamlined the qualification / training requirements of Cause Evaluators
  - Implemented the Performance Analysis process in Performance Improvement
- Changes not implemented: N/A
- Site reaction: Mixed.
- Benefits noted to data:
  - Improved Condition Report screening guidance.
  - Simplified investigation tools.
  - Reduction in single event investigation hours.
  - Two successful PI&R inspections since implementation.
- Lessons learned:
  - Loss of ACE sometimes leaves a void – ex. Safety system actuation warrants more than a simple checklist, but not a RCE. Continuing to reformat FCE.
  - Performance Analysis – rocky transition from Training to Performance Improvement.
  - Staffing cut; however, additional effort is required to validate quality and reinforce standards upon initial rollout.
  - Effectiveness reviews scheduled the end of 2018.

Jim Schlesser (Dominion Energy)

- Status: Implemented by 6/15/18
- Changes implemented:
  - Restructured CR significance determination
  - SCAQs Events focus on Nuclear Safety (10CFR50)
  - Shifted 'Non-CAP' Issues out of CAP
  - Root Cause Evaluations only performed for SCAQ Events
  - Replaced several lower level cause evaluations (ACE, E-ACE, QCE) with a single Level of Effort Evaluation (LEE) that utilizes the check list format of NEI 16-07.
  - Level of effort required is based on the consequence and type of event
  - Streamlined the qualification / training requirements of Cause Evaluators
- Changes not implemented: N/A
- Site reaction: Positive
- Benefits noted to data:
  - Implemented 6/15/18 – insufficient time to fully assess any realized benefit, but ongoing benefits from CAP-01 are as follows:
  - Fleet % for CRs closed at screening is >80%
  - ACEs reduced by 32% over past two years
  - Average CRT 15 minutes
  - Average CAART < 5minutes
- Lessons learned:
  - Gradual introduction and incorporation of concepts prior to full implementation facilitated seamless transition.
  - Effectiveness reviews scheduled before the next PI&Rs to look at what we did, and what we didn't do because of the changes. What used to be higher significance, what used to get a cause evaluation – any negative performance trends for equipment because of the reduced analysis?

Southern Nuclear (presented by Jim Schlesser)

- Status: 90%
- Changes implemented:
  - Implemented to new terminology, Cause Evaluation Checklists
- Changes not implemented:
  - MRule Template, Performance Analysis Tool, ACD like tool still being used (Level of Evaluation)
- Site reaction: Positive
- Benefits noted to data:
  - Successful PI&Rs regarding process implementation
  - SCAQs are occurring less
  - CAP backlogs continue to decrease
  - Analysis time substantially decreased
  - Sites are able to focus more on core business
  - Less CAP MRCs and more OR/PI MRCs
  - Substantial reduction in PI staff
- Lessons learned:
  - MRCs are still having to review checklists for quality (working on behavior changes with leadership expectations)
  - Gaps in 'yes' answer corrective action linkage
  - Gaps in SMART criteria (mostly Specific to ensure gap closure)
  - Management have not been proactive with the 'Management Action' items
  - Issues with the ERC exit criteria (added more specifics to the ERC)

Key Learnings, Recommendations, and/or Best Practices

- We confused people a little bit. We need a process for all tools.
- We can close a screening without always doing a checklist. Communicate that clearly.
- Simplify wherever possible.

Q&A

Q1. When you have non-CAP closure, does it have to be quality closed?

A1. It varies by the implementation at the stations.

Q2. Did you implement back-end reviews at Columbia (a single-site station)?
A2. Answer not captured

Q3. What does robust oversight look like?
A3. We have a group that looks at the screening results (CAP and ENCAP). The program managers do periodic reviews.

Q4. How many condition reports do you do a day?
A4. About 10 a day (CAQ and non-CAQ).

Q5. How many people are on the screening committee?
A5. 8-10 people.

Q6. Did you implement the program as-is (without a coversheet)?
A6. Varies by site.

Q7. Did you have a decrease in root cause?
A7. We did a modification to the ACE investigation. We have decreased the number of actions. We have a target of 5 actions per root.

Q8. Have you made the checklists electronic?
A8. No, they are in Word.

Session 4: Second License Renewal: Delivering the Nuclear Promise from 60 to 80 Years

Session Organizer: Andrew Taylor *(Sargent and Lundy)*

NRC approval of a renewed nuclear operating license under 10 CFR 54 allowed for an additional operating period of 20 years, which could require plant shutdown at the 60-year point. However, operation of a well-maintained facility with a sound design basis and a clearly-defined licensing basis for 80 years is a key element for realizing the full value of the asset. By the end of 2018, thirty-four units will have passed the 40-year mark for plant operation, with no plan for premature shutdown. Thus, one-third of the U.S. nuclear power industry will be eligible to apply for a second license renewal.

Subsequent License Renewal - NRC

Eric Oesterle *(US NRC)*

- NRC receive two applications for SLR this year.
  - Turkey Point Unit 3 and Unit 4 in January
  - Peach Bottom Units and 3 in July
- SLRA review can take 18 months since accepting the document
- There are existing sources and conferences providing SLRA guidance.
  - In July 2017, NRC published final SLRA guidance.
    - Companion documents are provided December 2017. NRC issues interim endorsement letter for NEI guidance. And NRC is currently revising regulatory guidance to endorse NEI guidance.
- The new GALL-SLR report adds over 1035 items.
- How to prepare for NRC review:
  - Applicant should have a good sense of review focus (check NRC RAIs)
  - Ensure the consistency of the internal application.
  - Provide sufficient information, improve report quality, provide RAI response timely
  - Pre-submittal meetings will be very helpful
  - Do not refer to unapproved topical reports or methodologies.
  - The documents should be well organized, easy access, user friendly
- Review process changes in many aspects
- Lessons learned for first SLRA includes:
  - Not interact with other agencies since it is proprietary application
  - Communication with the applicant is good. Electronic document helpful
  - Frequent and timely compunction is the key to keep thing moving.

Subsequent License Renewal: FPL Perspective

William Maher *(FPL)*

- Initial feasibility study has been done before the SLRA. Identified that the application risks since NRC for 60-80 years is not finalized yet.
- FPL incorporates the project into the fleet and went through internal and external reviews.
- FPL has frequent interactions with NRC.
  - Application review cannot rely on any unapproved document.
  - Work with NRC for those supplement material which are proprietary material
- In-house audit is helpful. Doing it remotely can be beneficial in terms of reduce response time. Get one half reduction about RAIs
- Lessons learned includes:
  - Work with different vendors make sure proprieties identified in the document is correct.
  - Structure of your folders should be very clear. Correct the portals to help NRC
  - Let NRC know where you are placing the documents.
  - Vendors of portal should be prepared and aware of the visiting and data usages.
  - Setup individual project plans for each major review task which will be interface with NRC.
- Turkey-Point going from pre-GALL to SLR-GALL.

Delivering the Nuclear Promise from 60 to 80 Years - Duke Energy

Mike Franklin (Duke Energy)

- Most of the current Duke Energy units licenses will expire at the beginning of 2030s.
- Duke energy is making efforts to reduce the 40% total carbon dioxide emission by 2030, compared to 2005 levels.
- While no decision made yet, the Oconee Nuclear Station is being considered as pilot for SLR among the Duke Energy fleets, considering the cost and operation conditions.
- The implementation of NEI 14-12 and NEI 14-13 both have actions included in license renewal aging management procedures.
    - In NEI 14-13, License Renewal Program Manager and AMP Owners required to review both internal and external plant OE as it relates to AMPs.
- The quality of application is very critical and the peer reviews can ensure the quality is embedded in the applications.
    - The peer reviews are recognized by NRC.
    - The Duke Energy plan to use utility peer reviews as part of the SLR application development.

Second License Renewal: Delivering the Nuclear Promise from 60 to 80 years

Andrew Taylor (Sargent and Lundy)

Session Notes:

- The industries should put all parts and aspects together to achieve this goal
- Anticipated SLRAs per year (non-attributed survey) is shown in presentation. Dominion may submit on 2018 or 2019. Applications are expected to jump up at 2030s
- Recommend procedures called “Fifteen-year optimizer” for maximum flexibility.
- Path to success: The gaps in aging management programs should be anticipated. The second license renewal is based on NUREG-2191
- The company should be prepared to response to RAIs concisely, completely and timely.
- The procedures and trainings of SLR application include:
    - License renewal project overview
    - Environmental report guidelines
    - System and structure scoping
    - Screening and aging management reviews
    - Evaluation of aging management programs
    - TLAA
- More information can be found in webinars with the following links:
  http://www.sargentlundy.com/in-the-news/sargent-lundy-webinar-making-the-decision-for-second-license-renewal/
  http://www.sargentlundy.com/in-the-news/webinar-second-license-renewal-part2/
  Third coming soon focus on environment aspect. Contents are still being added
- Where are you on the timeline figure for application? You need to move early and be prepared.

Key learnings, Recommendations, and/or Best Practices

- In SLR, the well organization of the document and timely communication with NRC two important factors to help the application go smoothly and reduce the delay.
- At the beginning of 2030s, it is expected there will be a sharp increase of application numbers. The potential applicant should have a good and clear plan for SLR.

Q&A

Q1: It is interesting to see the application timeline – who should be responsible to provide information for SLR? Baby boomers are retiring. How to capture the knowledge and information for SLR? And the transition from baby boomers to millennials are expected to be difficult.
A1:
William Maher: Concerns is now. In next 5 years half of NRC expertise will retire. In this cost controlled regime, how to do knowledge transfer is critical. One of the major competitor is solar whose price now is as cheap as gas.
Mike: Companies are struggling with this. In Duke, many expertise are retiring. Going forward can be challenge for the industry.
Andrew: we recognized that is a problem. Digitalization of the knowledge base can help to reduce gap.

Q2: How to prepare the next generation for this challenge?
A2:
Senior works with junior engineers. Prepare for the knowledge transfer. Training junior engineers while be aware of the knowledge gap.
William: Young people thinks differently and they are capable of innovation. I like to listen more from them and keep in touch with them.

Q4: What’s the difference between the LR and SLR?
A4: William Maher: Format of the application is significantly different. Before is all paper and now are all electronics.

Q5: How to handle modifications in plants? How to convince NRC the changes are safe?
A5: Eric Oesterle: Create new division with material focus. NRC stays in touch with researchers and labs to keep engagement into those new researches and projects, to know how they can impact SLR, and how to treat and inspect them. Optimize the organization to address these challenges and create a comfort zone to review these issues.

Session 5: Risk Informed Decision Making (with Risk Management)

Session Organizer: Greg Krueger *(NEI)*

The incorporation of risk insights and concepts has been a fundamental objective of the NRC since promulgation of the PRA Policy Statement in 1995. The desire for increased use of risk insights has spurred a number of NRC and industry initiatives to better define risk informed decision making (RIDM) in the regulatory process. The goal of RIDM is to incorporate risk insights to accelerate implementation of a risk informed framework focusing activities and resources commensurate with the safety significance of an issue. Key topics will explore improved regulatory reviews of existing risk-informed licensing applications, incorporation of risk principles in traditional deterministic applications, incorporation of the improved understanding of the margin to NRC safety goals, and a focus on the use of risk insights rather than PRA models and numerical results.

Insights on Risk Margins at Nuclear Power Plants

Kelli Voelsing *(EPRI)*

- On the insights of margin, EPRI published the white paper which is made to public on May, 2018.
- By utilizing previous EPRI and NRC works, the paper provides technical bases. Significantly more margin than previous expected.

- The EPRI white paper does not address the existed margin.
- At the time of safety goals were established, the goals have margins with very few PRA results available.
- There is significant evolution in severe accidental analysis since (1985).
- SOARCA study shows that even being conservative, additional margin still exists.
- Similar conclusions are acquired from Post-Fukushima studies.
- The attendees are encouraged to take a look at the EPRI white paper. The margin is still wide.
- Plant populations sensitive study are looked by the EPRI white paper.

Consideration of Margin in Risk-Informed Decision-Making

Greg Krueger *(NEI)*

- Focus on details of the models as an engineer.
- Risk insights can be used to provide alternate and confirmatory perspectives in support of regulatory and operational decision-making.
- Risk insights are more than quantitative numbers.
- RIDM is great, but we have not fully embraced it. The difficulties lie in many aspects. The understanding of the risk tools is still limited.
- The current regulatory framework and QHOs should be reevaluated, as these framework and guidelines are developed with limited data and experience.
- The improvement and RIDM can have many potential benefits including better focusing resources on issues commensurate with their importance.

Increasing the Use of Risk-Informed Decision Making

Mike Franovich *(US NRC)*

- Need have an environment and culture for implementing the RIDM.
- NRC developed cross-cutting strategies to overcome challenges.
- A RIDM action plane implements strategies are developed with eight specific tasks.
- Phase 1 of the RIDM action plan is complete on January. 10% officers are involved for this.
- Different division leaders are responsible for different tasks for licensing review actions. The RIDM action plan supports the use of integrated teams in licensing reviewing.
- NRC provide pilot training course for leadership. 50 NRC mangers participate. This training aims to broaden use and recognition of RIDM and demonstrate its capability.
- Transformation initiative recognizes the importance of Risk and safety insights. A dedicated team is working on identifying the potential transformations to NRC regulatory framework, infrastructure and culture.
- The revisions to the NRC Risk-Informed Steering Committees are underway.
- It will risk your reputation if you don't' get the program right.

Risk Informed Decision Making Utility Perspective

Joe Donahue *(Duke Energy)*

- Joe Donahue has 34 years' experience in energy industry.
- Being the last speaker, he will pull out insights from previous speakers.
- The RIDM used in site operations on many aspects: control plant risk during maintenance, outage plan status risk, application of 10 CFR50.96, plant modification etc.
- RIDM is not just tool. It can be used in everyday decision. We can learn from outside Nuclear industry for RIDM insights.
- Changes in tech spec surveillance frequency
- 10 CFR50.69 help go forward.
- The consideration of environment risk is also important, not only personnel safety, operation safety.
- Keep good list of plant modifications.
- Learn outside of nuclear industry to see how risk insights are applied in daily life and other industries.
- Improve work process to reduce duration of the exposure.

Q&A / Discussion

Q1: Risk Informed is all about nuclear, has anyone applied RIDM to maintenance activities not necessarily associated with nuclear related activities (maintenance of pumps, terry turbines, etc.)?
A1: Pre-determined set of evolutions with additional management oversight. Falls into PJB discussion. Apply lessons learned from across fleet shared to determine best way to implement. Document on integrated risk management that covers a broader scope of risk.

Q2: Can you give a sense of what is being done to mitigate the stall in RIDM in the NRC?
A2: The agency does see some Knowledge Management challenges when people leave the agency and there's no turnover, potentially cause a step back in the initiative. Had a diverse group of people come in for NRC training to teach non-PRA managers, etc. about PRA and RIDM. Some of those who left the PRA RIDM group are still in the NRC and the current group has access to some who are still in the agency and have that history. Bring those senior advisers in to bridge the gaps in the development of increasing the use of RIDM in NRC.

Q3: Deterministic organizations are not receptive to risk – in industry, PRA staff focusing on quality, but once everything with the model is finalized through peer reviews, etc., NRC staff is still asking questions relating to quality, and it seems that this is because they don't fully understand the regulations relating to PRA quality. Is that something the NRC is aware of?
A3: It is agency policy for phased approach to PRA quality. Not doing as much review of the models, more of a process, focused mostly on documentation and closure process. Need to figure out what questions do we not need to ask in the future. Valid observation and efforts are being made to fix that. Still will sample to ensure that outputs look reasonable.

Working on the culture to improve on RIDM and other risk initiatives. Ops departments really buying in to 50.69. Need senior leadership to buy in as well. Putting training together for non-PRA personnel at sites, training for NRC may help with initiatives across the fleet.

How do we capture this resident knowledge and transfer it to the next generation? Transfer into a technology based culture in a way that everyone can follow and understand. There are efforts going on with NEI, ANS, and others, and DOE and start looking at this transformative issue to a technology based culture.

Session 6: Let's Get Down to Business (see Business and Economic Performance)

Maintenance and Work Management

Session 1: INPO Review of 2017 & 2018 Trends in Work Management and Maintenance

Session Organizers: Jon Anderson *(ACA)*, Pete Arthur *(INPO)*

This session starts with a presentation by INPO on the current trends in performance. The session then opens to a discussion of what is working and not working by plant personnel in the areas discussed by INPO. Participants will take away from this session a deep understanding of industry performance in general and specific information and contact personnel they can talk to about what is working and what is not working in the areas discussed by INPO.

2018 MAWM Performance Update

INPO Presentations available on INPO Website around September

Pete Arthur *(INPO),* Bryant Hearne *(INPO)*

Session Notes

- IPSR Ratings used by INPO to communicate department and station Maintenance performance to the sites (E – Exemplary, S – Strong, A – Acceptable, M – Marginal + trajectories for all – increasing, stable, declining)
- Heat Map: Maintenance at 74% (improving) – was at 60% prior to focus on Maintenance Fundamentals; Maintenance is lowest area
- Maintenance Areas for Improvement (AFIs) for 2018 trending to be close to 2017 values overall; Supervisory Oversight and Work Instructions values are up. While number of 2018 AFIs have been down, the inputs and practices piece of the data is up. Supplemental work/worker AFIs are also trended.
- Positive Recognition (included as a result of feedback from previous year) – Craft ownership & industrial safety are up.
- 2Q2018 Consequential Events reporting value appears low – is a lagging reporting metric. Expected to end up around 6.00 when all data for 12 month rolling average is collected. 2018 Goal is to be at 5.00. Goals exist for each year through 2023. Progress is being made to meet that goal.
- Maintenance Simplified Index is being revised.
- WM IPSR ratings – The difference between the various E/S/M/A ratings are often based on a single indicator or event. They're very close together.
- WM Heat Map – doing well, but don't get complacent. Ensure strict compliance with rules – that's how WM got to the point of having positive performance.
- In 2017 at UWC, only had 1 WM AFI to report. This triggered a deep dive to be very critical. Does the site and site management understand the work management process the way that the WM gurus do? Are we, as an industry, being appropriately self-critical? We are seeing this across all organizations and are working to make sure that AFIs for individual areas (WM, MA) are appropriate in the individual area or if it should reach a site-level AFI in the OR category.
- The WM and MA Simplified Indices are not working – strong performers are getting in the 70s as weaker performers are getting in the 90s. This doesn't make sense. The Indices should match actual performance and tell the true story. Both being rewritten.

Q&A

Q1: Any correlation to Maintenance involvement with vendors and a potential higher number of "shots on goal" and the Heat Map outcomes?
A1: The metrics are associated with what Maintenance is responsible for, so contractor Maintenance events would apply.

Q2: Example of written instruction deviations AFIs? Skill of the craft apply here?
A2: Would fall under other areas. Written instruction deviations associated with read/do performance of procedures.

Q3: Training impact AFIs – what about this?
A3: Has risen for 2018. IER 17-9 issuance has also increased training focus to ensure 17-9 topics are being taught.

Q4: Not all AFIs are created equal – have these been binned by forward looking or not?
A4: AFIs based on behaviors are forward looking, some are not that correlated. These were not binned this way.

Q5: How many inputs as categorized for each AFI?
A5: 3 or 4; if there were more, it would not be listed here.

Q6: Any insights into what these [consequential events] were and how to deal with the fact that 2 fleets have 52% of consequential events?
A6: We are meeting with the fleets at INPO, trying to figure out what the drivers might be, and working with supplementals to see where they're having issues.

Q7: Are you looking at productivity/efficiency and resource loading for positive recognition data?
A7: INPO did not consider this for Maintenance information slides. More info to come in Work Management discussion.

Q8: Strengths on use of technology positive recognition area?
A8: Mostly related to use of electronic work packages.

Q9: What goes into Maintenance Efficiency in the Maintenance Simplified Index?
A9: 1 input – are you using Minor Maintenance? This metric is based on the number of tasks and how it is being used. Both Maintenance Efficiency and FIN (Fix-It Now) Effectiveness are based in EV.

Q10: What is the basis for Schedule Completion Maintenance Simplified Index?
A10 : Schedule completion is measured by completion during planned work week. Did the work get done or not?

Q11: Rework comments says Level 1, 2, 3. Why is Level 4 not included in Maintenance Simplified Index?
A11: Level 4 is reported through indicator. When revision is issued, won't be reported through indicator monthly, but will be reported to INPO eventually.

Q12: Does Rework in Maintenance Simplified Index include things like parts deficiencies?
A12: Rewrite removes premature component failure. This is all about maintenance performance of activities. If Chemistry or Contractors are performing Maintenance activities, their rework efforts on Maintenance tasks would be included because they are doing Maintenance.

Q13: How are we making sure that all departments that impact Maintenance on the Maintenance Simplified Index getting the training that they need to be effective?
A13: Not specifically considered, but worth communicating to the sites.

Q14: When does new Maintenance Simplified Index go into effect?
A14: March 2019

Q15: Why is Emergent Work included in indices for Maintenance and Work Management?
A15: Both groups can impact through allowing emergent work to be required, to creep in, etc…

Q16: Is there an agreed upon definition of what LCO Execution looks like?
A16: Yes. Maintenance and Ops both own parts of this. Measurement starts on a 12-hour LCO.

Q17: Why are we waiting until March to implement new indices?
A17: Consolidated Data Entry (CDE) update won't occur until March. Bear in mind the level of effort throughout the industry when we make a change to a metric index like this.

Q17: On calculating Simplified Index values – does this include time in schedules built in for contingencies?
A17: If the contingency was not met, the Index value would be impacted. Contingency should be planned alternate paths, not "oh, didn't expect that to happen, let's extend time." If the contingency is on the scheduled with a defined path, then it is a real scheduled item. Consider what the words "investigate" and "inspect" indicate on a schedule – likely mean that something will come up that should be addressed and consider contingency use.

Session 2: How We Are Transforming our Maintenance Organizations

Session Organizers: Jon Anderson *(ACA)*, Bryant Hearne *(INPO)*

One of the more significant initiatives being taken on by the nuclear industry is the transformation of Maintenance organizations. The objective of this initiative is to improve efficiency and effectiveness and reduce the cost of maintaining the plants. In this session we will hear from plants that are piloting this transformation. Participants will take away actions that have been taken, their results and lessons that they can implement in their organization.

Transforming Nuclear for Long Term Competitive Operations

John Boesch (Xcel Energy)

Session Notes

- Benchmarked airlines, automotive industry: Biggest difference is ownership and pride of work
  - Performed airline mechanic observation and interview: No FME controls for engine work, mechanic didn't know what FME was and didn't think that it needed monitoring.
  - Auto industry observation: Large number of (Just In-Time) JIT parts delivery in warehouse, no observable routine, routine based on principles.
- Wind power in Midwest and West is gaining momentum and affecting nuclear viability. Goal to keep nuclear in energy portfolio.
  - Gas prices dropping, and wind are biggest challenges
- 2016 started the focus on efficiency improvements to reduce generating costs
- Xcel developed performance indicators to reduce cost and maintain high standards
- Closing nuclear plants are not cost-competitive, need to drive costs down while keeping standards high
- Typical organization structure today includes:
  - Many low value activities required to complete maintenance work
    - If there is little risk to schedule or risk to plant, then reduce number of people required
    - Increase automation to save planning time
  - Many departments to keep reliability up, each had own mission and own indicators
- Xcel is creating a new organization without the silos mentioned above
  - Combine work management and maintenance
  - eFIN and FIN merged
- Example of possible savings: $36,000 to repair AOV in RCA of "typical" organization
- New organization could reduce cost to $2,600.
  - Same duration for repair
  - Less handoffs
- Summary of the Xcel organization transformation:
  - Streamlined from a business and process perspective
  - Created an agile organization that can quickly adapt
  - Pealed back processes to make them more efficient.
  - $5-6M effort
  - Addition of pride in role with an increase of responsibility
  - Do not assign low value work
  - As risk goes up, you add tools to help (graded approach to risk mitigation)

Q&A

Q1: Is the duration in slide 11 the same between organizations
A1: Yes, but we think it could be reduced due to less handoffs

Q2: Regarding new "generic" organization slide 14, is the structure and level managers typical for all organizations?
A2: This is the GENERIC INPO model, non-union organizations might be different and slide 14 varies by organization, but the organization must have engagement from all of the organization

Q3: What led you down this path to the new organization
A3: Taking advantage of technology that is available
- Remote monitoring
- Observed 25-35% work reduction

Q4: Are the maintenance subject matter experts doing the planning?
A4: Online scheduling department exists
- Component specialist will assist all work on that component
- Component outage schedule will be made by component engineer
- Combining roles will allow headcount to be moved to other roles

Q5: Regarding a component specialist role, have you considered the vulnerability of relying on an engineer who is now also in a leadership role and its effect on efficiency?

A5: Yes, and it was found that 40% of the engineer's time is spent on supervision

Q6: How is the role of component specialist and systems engineer different?
A6:

- Component engineer manages specific items at a site, and has specific areas of influence
- Systems Engineer manages things like value-based maintenance and outage planning, not all classic systems engineering tasks included

Q7: Is there too much accountability at the director level?
A7: The director and other supervisors with a larger role will have to learn how to delegate. The busiest guy in plant will be support manager, he will have to know everything

Q8: Has this new organization been rolled out to craftsmen?
A8: Yes, they are in that structure today. Also discussed high up in nuclear side. Important to understand new organization saves jobs, does not eliminate them

Q9: Who will be interface with INPO
A9: Single point of contact will be a corporate interface with INPO

Q10: How is the effectiveness after one month… and how are you measuring it?
A10: Measuring work and worker efficiency. Found work was reduced by 25% and worker efficiency up to 45%

- Workers take ownership
- Less admin
- Supervisors role to make sure work is up to standards.

Q11: Have you always had >4 managers?
A11: 4 general supervisors, who were transformed to more of an oversite role

Q12: Who in this new organization can take care of backlog of POs?
A12: You'll notice many without a place on the org chart. We will use them as strategic people to work others in the organization

Session 3: Is the Nuclear Promise Delivering on Value Based Maintenance? (see Business and Economic Performance)

Session 4A: INPO Event Report (IER L2-17-09), Maintenance Technical Fundamentals

Session Organizer: Bryant Hearne *(INPO)*

Since January 2015, weaknesses in maintenance technical fundamentals have contributed to 12 reactor scrams, 18 power reductions, and numerous consequential events. Ten outages were affected adversely. Although INPO did not classify these events as significant, operating experience shows that the probability of a significant event remains increased until these weaknesses are corrected.

INPO Presentation

INPO Presentations available on INPO Website around September
Bryant Hearne *(INPO)*

- 10 years of effort on error prevention tools, but not focused on technical portion of job
  - Not a good job of incorporating in training
  - Now developing training on the fundamentals (INPO)
- 10-05 technical conscious of engineers being revised and incorporated in how it applies to maintenance
  - Mostly focused on inspections
  - Rewrite of conduct of maintenance described as a pyramid
- IS number of events has jumped up in 2018
- On average. 15 consequential events attributed to maintenance personnel performance per quarter
- Spring outage season in 2017 had more plants than normal, which probably attributed to the increase in consequential events
- 2017Q2 was when the AR was written, which probably attributed to the decrease in consequential events
- Stations/Fleets should understand what has been submitted to INPO in the IER 17-09 report, even if the report comes from corporate
- INPO monitoring visits are a minimum of 4 days
  - Data should be received 3 weeks in advance for INPO to review before visit
- INPO evaluation visits are a minimum of 2 weeks
- INPO reviews open actions and data for one week before site visits to determine focus of visits
  - How-To document sent out by INPO in January to outline how sites should collect and analyze data **before** visit
- If given a recommendation from 17-09, open a corrective action before INPO leaves the site

IER 17-09 Rec #5 Technical Skills Update

Joe Fiesel *(Exelon)*

- Currently 13 fuel leakers in US plants (5 in Exelon)
- Joe attended FME/Fuel performance class on why there are so many leakers, which covered the following topics
  1. Communication about FME, training on FME for all disciplines
  2. Maintenance practices
  3. Operations
  4. Fuel design – new screens
- Looking for ways to keep Rec #5 fresh, and ways to keep everyone engage during pre-job briefs
- Industry working group for Red #5 needs volunteers
  - Meetings every 2 weeks, but enthusiasm has trailed off

Q&A

Q1: Is it correct to think you work your way up on hierarchy pyramid of Maintenance Excellence?

A1: Yes, if you don't have base knowledge, you will never reach ownership stage. Very few people have all traits. Performance space will have largest learning curve. The reason the pyramid was chosen is because fewer and fewer people have the upper traits.

Q2: Is this an effectiveness measure? Where ownership could be a leading indicator?
A2: Yes, Craftmanship is an example of ownership around that trait.

Q3 Status on technical fundamental AFIs?
A3: If we stay on track for the year, we'll probably have more round mechanical component assembly practices and this is where the problem will be.

Q4: Technical fundamentals AFIs started to be tracked in 2016?
Q5: May of 2017

Q5: Have there been site visits where no technical fundamental AFIs were written?
A5: Yes, 3.

Q6: How many AFI's are supplemental worker related?
A6: No slide or data available today, but available, not overwhelming number

Q7: What is the technical fundamental of building a scaffold
A7: IR was focused on out of service and then back in-service components. Could focus on technical part of building a scaffold, but it's really covering components which can be taken apart and put back together.

Q8: Any operator doing maintenance activities should understand fundamentals around the work.
A8: Example: When Chemistry staff started doing tubing maintenance and saw increase in leaks because they didn't know the fundamentals.

Q9: The number of events should start to reduce the number AFIs
A9: 75% do still have events related (outage extension, outage)

Q10: Do Stations with AFIs get re-sat?
A10: Not necessary, some stations have received RECs with open action items

Q11: What is the threshold of consequential event?
A11: OSHA recordable, loss of time. 9 total types of consequential events. 7 of 9 are supplemental only.

Q12: Why was there a reduction in the number of consequential events?
A12: Plants developed actions immediately and communications came out quickly.

Q13: Have there been visits on supplier support?
A13: Yes, TVA 2 weeks ago had all alliance group in Atlanta which covered 17-09 presentation, showed graphs of supplemental pieces broken out for this group. The company's traveling crew came in because they are supplemental. Great trip, suppliers saw INPO statistics, positive meeting, eye opening for challenges.

Q14: What is the report sent back after a site visit? We haven't seen anything yet?
A14: Evaluation is sent back in package. The status is listed in actual report. The How-To document, observations and recommendations are in overall report. Monitoring IPEC will have a report with gaps, recommendations and conclusions.

Q15: Are these observations from 17-09 classified as an OBE? Or DLA?
A15: Could be an OBE which includes an evaluation piece.

Q16: How do sites submit a revision to their 17-09?
A16: Follow APOC process through INPO admin.

Q17: Is observation data taken at sites?
A17: Most plants do document observations, but not in a formal document.

Q18: If a site doesn't record observation data, but supervisors are coaching on technical behaviors and it's visible to INPO, do plants get credit?
A18: Yes, if INPO sees it in a positive manner.

Q19: What sites to benchmark this 17-09 process?
A19: Harris (non-union) strength in fundamentals, no AFIs. Peach Bottom (union) had no AFIs.

Q20: Is CBT a one-time thing? Are on-site staff required to do it every year?
A20: It's part of tool box for when needed. Not for Exelon internal employees.

Q21: How do you distribute and know that the Precision Maintenance Alert is being received and read?
A21: Staff at site requirement to read and brief must occur after it's emailed out. It's printed and posted in shops. Exelon conducts observations on how briefs are conducted.

Q22: What learnings are featured in the Precision Maintenance Alert?
A22: Prompt issues and rework. The mistake of torqueing a component the wrong way is an example. It's not for observations and only focuses on the maintenance department.

Session 4B: Streamlined Work Management (Status of Implementation)

Session Organizers: Pete Arthur *(INPO)*, John McDonald *(Southern Nuclear)*

Revision 5 to INPO AP-928, Work Online Work Management Process Description includes actions to streamline the Work Management Process. This session will include a discussion of concrete actions being taken by utilities to eliminate inefficiencies and dramatically increase the amount of work being performed on the plant and their results. Participants will take away real life lessons learned they can use in their organizations to streamline their Work Management processes, results of a survey to know exactly what plants have completed for each of the elements in this change and the results of their improvements.

EB 17-20 Streamlined Work Management Process Update

INPO Presentations available on INPO Website around September

John McDonald *(Southern Nuclear),* Pete Arthur *(INPO)*

Session Notes

- John McDonald serves as the industry point of contact for Efficiency Bulletin (EB) 17-20
- The EB started as "efficiencies for improvement" to streamline the work management process industry-wide
  - Executive questions at the start: Why do we keeping touching repetitive work? Why does it take so long to get things fixed?
  - Rev 5 of AP-928 was an offshoot of EB 17-20. Two parts: standard work management process (no major changes) and the simplified process (new)
- The WM has put together a timeline and strategic approach White Paper as a success path.
- AP-928 revision implementation of the simplified process – need to have a detailed cycle plan, well-established FEGs, ability to effective and efficiently automatically generate the required documents for routine work (PM work orders, tagouts, RWPs, parts requests, etc…).
  - Largest challenge (technology, comfort level): automatically generated clearance orders tied to PMs and STs, automatically generator risk reviews
  - How does the process of automating work management reduce the number of required employees in each group? Fewer schedulers, fewer planners?
- Desired outcome: Optimized use of station resources in a cost-conscious manner to ensure that work is performed on the right equipment at the right time. Will be able to have a realistic long-range, resource-loaded work management cycle schedule.
  - FIN team work will be bigger than ever (75% of new incoming work) but will need to be careful to observe FEG boundaries and how to tie work together and divide shop vs FIN team assigned work. Some FIN team work will be scheduled, which is a change from what has been done in the past (eg – work an oil leak in an RHR pump on an 11-week schedule rather that as emergent work when the leak is not impacting RHR pump operability).
  - You cannot plant to rely on a combination of the existing full-blown WM process and a simplified process – you must commit.
- Cycle plan – Phase 1 is a detailed cycle place, Phase 2 is a resource-loaded cycle plan.
  - Contents: detailed, repeating cycle template of work by FEG (12- or 13-week work cycle, protected equipment weeks, resource loading); consider inclusion of outage work to identify long and short outage periods and identify appropriate sequencing.
  - Phase 3 is routine/recurring work for auto generation. This phase consists of getting auto-generated tasks in the right spot at the right planning level with consideration for EB 16-15b (Utilizing Minor Maintenance), EB 16-31 (Pre-Approval Criteria for Execution), WM-2 (PM Generation - Ready to Work), WM-3 (Single Person Tasks)
- Auto-generation gap analysis – what is required to get to the point that auto-generation of work and supporting documents can be performed? Identify so that there are no unnecessary long lead time piece parts in the process. Obstacles could include interface between various platforms. Must complete gap analysis so that executives can be told how to get from point A to point B and what it will cost. Also need to know what the return on investment is.
- Progress to date: No one in the industry has this process up and running. This does not mean that stations are not aligning or gearing up to transition. These sites could be used as a road map benchmark, but not for all-inclusive adoption, at this time. The goal is not to have everyone implement this process, but that sites are better able to execute the Performance Objectives & Criteria, work is getting done, equipment protected, and reliability ensured.
- Transition: First, move to a "shortened" process and then transition to the proposed "simplified process."
  - Be prepared for performance indicators to be out of whack as the calculation is based on the T-week. During the transition, there will be 2 sets of T-weeks for scope selection, scope freeze, and schedule freeze. Critical Scope Survival (and ERI impacted until the Engineering Simplified Index is implemented) will be impacted.
  - When and how to perform check-and-adjust reviews during and after the transition.
  - EB 17-20 Guiderails
    - If the simplified work management process is implemented, monitor critical and noncritical backlog growth, safety system unavailability, equipment reliability and weekly work schedule completion rate for potential adverse consequences.
    - Establish contingency actions, such as a phased elimination or reinstitution of T-week meetings, based on work management performance under the simplified process.
    - Scheduled work management self-assessments should determine the effectiveness of changes implemented from this efficiency bulletin and identify and resolve unintended consequences.

Q&A

Q1: In the simplified WM model, are the PMs issued as reviewed?
A1: They are prepared, ready to go, and automated, but if nothing has changed since the last performance, should be able to issue PMs after quick transition to "ready to work status." No SRO signature obtained at auto-generation time. Could utilize a T-1 "signing party" to get pre-approval for issuance in field.

Q2: How are modifications and plant changes incorporated into this simplified WM process?
A2: Must start early and make the effort to adjust PMs and WOs as appropriate. Changes due to mod implementation should be incorporated during configuration control document closeout for the mod.

Q3: Is the simplified process appropriate for all risk levels of work?
A3: Would need to have a graded approach to risk management to address properly. For example, high risk work might require a longer lead time on reviews and sign offs after the initial automatic generation of work documents.

Q4: Is there any initiative to stop using the PM process for low- or no-value activities (e.g. – taking water bottles to/from the main control room)?
A4: Not specifically in this initiative. You must review work documents periodically (and in the auto-generation process) to ensure that schedule padding "junk" is not consistently included. For example, "fluff" tasks for Ops are things associated with their core job functions (performing shift rounds), but there should be consideration for activities and resource loading for above beyond activities, such as hanging and clearing a tagout.

Q5: What timeline is expected for implementation? 2 years, 5 years, 20 years?
A5: This is a Green bulletin, which means you do not have to implement it. There is executive level buy in and some great economic opportunities with this process. Only a few Red bulletins exist that require implementation (e.g. – common design change, training, CAP). Blue bulletins require a transition period. Green bulletins are optional to the utilities.

Q6: Is it fair to say that this process takes someone out and puts something in its place?
A6: Yes, while it sounds callous and cold, that was the initial approach in beginning this process.

Session 5: What is Behind the INPO Performance Based Evaluations and How Are They Going to Affect Us?

Session Organizers: Peter Arthur *(INPO)*, Bryant Hearne *(INPO)*

INPO, as with other organizations, is taking actions to improve their effectiveness and efficiency. This session will include a discussion of what the new Performance Based Evaluations will look like, the new simplified index, value based evaluations and how these Evaluations will be conducted. Participants will hear from INPO on how this process is supposed to work and utilities that have already been through the new process.

INPO Presentation

INPO Presentations available on INPO Website around September

Peter Arthur *(INPO)*, Bryant Hearne *(INPO)*

Session Notes

- Big change to evaluation process
  - Performance based
  - Graded approach
- Less people on site visit INPO team (Base team = 6)
  - Team members added in proportion to issues found in data analysis conducted before site visit
- Should improve conflicts in INPO team
- AFIs will be only left with the station if it is a true safety issue
- INPO reserves the right to add people to the team when needed (If problems are observed during the first week)
- INPO will use their knowledge of plant data to know if an observation is above the threshold of reporting
- New INPO evaluators will be reviewed later (with a follow-up visit) to make sure INPO agrees that the plant evaluation and ranking are accurate
- INPO probably won't change the plant ranking without an on-site visit
- Independent person presents T-4 analysis to team
- An AFI doesn't necessarily indicate INPO has to visit station
  - Team lead will debrief AFI
- Review of data in T-4 will be communicated with DSPOK
- An observation found during T-4 data analysis will only be included in assessment package if it is strong enough that the team should see
- Top performing plants can expect only an annual INPO visit
- T-4 analysis will determine if there is a site visit

Q&A

Q1: Any change in the number of WANO visitors required for peer reviews?
A1: WANO teams will stay the same size for peer reviews (Required by WANO)

Q2: Risks of smaller team size?
A2: Not enough observation data, example: observing a bad T2 meeting, is it a one off or is it standard? Not enough time working with the craft at site. Won't have input, perspective and expertise from those not on the team.

Q3: When will this start?
A3: Started this spring and have only completed 2 or 3 site visits with the smaller teams. More OE to come next meeting.

Q4: Will the cross functional data requested change?
A4: Data requests will come out earlier now.

Q5: What will happen with peer observation opportunities?
A5: Peer opportunities that were available before, will be reduced. Less opportunities for unqualified peers on team. Should still try to volunteer for teams and put your name in the pool.

Q6: If you're not visiting a station, will there still be an assessment, and if you are "still improving", but analysis of the data shows improvement, how do you get your ranking changed?
A6: If INPO observes these improvements in the remote data assessment, they will schedule a site visit

Q7: When is an AFI from data analysis communicated?
A7: Should be almost immediate.

Q8: How do facts get validated? How can you issue an AFI without verifying?
A8: If AFI is issued, there will be fact validation.

Q9: Traditionally there would have plan of what the INPO team would want to observe, will there still be a plan of what the visit team will want to see?
A9: Yes, but INPO can still opt to go observe teams or evolutions not in the visit plan. INPO will no longer provide a list of gaps to observe during site visit.

Q10: How is the success of the new plan determined?
A10: Every quarter, individual grade vs. what the IPSER rated is reviewed.

Q11: Who will present assessment to site?
A11: Person who does T-4 will present assessment package.

Q12: Will there be trajectory observations?
A12: Included in T-4 process.

Session 6: Mis-position Events and Electrical Safety

Session Organizers: Jon Anderson *(ACA)*, Pete Arthur *(INPO)*

This session will discuss recent emerging industry events around component mis-positions and electrical safety.

Plant Status Control Events

INPO Presentations available on INPO Website around September

Bryant Hearne *(INPO)*

Session Notes

- Some plants have improvement plans created for status control events. Some fleets have identified this trend.
- The majority of plant status control events are made by non-licensed operators. The cause of these events is primarily valve mispositions. 30% occur during performance of work, 21% during restorations. The vast majority are Level 3 events
- Non-licensed operators made the greatest number of mispositions between 2013 – 2017. Major drop off in number of events, followed by Operations Supervisor and I&C Maintenance. I&C errors thought to be caused not by fundamentals errors but rather through procedure use and adherence errors.
- A Level 4 IER to be released on Plant Status Control. INPO discussing on DSPOC phone calls and improvement plans are being reviewed. IER is in the review cycle and is expected out near the end of 3Q 2018. IER number will be issued when IER is approved and released.

Industry Practices

- Observation blitz to reinforce standards. Situational awareness focus was a major contributor to the process. Performance improvements have been seen, but continued effort to observe will be required to maintain standards.
- Ensuring Operations is utilizing manufacturer-installed operating devices.
- New build UAE – number of events have occurred and the schedule has been taken control of by WM. Personnel are being forced to go through the control room and work items only on the schedule
- Hardening of plant components (covers, handles, etc.) has made a major contribution to eliminating mispositions. Commonly bumped areas are specifically protected. The site has implemented a self-check card to help raise worker awareness of how tools, clothes, etc… on their person could cause a bumping misposition event.

Q&A

Q1: Are we considering Operator Fundamental Events just mispositions?
A1: No, the slide titled “Operator Fundamental Events” is just operator fundamental events.

Q2: How does an Operations Supervisor cause a misposition?
A2: The supposed tie is the authorization of a plant evolution that results in a misposition, so they get a piece of the pie. Some utilities allow Operations Supervision to operator components during special tests and surveillances.

Electrical Safety

Bryant Hearne *(INPO)*

Session Notes

- INPO Executive VP Communication to the Industry – March 23, 2018; a number of IERs and worker hospitalizations contributed to issuance of this communication.
- An industry team has been established to develop and issue recommendations.
- IER L2-12-84, Serious Injuries from Arc Flash
- IER L2-14-42, Supplemental Workers Cut an Energized High-Voltage Cable
- IER L2-15-39, Recurring Electrical Shock Hazards
- Actions to the Industry
    - Review electrical safety practices and those of supplies against referenced IERs
    - Prevent injuries by detecting and correcting remaining vulnerabilities
    - Confirm sustainability of existing barriers
    - Assess ”near miss” management culture of reporting heath to address behavior gaps
- International Events – 3 electrical safety fatalities
    - Contractor electrocution during maintenance on an electrical switchboard (220V)
    - Workers were transporting spare parts. Once transport was complete, a worker returned to the room, did not return. The second worker found body in energized switchgear
    - Contractor crew member performing transformer removal/installation
- Electrical safety events are rising - nonconsequential events are down, consequential events are up. Clearance events are down. Contact with live circuit events are up.
    - “Shots on goal” - The drivers for these events are procedure and process adherence, assumptions not validated, no live-dead-live or clearance checks, use of test equipment, and unawareness.
    - Most potential energy events are being detected and prevented by last line of defense activities - live-dead-live checks and walkdowns. 4 possible events were not missed and resulted in an electrical safety event.
    - It is important to understand the clearance purpose, process, and established boundaries. It should not be up to workers performing a live-dead-live check to identify energy within a clearance boundary.

Industry Practices/Shared OE

- Addressing the configuration and electrical standards with a focus on the fundamentals (clearance walkdowns, electrical hazards, right component/train/position). Ops and Maintenance breakout session days of practice with clearances and work practices to enhance proficiency and ensure that supporting procedures and documents are adequate.
- Standards and expectations – getting the culture and behaviors right so that workers are making the right decisions all the time. A lot of events have occurred after work was complete due to poor decision-making. Taking stops and correcting behaviors when it is necessary even if it isn’t convenient.
- Electrician involved in a potential event where supplemental workers were not signed on to the appropriate tagout for a work location/activity took ownership of the error and created a video outlining potential issues and the process to prevent. The video was presented to employees and site management.
- Management performs observation of tagging activities being performed by tagout writers/reviewers. This is a daily task.
- Live-dead-live check performed on both AC and DC power due to an event earlier in year where DC was found in an AC panel. This has also reinforced use of prints and drawings and enhanced proficiency.
- Focus on mindset around working on electrical equipment. It is very rarely appropriate to work on electrical components when they are live. Trying to identify how to move work into windows where the components are dead, even if that means waiting for the whole associated bus to be out of service.
- Training to provide an understanding of ring buses and how they work to supplemental personnel. A specific training course with DLA has been put in place to show workers how ring buses are different and may have more than one feeder.
- As a result of a fatal accident: non-nuclear – worker attempted to remove an item from a cabinet that didn’t belong but was out-of-scope of the work package; worker did not have on appropriate PPE not was on the right clearance and contacted head on high voltage electrical equipment. Good catches are good but use

available processes appropriately to ensure worker protection. Doing the right thing at the wrong time or in the wrong way isn't doing the right thing and may not keep workers safe.

- Electrician received shocked working on an electrical switchgear (4160 V). A seasoned employee questioned if work was allowable – supervisor said if live-dead-live was sat, go ahead and work. This was contrary to what was allowed by procedural guidance. During work under an exceptional tagout (not all energy removed), the employee contacted the energized high side of the feeder breaker and received a shock. The orientation of the employee's body resulted in the energy passing through elbow and hand on the same arm. The individual sustained major injuries but survived and has returned to work.
- It is important to keep seasoned workers proficient, but we must ensure that adequate, robust training is provided to new workers to ensure that the correct habits and practices are cultivated. This is important for supplemental workers as well.
- A lot of the time, issues and events occur not due to lack of initial training, but a lapse in proficiency resulting from limited retraining and in-field activities to reinforce good habits and practices taught during initial training.
- Contractor delivering and using man lift contacted overhead power lines. The same contractor company had the same issue in the previous week and failed to adequately address to prevent recurrence.

Q&A
Q1: Are international events included in the data presented?
A1: No, the data in ICES is domestic event data only.

Session 7: What Others are Doing to Improve Work Management and Maintenance That Are Out of the Box for Us (see Business and Economic Performance)

Operations and Ops Training

Session 1: Reactivity Management Improvements

Session Organizer: Alex McGalliard *(STP)*

Several utilities will provide insights into philosophy and process controls, including changes implemented following assessments and benchmarking aimed at improving industry lagging performance, that have been effective in improving Reactivity Management performance at their sites.

Reactivity Management Improvement (1/3 presentations at this link)

Alec McGalliard *(STP)*

Session Notes

- Fleet average has been improving reactivity management efforts
- Steps to improve performance:
  - Performance of a self-assessment against the standard
  - Follow-up cycle assessments
  - Continually re-evaluate the standard and benchmark the industry
- 70% equipment, 30% human performance is the ratio for hindering the Key Performance Indicator (KPI) (USA specific)
- Site reactivity management oversight committees should own the reactivity management process
- Items sometimes will not be fixed due to cost, and the hit to KPI is unavoidable, but writing this down in a living document and addressing what you are going to do instead is vital.

Key Learnings, Recommendations, and/or Best Practices

- Reactivity management efforts are doable by both fleets and individual plants, regardless of size. The communication is vital between craft and operations. Documenting everything is imperative to success. Even if you aren't going to make the change or repair, address how it will affect your KPI and state other steps you will take, if any.

Q&A

Q1. How did you tackle the 30% of issues that arose from human factors?
A1. First, we made sure we did an investigation on the issue to determine how easy it is to fix. Typically, this results from lack of peer review against the standard, lack of briefing on risk recognition, and lack of follow-up.

Q2. Low-level events can be trended for usage in the future. How does this impact reactor trips?
A2. If you are having plant trips, you are going to do a root cause analysis. I am not worried about fixing those, but I certainly want to prevent them. I am trying to focus on the smaller things that will not rise to the root cause level, but it can harm your KPI, and you have a plan for fixing it.

Q3. How do you successfully use the flags in your database for reactivity management efforts?
A3. If you are going to use that flag, know when to put it on your database, and ensure that the purpose of the flag is known by all, including the craft personnel turning the valves.

Reactivity Management Improvement (2/3 presentations at this link)

Jesse Key *(Southern Nuclear)*

Session Notes

- A mix of human factors and equipment reliability problems are causing the issues in the reactivity management program, with the majority being caused by equipment reliability issues.
- For equipment related Level 4 and 5 events, if you correct them in a 4-month period, you are not penalized for the fix.
- Southern Nuclear Company will take on more of the projects from the vendor and develop a deeper understanding of the faults they are finding from the vendor-supplied items.
- Problems that are encountered are not visible on the control panel but can be found on a testing point, but this wasn't being done.
- Engaging the workers on where the supervisors can do the most good is just as beneficial as the other route of supervisor to workers.
- Moving from the event-based indicator to the consequence/risk-based indicator has down-graded the events, and INPO agrees.

Key Learnings, Recommendations, and/or Best Practices

- The INPO standards can be applied to all parties, and the communication about truly meeting these standards in your living reactivity management document is the best way to get all party buy-in. The ability to have and withstand and equipment reliability event will create solid reasoning in the organization for rapid fixes as they relate to HU events.

Q&A

Q1. Can you address the human performance error and the four-month route for fixing this?
A1. If you have an HU event, this will not be on your record for the one year.

Reactivity Management Improvements (3/3 presentations at this link)

Joy Ramsaywack *(Exelon Corporation)*

Session Notes

- Differences in definition between plants in the same fleet can cause fundamental misunderstandings and different testing requirements between facilities
- Utilization of a test box to run overlapping tests has been able to prevent a number of half-scrams and protect against full scrams

Key Learnings, Recommendations, and/or Best Practices

- Standardizing testing procedures and definitions across fleet facilities is not always readily doable, but with some ingenuity and creation of new system check instruments, this difference can be resolved.
- Every license is different but there is potential for the methodology at Peach Bottom to be applied to a variety of PWR systems without NRC approval (50.59 screening).

Q&A

Q1. Have you had any issues when installing the test box?
A1. If the light remains on, and the test box is taken off, the system will trigger a half-scram. This has been reduced with training with the test box.

Q2. Did you just go through the procedure change process and a 50.59 to use the test box?
A2. The changes to their procedure screened out in the 50.59 process and did not require approval of the NRC.

Session 2: Operator Self Criticality and 4.0 Critiques

Session Organizer: Stephen Harris *(Southern Nuclear)*

Operating Crew continuous learning is a key component of sustained operator performance. The panel will discuss methods for identifying low level performance gaps, improving the self-awareness of Shift Managers and use of 4.0 critiques to drive this behavior.

Self Criticality and 4.0 Critiques

Stephen Harris *(Southern Nuclear),* Ron Gibbs *(STP),* Dan Randolph *(Exelon Corporation)*, Wayne Jarman *(Duke Energy)*

Session Notes

- You don't want to have someone who is newer at it, or doesn't have the standard for excellence built into their day-to-day
- At one year into the new critiquing process, there are still some growing pains associated with switching
- The disagreement between Training and Operations crews is reduced by having the standard of excellence be the critique
- The ground rules are written directly into the training materials that are read before the critique begins
- An overview of the fundamentals is included and used to trend the critique results.
- Only questions not covered in the fundamentals section are including in the leadership and effectiveness questions
- "Quantifying external factors" is very infrequently populated on these critiques
- The Shift Manager learns what they missed when looking at self-criticality for the grade they provided to the worker
- Reframing self-criticality into a positive experience is doable by asking "What would you do differently if you made a mistake?"
- Self-criticality doesn't apply to just individuals but can also apply to the operating philosophy
- Managers are learning from the 4.0 critique how to make changes to operating philosophy
- Training instructors can be used during the outage in leading 4.0 critiques
- Pushing for a teamwork aspect has really arisen from the 4.0 critique process
- Being willing to acknowledge what they do not know by looking for help is an intended consequence of the 4.0 critiques
- Logkeeping would combine some items into one line, which might help identify an operating procedure problem

Key Learnings, Recommendations, and/or Best Practices

- As a leader, nurturing self-criticality by helping the crew is more useful than being the hammer looking for a nail.
- Training personnel and operators to come forward, ask questions, and take the time to be truly self-critical can be a lengthy process, but the benefits from implementing a 4.0 critique program is vital to continuous improvement in operations

Q&A

Q1. Does pre-populating the critique sheet cause problems because the personnel already know the event they are responding to?
A1. The critique sheets were blank sheets initially, and they took a lot of time, and argument. The personnel would only discuss who did what, rather than the true self-critique.

Q2. Have there been any common results from the Leadership questions in the critique?
A2. There have been no commonalities in the leadership effectiveness in the 1-year that Duke has been doing this.

Q3. Is the conduct of simulator training and evaluation only useful for the simulator, or can it also be elsewhere in facility?
A3. This evaluation is used both in the plant and with the simulator

Q4. Do you finalize the gap closure during the critique with detail?
A4. Some items are closed in the critique, while others may go to a gap closure check sheet. This can include the next training segment and it should be populated in the crew notebook

Session 3: New Generation Operators

Session Organizer: Meagan Neydegger *(Southern Nuclear)*

As the industry ages the licensed operator turnover has been significant. Operations Managers are faced with challenges on how to manage this change. This discussion will focus on how to attract and retain the new age operator: What is different with their learning style and technology that makes them successful, How can organizations improve retention of younger talent, What changes need to be made to attract the new generation, How do different management styles impact the new generation compared to previous generations, and What are we as an industry doing to promote operations as a viable, versatile career path?

New Generation Operators

Meagan Nydegger *(Southern Nuclear)*, Dan Randolph *(Exelon Corporation),* Joy Ramsaywack *(Exelon Corporation),* Michael Spellman *(Duke Energy)*

Session Notes

- Megan Nydegger

    - What is your current role? Nuclear Duty Officer at Corporate
    - What was your first job in nuclear? Systems Engineer, Braidwood Generating Station
    - What is next in your career? Back-Up Shift Manager, Hatch Plant
    - What made you choose nuclear? 18 years old and had first internship at Exelon Corporate
    - What do you see changing in the industry in the coming years? Switching from Baby Boomers to Millennials, automating processes, building new systems, building new nuclear in the United States
- Dan Randolph
    - What is your current role? Senior Reactor Operator, Three Mile Island
    - What was your first job in nuclear? Nuclear Navy, 6 years Reactor Operator
    - What is next in your career? Becoming a Shift Supervisor for the Three Mile Island plant
    - What made you choose nuclear? Fell in love with the plant as a whole, how each system effects each other when in the nuclear navy.
    - What do you see changing in the industry in the coming years? Replacing the large plants with smaller plants (SMR's), greater efficiency for plants across the board to make them competitive
- Michael Spellman
    - What is your current role? Shift Supervisor, Harris Nuclear Generating Station
    - What was your first job in nuclear? Nuclear Navy in the 1980's, Worked at a research reactor
    - What is next in your career? N/A
    - What made you choose nuclear? Mike was interested in the funds provided by employment in the nuclear industry
    - What do you see changing in the industry in the coming years? Unsure how the market will change but the new workforce will take the reins
- Joy Ramsaywack
    - What is your current role? Reactor Operator, Peach Bottom Nuclear Generating Station
    - What was your first job in nuclear? Electrical Systems Engineer
    - What is next in your career? Interested in a transfer to Instrumentation & Controls or becoming an SRO at Peach Bottom
    - What made you choose nuclear? Worked in nursing, but changed passions, and still wanted to help save the world and make people's lives better
    - What do you see changing in the industry in the coming years? Implementation of digital systems across the board
- Digital technology implementation in nuclear generating stations can be done by the newest operators
- New generation understands that feedback is part of the process in continuous improvement
- The difficulty of implementing innovation in a nuclear generating station typically stems from the experienced vs. the non-experienced
- The younger generation has been exposed to greater diversity and inclusion their whole lives and is going to be more accepting.
- Climate change is a driving force for many millennials
- Rewarding behavior of individuals who seek to lower dose and make people learn new things is vital
- Generation Nation turns operators in to advocates for the nuclear field and is a useful tool
- Inter-generational teams are actually a massive benefit to every generating station, far more so than having all individuals of one age group over another.

Key Learnings, Recommendations, and/or Best Practices

- Millennials are some of the newest operators but they suffer from a very high turnover. This turnover is related to a lack of clear career progression and clear-concise feedback.
- Perspective and Heuristics is wildly different between the generations, but if both parties are allowed to speak they can reach the common goal
- Climate Change has a massive impact on recruitment efforts for the nuclear industry and it should come up when recruiting operators

Q&A

Q1. What do you mean non-selectees for licensed operators leave?
A1. The non-licensed operators who were not selected to attend license class will leave the facility.

Q2. How can I get people to work shift work on the weekend or at night?
A2. Explain the benefits of the shift work schedule rather than the negatives. You can be on shift for a couple years and look at further opportunities.

Q3. How many companies have their job postings on LinkedIn or some other central website?
A3. Exelon only uses the career site.

Q4. How do you get a recruiter to visit your university?
A4. Recruiters are looking for a large grouping of people that they can bring into the plant.

Q5. How do you convince people to work for the nuclear generating station when reduction of force is a very real possibility?
A5. We can reduce force but it will be a very small amount. If the number of full-time jobs for a nuclear plant drops to 400, that is still more than the 190 for coal, and way more than the 50 for natural gas.

Q6. Has the program for training operators changed over the last 30 years?
A6. It has, but there is always an opening for improvement.

Session 4: Crew Performance Evaluation

Session Organizer: Bruce Hennigan *(Exelon Corporation)*

As the CPE process continues to evolve. Operations Managers must effectively and efficiently implement strategies for success. This discussion will center around the changes to the process and the best strategies for making the crew's successful.

CPE

Bruce Hennigan (Exelon Corporation), Dan Randolph (Exelon Corporation), Gregg Ludlam (Entergy), Ron Gibbs (STP), George Pickar (Southern Nuclear)

Session Notes

- Continually updating the Crew Performance Evaluations (CPE) just keeps making the process a new one, but this isn't a bad thing

- AFI = Area For Improvement
- When Revision 16 came out, a more common scenario was implemented including an Out of the Box scenario
- Other scenarios were dropped in Revision 16 including the JPM's
- Training can be commended for the work that is done by the operators, however, what training is going on to either benefit or be a detriment to performance of Crew
- Make sure the supervisor is present and owns what is going on in both CPE's and training
- If you write it, the INPO evaluator will grade your Crew on it
- If you have your Crew validate for your criteria, then you can have a better overall product
- The operations director or shift supervisors will have facts from the critique, so they need to be ready to review and receive feedback
- Starting off with nearly impossible scenarios can lead to problems which won't present themselves until a CPE
- Stick to the R & O columns, rather than all the extra stuff to avoid an AFI for Operations
- Write an ILT scenario and if you send it to the regulator and they immediately accept it than you are in trouble
- Make the scenario realistic for these operators, rather than unrealistic
- CPE was expected to fall in a skip-week or non-training week, but new lessons-learned state that it should be in the second to last week of the cycle, i.e. a cycle training week, or week 4 in a facility's 5 week cycle
- Don't shake up the mix of each of these crews right before INPO evaluator shows up
- Training observations are not deal-breakers, but field operations are a very narrow window that deals directly with performance improvement.
- The INPO evaluator looking at field operations will evaluate some of the following: Is there spots where crew briefs can be improved, or 4.0 critiques can be implemented.
- Many folks want to be observers at the initial CPE's for either Beaver Valley or Diablo Canyon, specifically in the field operations CPE
- The specifics for the scenario are in Appendix C of the newest OSDI 3 with 8 pages of specifics including distractors, and direct communication in the simulator rather than communication cards
- Writing an initial scenario that meets the attributes in the scenario guide is good starting point, from which the INPO evaluator may bring the scenario up to meet their standard for evaluation.
- You need to have the material for 2 years ahead, ready to prepare the validation crews and working crews for the INPO evaluation and input the year ahead of the scheduled CPE
- On the CPE team, there will be a training evaluator
- The off-the-shelf scenario can't have been used in the previous 12-months
- There is a struggle (even weakness) with citing methods for closing the gaps shown in crew performance notebooks each week
- When looking back at the training exercise, it is okay to state that the crew is going to work on it, but how are they going to fix it?
- Always ask the crew if any additional gaps were identified since their last training, so these can be addressed now rather than waiting for the next cycle
- It is worthwhile to spend some time on developing and certifying a new critical task ahead of time for the INPO evaluation

Key Learnings, Recommendations, and/or Best Practices

- The newest revision of the OSDI 3 has some differences which are imperative to understand in creating a scenario for a CPE
- In building your scenario, ensure that attributes in Appendix C are all met, but also be prepared for the INPO evaluator to bring the scenario up to a level they want to evaluate
- Training observations can be a wide-ranging suggestion from the INPO evaluator, but field observations are very specific and must be addressed with gap analysis

Q&A

Q1. Validation Crews move more smoothly then the Crew performing the CPE, so how do you add that realism for the Validation Crew?
A1. The Validation and Operations folks can pull lessons learned for the new crews, but a direct solution is to push the validation crew harder than would be expected for the CPE crew.

Q2. For a for-credit scenario, where do you place the two people who are displaced on the mixed group to make room for the ACTIVE staff?
A2. Either you can bring them in on overtime, or if it is dual-unit plant, they can be moved to the other side,

Q3. How do you document surveillance that might be performed with training instructors, but that does not fit into your long-range training plan?
A3. Even though there are no objectives associated with this informal training, documenting what was done with pre-approved objectives can still allow free-form training and can count the training towards the technical training requirement for the crew.

Session 5: INPO IER 17-005 Line of Sight to the Core and Improved Operator Performance

Session Organizer: Stephen Harris *(Southern Nuclear)*

Operator performance has been cyclical with downturns occurring approximately every six years. Previous improvement efforts have not achieved sustainable results. IER 17-005 addresses seven key contributors to this continuing trend. The panel will discuss implementation strategies for the following recommendations and evidence of performance improvement.
Recommendation 1 - Improve Leadership and Crew Teamwork
Recommendation 4 - Recognize and Mitigate Proficiency Shortfalls
Recommendation 5 - Improve Operator Training
Recommendation 6 – Promote understanding of Procedures Important to Protecting the Core

IER 17-005

Stephen Harris (Southern Nuclear), Bill Stucker (Wolf Creek), Sara Lange (Ameren), Jon Austin (Southern Nuclear), Dan Randolph (Exelon Corporation)

Session Notes

- If you have an example at your site over the last year, where operators took the right steps, then the vice-president or other individual should communicate with the operations crew and station as a whole to let them know how their success related to IER 17-005
- Leadership plans can align with the goal established in IER 17-005, and should
- Alarm response procedures are some of the most easily modified using the IER
- Using the IER reduces the uncertainty between training and operators

- INPO has performance standards set forward with the usage of the IER
- Decreasing uncertainty on what a failed indication is means testing other systems to ensure all other systems are responding normally
- What can training better do for operators to allow them to grow, and not feel like they are just going through the motions
- The 5 liaisons from the five crews come together to focus on the big 3 fundamental codes or issues
- If you only pick your top simulator team for forming training standards, then you miss the opportunity to see more feedback from the crews and build on strengths of crewmembers other than plant response (command and control, regulatory standards, etc.)
- Using the Evaluation Guide, what was sent to INPO, Corrective Action Program results, and what ended up being done to fix the deficiency (wreck)
- Tracking the instructors is just as vital and tracking the operators. This means plotting their performance and addressing issues or commending actions
- A systematic approach to training says that 14 of the requirements in the IER (Requirement 6) are not required, but INPO says that is an unsound approach.
- Using a SAT systematic program for training will not meet the IER
- When INPO operations has a document which comes out, then the training program at INPO is consulted, and this 2-year program is thus pushing training at these facilities into a hole.
- Requirement 6 is not just due every 2 years, but it specifies not to exceed 2 years. This implies that based off performance you must be performing the training on a specific interval.
- The Southern standards of conduct procedure, states that the crew notebook should be consulted for any changes in personnel on shift (reconstitutes as well). This discussion should involve everyone on shift, including leadership and management.

Key Learnings, Recommendations, and/or Best Practices

- Meeting the IER standard for improved line of site has a variety of requirements but both requirement 2 and 6 are imperative to success for the group.

Q&A

Q1. Does the instructor also have a crew notebook? Does the operators and instructors have a conversation where they address each other?
A1. Yes, specifically in Southern, we do this as our interpretation of the IER, which suggest crew notebooks for both training and operations.

Session 6: Innovative Use of Simulator Training

Session Organizer: Darren Stiles *(Southern Nuclear)*

Innovative simulator training heightens operator engagement and allows stations to more directly focus their training on desired outcomes. Creative training solutions provide memorable and impactful experiences for operating crews. This panel will focus on innovative ways to challenge operators and improve operator performance.

Innovative use of the simulator

Darren Stiles *(Southern Nuclear),* Bruce Hennigan *(Exelon Corporation),* Bill Stucker *(Wolf Creek)*, Sara Lange *(Ameren)*

Session Notes

- Problems in the simulator will apply and cause problems in the plant
- If I follow my procedures, then I will be successful in the plant
- Perfect practice states that you can't leave the simulator until you have completed the task completely perfect
- 4.0 critiques typically start at 4, when an incident happens it drops to 3 regardless of severity. When you are looking at major events, no 2's or 1's commonly exist
- The workers will start at 0 and work their way up to a 4.0
- Starting with the key objectives allows the members to know their tasks before beginning simulator training
- Back-to-basics helps the operators to practice simple concepts to get the crews and instructors comfortable with the set-up
- Simulators can allow you to backtrack, freeze, or reperform
- There is an instructor in the classroom, who communicates with an equipment operator to make sure they know the communication methods and implementation for emergency procedures
- The shift managers love these emergency simulations because it allows them to practice with their crew, and equipment operators get to practice in plant evolutions
- The glass-top where you are able bring up the instructor station and turn valves, and put in malfunctions is useful to all
- The individuals can call out from the simulator and into the control room to better integrate the crew with the operators
- A non-licensed operator is the communicator because they can see what the crew has to see in communications
- The initial previous processes use to evaluate and critique every training session, rather than looking at them as learning station
- The freedom in the simulator needs to happen, where mistakes are pointed out before they happen, rather than waiting for one hour where they fail inside the simulator
-

Key Learnings, Recommendations, and/or Best Practices

- To get the most out of simulator training, trainers and operators need to work together to identify gaps and learn how issues in the simulator can be even bigger problems in the plant

Q&A

Q1. Have you found that having the trainers take a "time-out" during training of operators caused problems?
A1. As of now, more operators are requesting timeouts than any trainer is. They have been supportive of this.

Q2. Will Crew Failures be okay with doing additional training?
A2. Remediation Training can happen throughout the week, since the primary out-of-the-box scenario happens on Monday.

Q3. Does the crew grade themselves or does the instructors still provide the grades?
A3. If the crew identifies the gaps and are being self-critical, then the scores they provide for themselves is compared with the trainers scores. If they agree, then work will continue.

Q4. How do you decide the difference between critique and failure events?
A4. If you don't achieve a critical task, that is license for instant failure. If you do achieve critical task but miss something else, it becomes a critique.

Q5. Is anyone using the simulator for I&C engineers, electricians, mechanics?
A5. As of right now, it is a possibility, and it has occurred several times, but not consistent due to the other needs for the simulators

Session 7: Improving Shift Manager and STA Oversight

Session Organizer: Wayne Jarman *(Duke Energy)*

Shift Managers and STAs are continuing to be challenged to provide oversight and stay in role. The panel will discuss insights and practices to drive Leadership and Teamwork behaviors of Shift Managers and STAs.

Improving Shift Manager and STA Oversight

Matthew Norris *(Southern Nuclear)*

Session Notes

- Good oversight for crew deal with standards, behavior, and self-criticality
- A good supervisor is able to steer the crew in a correct direction and grease the wheels when needed
- Too often, the Shift Technical Advisor (STA) or Shift Manager (SM) is telling a Reactor Operator (RO) stop one task to take on a more trivial task or evaluate a parameter
- At times, the Control Room Supervisor (CRS) has had to step up and ask who will take oversight for a critical system (STA or Shift Manager), which is a part of clear communication in excellent oversight
- Feedback on performance for the crew is just as useful for positive as delta situations
- The oversight requires the leaders to know their crews, and know what excellence in operations is for each individual
- Variances can sometimes can be considered or can become deviations if they are left alone
- At times, the STA will not be in the control room, but shouldn't happen until after the SM and STA are in agreement about release
- Enhanced Crew Oversight can have both pre and post trip, or can have more of a focus on critical safety functions or system
- The STA has a continuous monitoring responsibility for the overview trees of each of the critical safety levels
- Monitoring frequency hasn't been set in stone, because there are positives and deltas which exist for both stances
- Most of the new initial license trainees (ILT's) don't understand the reasoning for the oversight model

Key Learnings, Recommendations, and/or Best Practices

- Being clear about roles in an oversight setup is an absolute requirement for the STA, Shift Manager, and CRS. With this clarity, the maintenance of oversight is on the forefront of every members mind.
- The expectation for oversight used to be following along with the procedure, but now it has changed to looking forward, monitoring the plant systems, which may be affected by the procedure they are performing.

Q&A

Q1. Is it fair to ask just the STA or Shift Manager to be in direct oversight of other individuals and critical tasks such as the steam plant?
A1. That is pulling double duty with a system, which is critical to both the plant and the public

Q2. Have the oversight excellence principles been incorporated into the simulator setting?
A2. Yes they have, this allows us to groom the best behaviors for oversight in a simulated setting, where stops for assessment are easiest

Q3. Would and STA be able to do peer checks on control board is just work process peer checks?
A3. The STA may do work process peer checks but shouldn't be doing anything on the control board during an emergency condition

Q4. What is your STA vs. Shift Manager training? How are they different?
A4. STA's earn cards, which is approved by the operations staff, without it, they will not earn that spot. Usually ILT will test into STA roles with both a simulator and written exam

Q5. Have you ever had a specific distractor or out-of-the-box system built in to challenge the oversight (STA or SM) in the simulator?
A5. No, we realize they are already being challenged by the situation, and thus haven't added it in

Performance Improvement

Session 1: Improving and Sustaining High Levels of Performance Through Organizational Effectiveness

Session Organizer: Fred Lake *(WD Associates)*

Learn about cultivating a deliberate and strategic focus on leader and team behaviors and actions that inspire the environment of uncompromising high standards needed to rise to the challenges that face our industry today. You will have the opportunity to gain insights from an industry leader about what they learned during development of current industry guidance on organizational effectiveness (OR), how the OR Model can be used to promote leader and team behaviors to achieve and sustain excellence, and how PI tools can be used to enable leaders to make sound decisions to improve and sustain organizational performance.

Improving and Sustaining High Levels of Performance Through Organizational Effectiveness missing presentation

Maria Lacal *(APS)* and Chuck Kharrl *(APS)*

Session Notes

- Palo Verde is the nation's largest power generator.
- ~70% staff turnover in the last decade led to human performance issues.
- Advantages of a single site vs. fleet:
  - Nimble, finger on the pulse, location, tactical and strategic
- Disadvantages of a single site vs. fleet:
  - Shiny object
  - Boiling frog syndrome
  - Tunnel vision
- Sought to change the organization to be more effective in Organizational Effectiveness (designed with a focus on site-wide, long-term strategic drive for excellence) and Performance Improvement (designed with a focus on departmental, tactical continuous improvement).
- Reorged and created new processes to improve and sustain high levels of performance:
  - Cross-functional team approach
  - Improved data stream analysis
  - Early detection / warning signs of decline
  - Sharp focus on leader and team effectiveness
  - Comprehensive picture of plant performance
  - Alignment on innovation solutions
  - Development of current and future leaders
- Created a rotation cross-functional program staffed with high performers, second-level thinkers.
- Results:
  - 2018 overarching priorities – live our standards and control our risks. (Addressed employees not using standards and unclear standards because doing so would reduce risk. As part of "live our standards" implemented quality pre-job briefs, quality 2-minute drills, and robust self-checks. As part of "control our risks" implemented Coworkers Keeper.)
  - Integration of essential outcomes into the daily fabric
  - Corrective Action Program elevation letter
  - Use of innovation, advanced data analytics, and AI applied to equipment reliability, outage work management, low-level condition report trending, and "smart" performance objectives and criteria. (System is called DIANA. Humans have innate biases and machines are unbiased, therefore, using data from machines leads to better decisions and more quickly than humans. Machines show objective data that aligns with what assessors find; site can take action prior to visits.)
  - Organizational effectiveness attributes
  - Leadership Development. (Conducted benchmarking and then created an intense training program for all levels of leadership based on the competencies they need at their respective level, including individual leadership plans and multiple assessments.)

Key Learnings, Recommendations, and/or Best Practices

- Machines produce reliable data because it is objective, continues to "learn," and can access volumes of data to inform decisions.
- Leadership training needs to be tailored to the level of leader.
- Intelligence comes from the machine, wisdom comes from the human, both have a role in achieving an accurate perspective of performance.
- Data and facts help solve trust issues early and drive accountability and alignment.
- It's a financial investment up front, but it does save money in the not-too-far long term.

Q&A

Q1. Do you have anything that you consider to be a leading indicator?
A1. Yes, we are doing some predictive analytics – e.g., ICES, dashboards.

Q2. What metrics are you tracking as a leading indicator?
A2. We don't have that right now.

Q3. Do all levels go through 360s? How receptive have employees been?
A3. The feedback we are getting is overwhelmingly positive. We have gotten a lot of "a-has."

Q4. How much back data were you able to trend?
A4. We had a singular view, but machine learning looks at all the data available that humans would exclude.

Q5. Can you share DIANA with the rest of us?
A5. We are trying.

Q6. All data will have inaccuracies. How do you address that?

A6. The more data you give it, the more accurate it gets.

Q7. Checks and balances, have you found that DIANA says one thing and your gut tells you something else?
A7. Yes, we had an employee who did not attend training and DIANA saw a non-compliance issue, but the leader didn't see the same issue. We used DIANA to help explain the issue.

Q8. We don't have the same structure as Palo Verde. Can we do a similar program?
A8. We brought employees into a rotational program that are matrixed. It took some maturation to get us where we are now. This is working for us because we are not a fleet. The integration of OE and PI tools is working for us.

Session 2: Enhancement of Workers Through 3-D Modeling, Virtual Reality, and Augmented Reality (with Technology and Innovation)

Session Organizers: Fred Lake *(WD Associates)*, Vincent Williams *(Southern Nuclear)*

This session will be a joint panel discussion between Innovation and Technology and Performance Improvement. It's focus will be on how we can train and prepare our workers using VR and AR digital modules. 3D Models mimic actual plant layouts and can expose workers to varying plant locations and train them in a dynamic environment, while eliminating and/or reducing other radiological and safety hazards.

AR in Nuclear - "Ready Now"!

Dan Arczynski *(Index AR Solutions)*

- Augmented reality (AR) is "ready now" for nuclear deployment
- "Super App" is an app built for one utility, that now works well enough to package and sell to rest of industry
- Trainer becomes mentor/ facilitator role with AR with the line between training and doing blurring
- Control group for maintenance productivity test was seasoned workers, test group was new hires, improved productivity 48% over 60 days

Virtual Reality and Simulations

Brian Doubinin *(3DInternet, LLC)*

Session notes:

- 4 months to build facility 2 months to scenes.
- Simulation builds to long term memory. Assume 90-95% information retention.
- 3D files or laser scans used to create models then every component in modeled to where every component can be manipulated
- 4X quicker learning via VR versus standard classroom sessions
- Disadvantages of VR: Height issues, motion sickness, need a spotter for person in VR, single user.

Q&A

Q1. How long does it take to build an environment?
A1. About 4 months to build an environment and 6 weeks to build out the scenarios.

Q2. Do you keep metrics on how many students have used the simulations?
A2. Yes. We have about 20,000 students going through just one simulation.

Q3. Have you used the students for task evaluation?
A3. Yes. For example, we can track all the steps a student does (165 steps)

Q4. Do you build this from scratch?
A4. We model every screw and every piece so they can be interactive. We take CAD, microstation, laser scans, etc. and then create individual pieces.

Q5. Do you see transfer from real world to simulation?
A5. Yes, for example, we have people go through the simulation of a bucket truck to learn if they are afraid of heights or to see how they would react with the feeling of going up. We have also used VR with kids to get them excited about the utility industry.

Exelon's Virtual Reality Initiative

Carl Rytych *(Exelon Generation)*

Session notes:

- Ginna site will be the pilot for modeling an in Virtual Reality (VR)

Q&A

Q1. Have you thought about configuration management?
A1. Yes, we are doing it internally. We will do scanning and then model it from there. We can update the model with any big changes.

Q2. Is there an engineering process for changing and updating models?
A2. No, we don't have that yet.

Q3. Are you able to overlay scaffolding on the model?
A3. Yes, we can do that. We have layers built in and we can modify the base level and add a bit of code to modify. It will save costs so we don't have to recreate everything.

Q4. How long would it take to build one from scratch?
A4. We bought a laser scanner and 360-degree camera which is hooked up to something like a Segway. The laser scanning goes really fast with this device. The 3D modeling takes about 6 months. Total cost is less than $1m.

Q5. Are the laser scans accurate?
A5. Our measurements are accurate to the millimeter.

Q6. Are you using Microstation?
A6. No. I will look into that.

Q7. What cost savings would you put into it?
A7. We do a fair amount of laser scanning, so owning the machine is good for us. For training, we're more efficient because you don't even have to leave your desk. For example, doing training virtually allows you to do a walkdown, even in the winter, and you don't have to have to wait until summer.

Session 3: DNP Initiative Status for the Industry and CAP-002 Lessons Learned (see Executive and Leadership)

Session 4: Aggregate Assessment Working Group Update

Session Organizers: Fred Lake *(WD Associates)*, Reiko Perleberg *(Southern Nuclear)*

Have you ever wondered what the industry stance is on Trending? Is there industry guidance for Trending? Well, look no further, this session will cover the work CAPOG has been doing to do just that. Hear where this initiative is at and where it is going.

Aggregate Assessment

Peg Lucky *(Entergy)*

Session Notes

- Entergy conducted and completed an aggregate assessment.
- Established a working group charter.
- Conducted benchmarking using a questionnaire – hit a 60% response rate.
- Followed up with some benchmarking of peers for further clarification. (Results and findings available in the presentation.)
- The working group received very little data on sites that are "doing things really well."
- Team concerns:
    - A lot of activities and resources being applied with minimum payback to stations
    - What is the percentage of externally identified gaps to excellence (trends)?
    - What is the value of trending?
    - Is a problem statement developed when trending is being conducted?
    - Little to no trending training being provided to resources to understand the variety of methods available for trending tools.
    - Are we working with the right tools, such as electronic methods? Or do we rely on personnel ability?
- INPO 14-004, Conduct of Performance Improvement: Aggregate Assessments of Data Objectives
    - Identify new issues for reviewing performance data in aggregate systematically and cognitively
    - Analysis and actions to fix new issues before more consequential events occur
    - Evaluate the effectiveness of actions taken for previously identified issues/conditions.
- Sub-Committees: Includes training (Palo Verde is starting a pilot), objectives will be:
    - Plant evaluation at Palo Verde, self-identification of potential AFIs
    - Mid-cycle self-assessment at Waterford for identification of trends
    - Plant evaluation at Surry for self-identification of potential AFIs
- Next steps:
    - Issuance of both INPO documents – targeted for September 2018
    - Activities of sub-committees will be to identify additional benchmarking actions for training and electronic methods
    - Determine effectiveness measure to assess trending improvements
    - Develop success measures for industry use, in either indicators or dashboard concept for trending.

Key Learnings, Recommendations, and/or Best Practices

- Collect information electronically to better analyze data.
- Reduce the burden of doing observations.
- Use a targeted approach to interventions (don't spread a response like peanut butter, otherwise you disengage compliant workers).
- Recognize good performance, and sanction poor performance.

Q&A

Q1. How much time is allotted for trending?
A1. It is not measured.

Q2. What can the sites use that don't have DIANA?
A2. Dashboards. Watch what toggles and then ask team members to probe. Monitor what the senior leaders pay attention to at the site.

Q3. How do you trend behaviors, things that lead to consequential events?
A3. Conduct observations. Managers and supervisors need to know what the standards are and hold employees accountable.

Q4. Does Palo Verde document observations?
A4. Yes, they are in DIANA.

Session 5: Industrial Culture and Human Factors

Session Organizer: Kimbel Leffew (CNS – Consolidated Nuclear Security, LLC)

A contemporary challenge of our time is the development of complex and significant technologies intended to improve our performance and ensure safe and highly reliable operation of our facilities. We have the ability to create huge amounts of information, far more than anyone can absorb, that can help us improve operations at our facilities or can confuse and overwhelm our workforce. Organizations must rise to the challenge and ensure effective integration, collaboration, and coordination of these technologies to ensure that human factors, behaviors and proficiency are used to enable maximum performance. Come learn from our panel of experts how to ensure that we use these advances in technologies to improve performance, reliability, safety, quality, productivity in our organizations and to result in improvements in overall organizational culture.

The Post-Event Mindset

Kimbel Leffew *(CNS – Consolidated Nuclear Security, LLC)*

Session Notes

- Pantex is a company that builds and decommissions nuclear bombs.
- Employees had access to bicycles to move around the plant and plastic curtains separated areas. The safety standard was to dismount at the plastic curtains, but it was not followed. An employee had an accident, fell off his bicycle, and died from his head injury.
- Culture is hard to change and takes sustained effort.
- Culture is nested (can be unique to a small team, a department, an organization).
- Perspectives from Schein's Levels of Culture (strong and healthy culture when aligned)
    - What you do (artifacts and behaviors)
    - What you say you are going to do (values and beliefs)
    - What you feel you should do (underlaying assumptions)
- A weak culture has a misalignment on:
    - What you do (artifacts and behaviors)
    - What you say you are going to do (values and beliefs)
    - What you feel you should do (underlaying assumptions)
- The environment creates the culture. To change the culture, change the environment.
- The culture is not the problem, it is a symptom of the problem. Fix the problem. Address the organizational set-up factors.
- When considering an event, change perspective (paradigm shift).
- Change your post-event mindset.
    - Look for weaknesses (not strengths)
- Culture change means "fixing" the human (communication, training, reinforcement).

Key Learnings, Recommendations, and/or Best Practices

- When deciding whether your systems, processes and structures are adequate, look at it from the Post-Event perspective. How will that event be perceived (in retrospect) if something bad happens?
- Spend time digging for weaknesses.
- Take time to learn from every event (don't let it pass by or dismiss it as a one-off).

Human Factors Engineering Pantex's Implementation

Morgan Perryman *(Pantex)* & Lauren Clements *(Pantex)*

Session Notes

- At Pantex, people were offered voluntary training. In 2017, DOE created an order that resulted in a Human Factors group.
- The Human Factors Engineering group is to evaluate all areas of human-system interaction in new and, as needed, existing nuclear weapons processes and provide solutions for human factors concerns in an effort to proactively make improvements in nuclear explosive safety, personnel safety, efficiency, and overall mission success. Key considerations of the Human Factors Engineering group are user-centered design, error minimization and mitigation, and cost effectiveness.
- The group had to change the mindset of employees.
- Human Factors Implementation:
    - Manage human failures by identifying and following-up
    - Implement procedures at error traps (connect the dots between existing procedures and human factors)
    - Training and competency (introduced the Human Factors group and also is educational)
    - Design (early consideration to human factors with regard to ergonomics)
- Human factors integration is a production realization process with 7 phases from (1) conception, (2) Feasibility / Design Definition / Cost Study to (3) Development Engineering, (4) Production Engineering, (5) First Production, (6) Quality Production, and (7) Dismantlement. The first 4 phases can take 15 years.
- Pantex Human Factors Engineering Management Actions match to the 7 phases. (1) Planning and Analysis, (2) Design, (3) Verification and Validation, (4) Implementation and Operation.
- 428 controls are in place on site, accompanied by procedures and training. The group conducts evaluations and has a fresh view that longer-tenured employees do not have (they have gotten used to their way, tools, etc.)

Key Learnings, Recommendations, and/or Best Practices

- The group conducts evaluations and has a fresh view that longer-tenured employees do not have (they have gotten used to their way, tools, etc.)
- Bring in a human factors mindset early.
- An outside perspective is valuable.

Q&A

Q1. Was this work in response to something?
A1. No, there was no particular issue. It was seen as something that should be done.

Q2. How do you address knowledge transfer when the phases take so long?
A2. We document very well. Organize and plan ahead, and also recalibrate along the way.

Q3. Have you considered going to only pictures for procedures?
A3. No. We have pictures for some but not all. We write to a 5th grade level. They have to go step by step. We can't go to all pictures. They have to follow the specific wording.

Think Three Critical Behaviors
Darrel Perkins *(Entergy)*

Session Notes
- Entergy had some safety issues.
- A new leadership team came in and created a Nuclear Excellence Model. It is a stair model (see presentation).
- They have a Prevention / Detection / Correction (PDC) model:
  - Spend about 80% in prevention, and less than 20% time in correction (it's expensive)
  - It was not originally accepted.
- They could not just borrow a model from another plant and plop it into their organization. They knew they needed something that had employee fingerprints on it.
- They solicited feedback and engagement. Launched safety summits that produced plans that were not accepted. It was not until a serious injury that employees finally adopted the plans and committed to act.
- They created a Think Three (critical behaviors) model:
  - Pre-job briefs / Job site review
  - Procedure use and evaluation
  - Verification and Validation
- The sites that didn't implement Think Three had 11 site resets.
- Implementation included a change management plan, communication plan, observations, and reinforcement.
- Use of near miss safety messages and videos (video of peer check did not work in the room).

Key Learnings, Recommendations, and/or Best Practices
- Incorporate employees in the process.
- Conduct cross-functional peer coaching.

Q&A
Q1. Do you have metrics you are using?
A1. No, not yet. We are working on that. We are trying to get away from failure to track clock resets. We are tracking close calls and good catches. We are working to get more data and start trending.

Q2. Have you looked at undoing some things that have always been done at Pantex?
A2. Yes, we are reviewing. We are looking at what can we salvage what exists, so we don't start from ground zero. We are looking at ways to reduce errors in a way that is simple or reduces duplication. Our goal is to never over engineer anything for the engineers.

Session 6: Industry Benchmarking Session
Session Organizers: Fred Lake *(WD Associates)*, Reiko Perleberg *(Southern Nuclear)*

An open forum to ask all the questions of the PI leaders in the industry to get a pulse on what, where, and when, and how your peers are headed. It is a great opportunity to see and hear what everyone is doing around the industry. You will not want to miss it!

Industry Benchmarking - Open Q&A with the Industry's PI Leaders
Kevin Rackley *(TVA)*

Session Notes
- When CAPOG started an open session was always included on the agenda and that continues with this session today.
- Sal (*Duke Energy*): We are trying to figure out the best way to bundle engineering solutions (e.g., we are replacing feed water heaters, digital upgrades) across all 6 sites to centralize the work. I am looking for a way to better handle common designs in one central location.
  - Attendee offered to connect offline.
- Chris (*DC Cook*): I heard there is an efficiency bulletin. Is there a date for implementation?
  - The original efficiency bulletin team was disbanded. CAPOG took it on and issued an efficiency opportunity and it will be published in the NISP format on the INPO website.
- Nick (*Susquehanna*): Has anyone reduced the amount of formal benchmarking requirements?
  - Kevin (*TVA*). NextEra has. TVA has changed requirements.
  - (*Southern*) offered to connect offline. A plan to better train engineers on the OE changes.
- How many plants assign POs to PONC?
  - About half and half.
  - Caitlin (*Diablo Canyon*): We only do that for equipment training. Our cognitive trending aligns closely. We don't see a lot of value in trending all of them. We only use it for engineering or equipment issues.
- Who uses a single-point?
  - Ted: We use an asset suite.
  - Caitlin (*Diablo Canyon*): We use SAP.
  - Palo Verde: We use condition reports.
  - TVA: Maximo, condition reports.
  - Exelon: Same as TVA.
- Do plants allow changes to CARB?
  - Southern: If it was not a CAPER, it does not go to committee. If it was something we want to change, then we go back to CARB. We pursue some older things that don't make sense anymore.
  - TVA: We source note that stuff. Apply critical thinking and same level of review (RCA). We create new condition reports when needed.
- What is the condition report criteria for initiating?
  - Calloway: We are considering allowing people to submit more CRs.
  - You have to almost say that anyone can write a CR.
  - Palo Verde: we had a CR for training-related issues. We gave examples using clear wording on the low-level threshold.
- Does anybody use a different system for CAP v non-CAP?

    - We have different databases. When we do CRs, those migrate to Asset Suite.
    - TVA: ours are in the same system. We had to change some of the rules in the software to make it easier to use.
- Would plants be willing to share how they implemented the procedures related to Delivering the Nuclear Promise?
    - TVA: We send procedures to anyone who asks.
    - Southern: Yes.
- Delivering the Nuclear Promise – what discussions did you hold with management as you were implementing CAP02?
    - TVA: We kept hammering at them. Meetings before, we did with leaders, active oversight, as we were doing it for consistency across sites (like not using multiple checklists for the same information).
    - Southern: The first bad day, people want to go back to their old behavior. We have to change the language. Changing culture and a system as important as CAP takes time and a lot of practice. Workers like the checklists. The senior team hates the checklists.
    - TVA: We are coaching our folks on pre-job briefs with managers. We say if there is a "yes", check you did do a CR. You want to know what the failure scenario was. Have that in mind and then answer the questions.
    - Southern: We give people permission to give 10 causes. It's okay to check "no" and move on. Equipment Reliability workgroup wanted an offramp.
    - Palo Verde: Our engineers are deleting some parts. The form is editable; it is not in the procedure.
    - TVA: We execute the checklist. We try to stop extra work.
    - Southern: The first question should be, "who cares?" you don't need a cause evaluation to go replace a widget.
    - TVA: We were not getting the benefit of the pre-job brief. So, we are working on that. We want to see more light bulbs come on.
    - Southern: We have that problem, particularly at Farley. We are going to try and remove things that don't belong in scope.
    - TVA: We have implemented more checklists to calm down our licensing folks. We developed a checklist to make other departments work with Licensing, so they can't say they didn't have the time.
    - Reg Affairs and Licensing want CAP to do it all for them.
- Human Performance errors, do you document in two places? It seems redundant.
    - Palo Verde: We document in the performance document worksheet. It's slightly modified from the NEI template.
    - Southern: We are implementing the new performance management worksheet this week.
    - TVA: We have not done it yet. Level 2 – we have tried to delete "cause" where possible.
    - Southern: We started calling them checklists, but they are really worksheets.
    - TVA: When we assign a level, it gets business risk assigned.
    - Palo Verde: We do the same thing.
- CR work orders, how are people tracking that?
    - TVA: We have a focus code field. It should keep people from cancelling it through process controls. Maximo allows us to put controls in now. We can query the database and share the information with management. We had hundreds that were 10-12 years old. By today's standards those wouldn't qualify.
    - Entergy: We have a monthly report out that we present. We also track the backlog. We try to clean that list up now.
    - Palo Verde: All of our CRs are assigned a due date on work orders.
    - TVA: The work management process should work.
- How long do you allow for the CR to be screened and an initial action assigned?
    - Southern: 5 working days.
    - TVA: We don't specify.
    - Entergy: Yes. We do have some exceptions.
    - Diablo Canyon: Screen and an owner with 24 hours. We have good compliance and little deviation from that standard.
- What is a quorum for your site MRC?
    - Entergy: 3. I can email the chart.
- What is the timeline for completing a Maintenance Rule qual?
    - Palo Verde: We assign 30 days. We want it sooner. Our engineering org with do an MRFF.
    - TVA: Nothing specified.
    - Diablo: We have 30 days technically, but we do a 2-week check-in. We have a soft milestone. We had had AFIs with our maintenance rule records. First due date is 30 days that is prompted electronically.
- Entergy: Did you see a decline on the assessment program?
    - TVA: We just made the change 6 weeks ago. Too early to tell. We had assessments that didn't match with performance.
    - Entergy: Heads up – you may see a decline. We did.
    - Palo Verde: You need a balanced, real-time picture of performance monitoring. Reliance on old self-assessments should go down. We cut down on them about 4 years ago. We had other tools.
    - Entergy: We were seeing problems on the PMs. We have externals asking why didn't we use assessments to find these?
- Does anybody have actual dollars of cost-savings data related to DNP? Objective data?
    - Palo Verde: Yes, we have an estimate. $2.4M annually based on reduction of 12 staff members (salary and base load). They didn't get fired, they retired.
    - Southern: We can't prove actual cost savings. 90% of our costs are people.
- Does anyone run into problems with how you communicate organizational issues or leader behaviors you are finding to not torque people?
    - Palo Verde: It depends on how receptive they are. We respond when an event occurs, and we have preconceived notions about what caused. We have people work on it for 30 days and the data will not match what the preconceived notion was, then worlds collide. Now, we try to bring those people in early.
    - TVA: We say go look at leadership and teamwork attributes and couch conclusions and CR language in those terms.

Session 7: An Innovative PI Model that Pushes Efficiency While Improving the Results

Session Organizers: Reiko Perleberg *(Southern Nuclear)*, Fred Lake *(WD Associates)*

Is there a Performance Improvement Model that drives the right behaviors, ownership, and accountability? Is there a model that does more with less? Can we still do this and achieve even better results? Well, come to this session and find out…

Moving Fleet Culture from "Correcting" to "Preventing"

Tim Steele *(Southern Nuclear)*

Session Notes

- We are in an extreme situation in our industry. Plants are closing, even top-performing ones. Economic pressures are real.
- We are facing stagnant growth and our efforts to reduce costs (e.g., DNP) are coming back to haunt us.
- 2014: Southern eliminated the observation program, made changes to CAP and PI, and reduced staff in PI.

- 2015-16: CAP-01 initiative and more staff reductions.
- 2017: 90% implementation of CAP-02 initiative
- 2018: business modernization. CNOs have said they don't want to be distracted by DNP. It has shrunk and now the goal is to deliver 3-5 initiatives. DNP has scaled back. In the midst of this, Southern has divested some assets.
- Southern was going to roll out 46 initiatives. Trying to move to more streamlined work, with digitization and more data analysis.
- But, the fleet is not ready for all the changes.
- 2 of 3 operating of plants are in "escalate" and now Corporate is, too. This was a wake-up call and CNO put out a call to action.
- Found Southern had problems in ops, maintenance, and leadership. They did assessments and found problems in PI and OR. Southern wondered if their CAP-02 changes contributed to these declines.
- INPO did not identify any problems with CAP.
- They have not found quality root causes. Still using root cause-like processes in the organization.
- But, determined that CAP-01 and CAP-02 did not cause declines in the plants.
- CNO pulled together multiple recovery teams and conducted assessments. They looked across the fleet, even if not all the plants had the same issues.
- Southern had grown PI into a large organization and that meant that the line did not feel individual ownership of PI. Sentiment was, "We have a PI group who does that."
- Southern had built multiple silos in their fleet. The leadership structure was nit optimal for managing and overseeing the fleet.
- Ops and Maintenance did not work well together.
- DNP compounded the situation because people thought it was just about stop doing stuff, but not that it was about being more effective. The message the organization heard was, "We don't care about performance improvement."
- Southern looked at 1) Call to Action, 2) plant recovery, and 3) sustainability.
    - Established OE and PI to support (clear roles, governance / oversight, best practices, communication plans, partner with HR on annual performance appraisals, change management).
    - Looked for ways to detect and prevent (rather than after the fact review – CAP).
    - Implementation is 75% complete now.
- Leadership and Teamwork Model – didn't adopt the management model at first because Southern had a corporate model, but then saw they needed a model that matched INPO expectations.
- Decided to build a new team that is not the "PI Team" but is more about OR. They built new job descriptions. They had reduced staff through previous efforts related to DNP. Then, they found that they needed high-level employees that are paid well.
- They created a blueprint for what the OR staff will do.
- Did training and provided tools for the line so they could do some of their own PI.
- In every area of PI, looked at what could be streamlined.
- Brought back observations. They made it much easier to use. Turned observations into a less burdensome process.
- Examined all PI processes (benchmarked, defined desired outcomes, created workflows, and added governance).
- All processes have a flow chart.
- Shifted to a Prevent – Detect – Correct (PDC) model. There is gray area in the programs because they could fall under each part of Prevent – Detect – Correct.
- Tied Prevent – Detect – Correct to existing Oz Principle content.
- Communicated the expectation of some kind of self-assessment and learning. Created a PDC learning activity template that is super simple. Improvement happens in little steps. Example: employee found that flammable material was within 50 feet of a transformer that could possibly blow up, and they decided to write that up and they moved the material.
- The learning activities are housed in Maximo. They are coded as non-CAP. Owners and dates are assigned.
- Stressed the importance that actions be bite-sized and not 40 big actions.
- Since April, about 1100 Prevent Detect Correct Learning Activities (PDCLAs) have been completed.
- Put more focus on lower-level resets. Not do the work, but provide more oversight.

Key Learnings, Recommendations, and/or Best Practices

- Remove non-value-add activities.
- Communicate in ways that are tangible.
- Don't worry about the initial quality of the learning activities, just make sure employees know they are being monitored. The quality (valued-added) will eventually improve.
- Automate the reporting feature (who did what, where) and review weekly.

Q&A

Q1. How many INPO loanees are active?
A1. Two.

Q2. Is everybody required to do learning activities?
A2. We don't require any one person to do them, but every department is required to do them every week. They can distribute the work how they decide.

Q3. You pushed work back to the line. How are they absorbing this?
A3. They are not getting more bodies. We hope that our other strategies will change the workload in the line and balance out. We know that the transition will be a challenge. We are going for impact now, but we know there will be complaints – it will be worse before it gets better.

Q4. Are you seeing more than just the minimum in PDCLAs?
A4. Yes.

Q5. What will be the deliverable for the new OR team?
A5. We expect a lot more condition reports. We want them writing tickets. They should call out if people are not doing enough or well enough and then coach.

Q6. Will slides be available?
A6. Yes, on the ANS website within 2 weeks. I will share with the CAPOG today.

Regulatory Relations

Session 1: Digital I&C Upgrade Benefits and Licensing Challenges (see Engineering and Equipment Reliability)

Session 2: Advanced Reactor Designs, Accident Tolerant Fuels, and Licensing Challenges (see Engineering and Equipment Reliability)

Session 3: NRC's Transformation Initiative and Risk Informed Metamorphosis Update

Session Organizer: Jack Grobe *(Exelon Corporation)*

The nuclear industry and the NRC are both challenged to be more effective with fewer resources. In addition, the nuclear fleet is operating at unprecedented levels of safety and reliability and new and novel technologies are being developed to meet future energy demands. The current regulatory framework needs to be refined and enhanced, and additional focus on safety and risk considerations in regulatory decision making is imperative. Transformation is critical to ensuring that the NRC's regulatory framework and organizational culture support adapting to external factors, and to facilitating safe and timely decision-making in a landscape of rapidly evolving technologies. In this session we will focus on the needs for regulatory transformation and discuss the recommendations and next steps emerging from the NRC's Transformation and Risk Informed Metamorphosis Teams.

NRC Transformation

Brian Hollian *(US NRC)*

- I plan to say both good things and bad things in my slides
  - With that being said, a lot of credit is due to the agency and industry because without cooperation we would not be moving forward
- The good piece is that NRC managers got together and came up with brainstorming ideas
- The bad news is that this was when the NRC still had 3 commissioners instead of 5
  - This means they didn't want to take on "too much"
  - It was decided to just take on new technology items
- The NRC has been changing
  - For example, the NRC has increased the amount of time a Diesel can be out of service from 24 hours to 7 days to 10 days to 14 days and now it's out to 30 days
  - We can change. It is slower, but it happens
  - Backfit training is another one

Risk-Informed = Improved Safety + Improved Viability of a Clean Energy Source

Scot Greenlee *(Exelon Corporation)*

- Most of the credit for improved safety initially goes to the NRC, but it have stalled out after Fukushima
- What do we need to do?
  - How many people have read the NEI or NRC documents on transformation?
  - We want to move along with the NRC for advance reactors
- If we give the licensees more ability to submit changes in house through 10 CFR 50.59 instead of submitting LARs to the NRC, more change can be accomplished.
- The NEI document had one main focus of removing white findings
  - Exelon consistently has 2-3 white findings to deal with at any given time.
  - If white findings were gotten rid of, it would be more like 2-3 events per year, which would save so much time and money.
- The other issue is low risk compliance tools, which would really take the teeth out of green findings.
- Doug's done a really good job on a white paper that could help reduce Security staff by 2/3 by tying performance to LERF, not CDF
  - Also makes target sets much narrower
- There was a meeting with the NRC about PRA methods to work on getting to a point that only the public review process can change PRA methods
  - Want to get realism back into fPRA modeling
- If you take one blade of grass, and you try to look at the safety goals for that one blade of grass, you have to look 100 yards away
  - This is what 1E-7 gets you – this is too restrictive
- All we want to do is add 24 hours to TS 3.0.3
  - Either 24 hours to get the equipment back, or 24 hours to get people onsite to shut the unit down
- Exelon was going to fully implement 50.69 at every site, and had all the amendments ready, but it was going to cost $40MM
  - At this time, only Limerick is going to move forward to show the cost savings that can be realized

How Safe is Safe Enough?

Doug True *(Jensen Hughes)*

- The NRC answered the question of how safe is safe enough in 1986.
  - They gave two qualitative health objective statements after three-mile island
  - The NRC further attempted to give a quantitative health objective
- The accidents that we have had, while unfortunate have given untold insight into how an accident can occur, and what the radiological safety implications and consequences of other such accidents could be.

What's In A Transformation

Greg Halnon *(First Energy)*

- There's been good transformations over the years and bad transformations over the years
  - Remember Coca-cola turning into "New Coke"(As an bad transformation example)?

    - Let's just all agree that bad change is not good (I spent a lot of time working on that quote)
- Industry SCRAM rates are just one high-level measure of industry performance. Another is CDF, another is LERF
    - After TMI-2 we learned a tremendous amount about SCRAM rate and how to reduce it
    - NUREG-0544 (1994 was the latest Rev.) is where all abbreviations for SCRAM rate plot are found
- We need to step back and understand what the math and numbers are really trying to tell us
    - The dots are important, but we can't rely on them entirely because when there's so many they can become meaningless
- Let's not spend so much time on a 50 year old design basis. Let's maintain the safe zone and move forward
- Why must we change? The answer comes from First Energy, half of which is bankrupt. This seems obvious

Q&A / Discussion

Q1: Brian, typically you did backfit training to the staff. I personally think the staff in some cases, the more deterministic branches, don't understand what does risk-informed mean. I think they think it's a substitute for adhering to the regulations. Do you agree with that and think that mandatory training to the staff on what does risk-informed really do?
A1: Yes, we're doing that. The backfit training is as good as it was. We think some of these findings has been a result of managers paying closer attention to it, so it's the managers paying closer attention to it, and the regions policing themselves. Besides training, we had a 6 hour management training to give industry examples to the managers really opened their minds. NRC failed a lot on risk-informed amendments. We would send them through after a year with the electrical branch knowing we'll get a shot at this after we get concurrence after a year. We've tried to stop that. We want teams from deterministic and risk-informed together from the beginning

Q2: This is more of a comment (Josh Kaizer, NRC Staff). When I was asked what is the biggest resistance to change, when I gave a speech about transformative change, was the only time I ever saw and heard people in the audience shaking their heads and actually agreeing.
A2: That is a tough thing. What does it mean? It is easier to say no than yes, there's more risk to saying yes. What does the staff really need to review and document to make a finding of reasonable assurance? We're working on cutting out documentation we don't need. We can change things. We've made mistakes, but we can fix them. Also, with all due respect to the staff, before something even gets to the NRC its gone through multiple layers of review. Some people think the SONGS steam generator vibration issues would have been caught by the NRC, but in reality even the agency would not have caught that.

Q3: This is more of a comment than a question: One of the challenges I've had is that many of the people who are studying the health effects of radiation as stated (not increasing cancer risk by x number) is completely wrong because it assumes that every single gamma ray has a cancer risk as opposed to some sort of threshold. I want to put it out there that the health physics society and the American nuclear society are having a joint meeting to talk about the science.
A3: I agree and this is another example of transformative change, and I think the only place that real change could come on that front is from the American nuclear society to change the low dose threshold.

Session 4: Innovative Strategies to Address Intentional Noncompliance

Session Organizer: Jamie Coleman *(Southern Nuclear)*

The key to achieving excellence as a company and maintaining compliance with regulatory commitments is ensuring employees work at the highest levels of performance, trust and integrity every day. That means establishing a culture of personal accountability where employees uphold behavioral expectations, observe behaviors of those around them and report concerns immediately. This session will explore innovative ways to address intentional noncompliance through strategies that engage employees in personal accountability and inspire them to take ownership of their personal performance. Panelists will share how they are responding to recent events at their nuclear facilities that occurred because of willful misconduct. You'll learn about what contributed to the event, how the behaviors impacted plant performance and the innovative strategies that are being implemented to guide the right behaviors and avoid reoccurrence.

Innovative Strategies to Address Intentional Noncompliance

(all session slides at this link, video linked below)

Juan Peralta *(US NRC)*

- NRC enforcement policy is very infrequently changed. It takes a commissioner's order.
- In the reactor oversight process (ROP), risk insights provide a major role.
- In traditional enforcement, PRA does not have as much of a role.
- I personally think sometimes we've gone to the table without actually realizing what type of place we've been in on both sides, and come out spending more time and money than we wanted to.
- I presently think we need to look at Alternative Dispute Resolution (ADR) and take a step back and be more judicious about when we offer ADR
    - Something ADR is offered and accepted when there's not really anything being disputed
    - If we get agreement from the utility that a violation doesn't just pertain to a single site, that is an abnormal circumstance and ADR would be appropriate in that instance

Jamie Coleman *(Southern Nuclear)*

- Video clip for Southern Nuclear Presentation: http://uwckb.ans.org/2018/docs/Conflict_of_Interest_and_Tims_Story.mp4
- This presentation is being given after recommendation of the NRC after a successful pre-decisional enforcement conference.
- The root cause essentially said "willfully falsified rounds". Some cases were deliberate, and some were just negligence.
- We chose to go the route of the pre-decisional enforcement conference because we believe we had a good story to tell
    - We had already taken a whole bunch of positive actions
    - We didn't want to go ADR because of all of the actions we had already taken
- The plant Vogtle event slide shows just how long and how much work goes into ADR process. Plant Vogtle would have just been so much better off to have found and self-identified the issues rather than allowing the NRC to identify them.
- At the end of the day, these were still good people who were still trying to do their best to do their jobs
    - They were trying to prioritize for themselves
    - They wanted to get to the important rooms and figured the ones they were missing were truly just not an issue in comparison to the work they actually needed to do
- If you're out doing operator rounds and everybody's doing them in a certain way, you'll be more likely to do it that way yourself
    - It's similar to speeding down the highway – if everybody's doing it, you'll have much less grief doing it
- In summary, you have to be aware to minimize your rationalizations
    - You have to check what your people are doing

  - There has to be a short distance between an act and a consequence
  - The longer it goes unnoticed, the more egregious it is
  - You have to provide ethical reminders

Ron Gaston *(Entergy)*

- Credit was given by the NRC to Entergy for self-identification after finding similar incidents involving operator rounds to Southern
- Will hopefully include new insights into willful misconduct into future training materials
- I was also involved in this root cause and other root causes that were involved in similar situations
  - Some are still in progress
  - There were a lot of similarities that we learned and what they learned
- People do round corners sometimes
  - If you give them 5 tasks, but they only have room for 3, you're essentially telling them to rationalize what is more important to get done
- We found that doing periodic audits also helped
  - We saw that if people were looking, better choices tended to be made
- We found it also important that whatever causal analysis tools you do are thorough

Q&A / Discussion

Q1: If an individual had a willful regardless of proper procedures and processes at a company are sound, would the NRC go after just the individual instead of the company?
A1: Typically both. The processes are setup such that the company is liable even if the individual acts willfully by themselves.

Q2: Juan, you had indicated situations when ADR would be available but not offered. When would ADR not be offered by the NRC?
A2: When we don't think we would get anything out of it. It is very expensive to go through the process, and sometimes there's nothing extra to get out of it.

Q3: Jamie and Ron, you talked a lot about the negative and needing to enforce certain integrity standards, but in your efforts but did you also look at the same time at the people who truly were trying to do a good thing? For example, an operator that says, "well this system is of low safety significance, so I'm just going to look at it every third round."
A3: One thing we immediately did was walk down the rounds to see things like when new barriers were put up, so the rounds didn't really make sense in the order they were in now, but that's how they were in the electronic log. So we did some work to try to get better human factors. The root cause teams went around and asked a lot of questions especially to the operations folks about how they were supposed to do their rounds, and the order, and the procedures and such, and we found a lot of areas to improve.

Q4: First of all I'd like to compliment the presenters, I thought it was very good. I think one of the things that really came through well that maybe people in the room should think about is "To ADR, or not to ADR, that is the question." We had two examples here and one took the route and the other didn't. There were differences- utility identified and NRC identified. Sometimes ADR can result in years of things you have to do. It doesn't hurt to get outside advice.

Q5: At Duke Energy we did the same review and didn't have any findings, but we did find it very labor intensive to sift through all of the data to figure this out. Are you continuing to do this, and if so, have you made it less labor intensive? Now that you were through the whole thing, did you think you picked the right path of ADR vs. not ADR?
A5: No, we have not made it less labor intensive, but we have continued to track and trend the data. It is labor intensive and time intensive, but for the time being we are still doing it. I think we did pick the right path of ADR since it was NRC identified and we're through it and its gone well.

Session 5: The Committee to Review Generic Requirements and Backfit Experiences

Session Organizer: Darani Reddick *(Exelon Corporation)*

Several reforms to the NRC's backfitting program have been instituted in the past year, including an increased role for the NRC's Committee to Review Generic Requirements (CRGR). This session will discuss the fundamental framework of the backfit rule and provide an update on the recent changes to the backfitting program. This session will also offer key insights from recent licensee backitting experiences, describe ongoing challenges with the backfit rule, and explore potential improvements to the backfitting program. Attendees will refresh their understanding of the backfit rule, and leave the session with practical advice on how to most effectively tackle backfitting issues.

The Committee to Review Generic Requirements and Backfit Experiences: Update on Recent Events

Eric Benner *(US NRC)*

- Up to ~95% of the NRC staff has already taken the new backfit training
  - There are separate modules for people who are in licensing and in regulation
- The NRC staff is currently working on a substantial update to the Management Directive for backfitting

The "Forward-Fit"

Jerry Bonanno *(NEI)*

- Talking about the concept of the "forward fit"
- The most complete articulation of this concept was articulated in a 2010 letter from Steve Burns to NEI
  - The NRC wrote back to a letter from NEI and essentially agreed with NEI's points
- The 1985 rulemaking's preamble is one of the best guidance documents out there
  - There are a lot of good examples in that document to follow
- If you're in an amendment process and you think you're being backfit in the process, you have the right to request a backfit analysis
  - Was ruled on by the NRC
- Backfitting is not retrospecting necessarily, it could be prospective.

Forecasting Potential Challenges in Backfitting Space

Darani Reddick *(Exelon Corporation)*

- Just wrapping up with a few thoughts going forward
- As a critic of the existing process, still agree that the NRC is still working pretty hard to attempt to fix any issues
- What will happen if there's an adequate protection issue that's also a compliance issue?
    - Is the intention of the NRC that adequate protection will always trump compliance?
    - Its unchallengeable – if you get to adequate protection, you will never get to compliance
- Is forward-fit a well-understood rule?
- A lot of the changes that Eric talked about are process-driven
- Most of the guidance that is being implemented, we would agree with, but the guidance is getting very precise and in the details
- It takes a lot of work to access the proper licensing basis documents
    - You really need to do your homework
    - A lot of these bases come down to some very historical licensing basis documents

Backfitting and Inspection: A Licensee's Perspective

Marty Murphy *(Xcel Energy)*

- Inspection in an of itself is just ripe with issues for backfitting
- If you look at the number of issues that come up during inspection, there are just far too many for CRGR to review at all
    - Many are low-level issues, but can still be extremely time-consuming to deal with
- We need a starting point for our inspections
- How do we get to this challenge that we have between licensees and inspectors?
    - This is not intended to point out that it's an inspector issue, it affects the licensee as well
- If you start to understand what can be causing the problems, you can start to think about what things are important to talk about when interacting with the inspectors
    - Just because something's not documented, doesn't mean it wasn't reviewed by the NRC
- The effort that the agency's made is very visible
    - You can tell they've been training their folks
    - There's greater literacy with regards to backfit

Backfitting - Progress and Opportunities

Chris Nolan *(Duke)*

- Duke has six sites in its fleet, 3 sites are newer, and 3 sites are pre-GDC sites
    - At the newer sites, inspections go well, and at the older ones it typically doesn't
    - That doesn't mean there's a safety concern, it just means the older plants' licensing bases are different
- The issue at Oconee really came down to current conditions vs. initial original licensing basis.
- Its very important to get an opportunity to tell your story
    - After presenting to the CRGR, it was noted that this side of the story hasn't been told before
- For these types of decisions, its assumed that the regions will have each other's backs
    - These types of issues are pretty widespread, and all encompassing

Q&A / Discussion

Q1: This backfit issue started with open phase, and to this date we are still being challenged during CDBIs on design basis. You want to talk about putting ourself out of business, it costs a lot of money to do analysis to prove you're meeting your design basis. How long are we going to have to continue to prove this? The same system is reviewed every 2-4 years over and over and over.
A1: When Marty gave his presentation he talked about "reproving the design basis". The issue is the NRC can say things such as "We are the NRC and we can give you violations". This is definitely something that needs to be tackled soon. For example, the cable issue.

Q2: At risk of sounding like an old fart, Eric, Marty used the concept of a presumption of compliance. The plant was design 50 years ago and reviewed 50 years ago and licensed 50 years ago. The presumption is the design from 50 years ago complied. Is that consistent with the NRC's view?
A2: Yes.

Q3: Chris said that they inspect to the standard review plan. Back when I was inspector you spent your preparation week getting familiar with the plant, and now you spend that week inspecting already because the inspector demands you send them all the information even before.
A3: One thing that has come out of dialogue of EQ is the idea that inspectors need to do some homework about what that plant's licensing basis actually is. The inspector should have an obligation to understand the plant's licensing basis before showing up and not just asking generic questions.

Q4: We have inspectors that we send out and they perform inspections, and we have fairly experienced inspectors come out for CDBIs. Where is the NRC leadership? What happens when these inspections have questionable outcomes?
A4: We're doing some things we can: The training is a piece of it. But the feedback is necessary. Your experience is we've made some process, but there's hundreds of inspectors doing certain inspections and asking certain questions all the time, so it's not going to be overnight. It's not to say that we're going to totally shut off what they have, but we'll offer more and better guidance.

Session 6: Incorporating Risk and Safety Insights into the Reactor Oversight Process

Session Organizer: Chris Nolan *(Duke)*

The Reactor Oversight Process (ROP) has proven itself to be an effective tool that incorporates risk insights and has guided the Nuclear Regulatory Commission's (NRCs) inspection and assessment processes for over 15 years. This session will explore ways to further use risk insights and operating experience to drive efficiencies and eliminate redundancy in the program. This session will explore the industries experience with significance determinations and their interface with the RAS Handbook to better understand ways to make risk determinations more efficient. This session will also to provide insights into how we can transform the existing process to eliminate redundancies and provide a greater focus on safety. Refocusing the program on safety behaviors and the performance improvements gained when utilities find and fix their own gaps can provide more balance to the risk determinations that guide the Agencies decision-making.

Incorporating Risk and Safety Insights into the Reactor Oversight Process (regulatory views)

Mike Franovich *(US NRC)*

- If you look at old risk studies circa 1980/1990s, what pops out of the models then and still even today is Station Blackout risk (SBO)
- The classic SBO concerns were raised regarding grid/diesel reliability. Hence, one of the first risk-informed rulings came in regards to SBO out of this.
- Common cause failure modeling is actually incomplete in both tracks, but so far it's the best tool we have. We are looking to make an update to the RASP handbook soon
- If we credit FLEX appropriately, we should see a large decrease in CDF profiles.
- The licensing of these plants is shifting. It becomes more risk-informed.

Use of Risk Tools in Support of the ROP

Greg Krueger *(NEI)*

- Wherever you draw a line (it doesn't have to be 1E-6), but wherever it is there will be results above and below the line
  - 1E-6 is a relatively arbitrary threshold
  - Just because something is just above or just below it doesn't make it any more or less significant
- More and more models and scenarios are being modeled and added together, but the threshold has remained the same
  - More and more models and additional burdens over time are making it easier and easier to go from green to white, while the threshold remains steady
- Scot Greenlee (my boss) happens to talk a lot about fire PRA and getting rid of whites and the like
- All nuclear plants operate today between 1E-6 and 1E-5
  - That's baseline operation, green, not white
  - We're not operating in 1E-7 space, so why are we measuring delta performance in that range, well below where we're operating?

A New World

Greg Halnon *(First Energy)*

- The next presentations will go into more details, but I want to go into some intro details about what transformation is vs. what I am calling heavy pruning
- Are we talking about a transformation such as the SALP, which was a true transformation? I don't think so; I believe this is something on a smaller scale
- We spent a lot of time and resources on these violation findings. We spend way too much time and resources on low significance resources like greens.
- Is there too much emphasis on pushing back on low-risk findings?
- People learn, but the regulations haven't really learned. We've gained a lot of data, but the regulations in some cases are still 40-50 years old that are still spitting out violations
- There's not a site VP around that won't say I want to do better, but we can help by setting the stage for them

Redeeming the White

Marty Murphy *(Xcel)*

- I am not advocating we get rid of white findings. I think they are important for the grading process, and fundamentally changes the process if they're no longer there
- OPA has latitude on whether they require a formal press release for a while. White's are always reported, but you have to wonder why if there's really no reduction in safety margins

Challenges Applying the RASP Handbook in Significance Determinations

Jim Barstow *(Exelon Corp)*

- Right now the way the NRC does the SDP is strictly quantitative
  - The challenge is to convince the regulator to start looking from a qualitative standpoint
- One of the things we talk about for CDF is if you run an SDP is baseline common cause factors and you run again it can be 200-300 times the baseline
- Just in time training is one of our first-line defenses against common cause failure
- An example is we had 5 relief valves. A spring bound up on 2 valves
  - We reset the valves
  - We never tested them again
  - We don't open them back up to test until the cycle is over, otherwise they just sit there if they're unused
  - However, the other 3 valves passed
  - Those valves would have performed their functions
  - This was a **yellow** finding

Treatment of Beyond Design Basis Events in the SDP

Ron Gaston *(Entergy)*

- Most of this discussion will be focused on BDB, SDP elements
- There are some people who believe there shouldn't be any greater than green BDB events
  - I'm not sure if I'm ready to go there yet, but if we do, we should have some good documentation

Q&A / Discussion

Q: I spent a little bit of time with the ROP myself. This group and your thought process, I was very impressed. I remember putting it together and we called ourselves the founding fathers of the ROP. There is an inspection manual chapter that I had my staff put together (a basis document) that may be a good document for you to get your hands on. You asked why we chose 2 whites to start with to advance, one didn't seem enough and three seemed too much. That's all.
A: The reason they chose to aggregate whites was they were concerned for a plant jumping from white to red, so they used the aggregation of two whites as a sort of intermediate point.

Session 7: Solutions for Licensing Risk-Informed Initiatives (RICT, 50.69, TMRE) and Incorporating FLEX into Regulatory Activities (with Risk Management)

Session Organizers: Dave Mannai *(Entergy)*, Bruce Morgan *(EPM)*

This session will discuss the regulatory roadblocks associated with utilization of risk-informed initiatives (RICT, 50.69, TMRE, FLEX) – and how the industry and regulator can arrive at consensus solution for these roadblocks. The session will be less about models and cutsets, and more about how industry can work more efficiently with NRC, to license and use these important initiatives. The session will explore what better licensing strategies can be employed, and understand what's beneath the review delays, the associated NRC questions, and the attendant regulatory concerns. These initiatives are not just needed by industry – providing operational flexibility with no compromise in safety or quality - they represent an improvement in public health and safety. The technical issues in question (methods, common-cause failure, loss of function, PRA model quality) are not insurmountable. This combined session will attempt to better understand this fundamental licensing dilemma and chart potential solutions.

Solutions for Licensing Risk-Informed Initiatives and Incorporating FLEX into Regulatory Activities (regulator views)

Mike Franovich *(NRC)*

- We had a whole session on 50.69 so I won't go into detail, but it's going well
  - We got Limerick out AHEAD of schedule
  - I'm confident that 50.69 is rolling ahead well
  - There are lessons learned though
- We have seen because of the seismic component that the 50.69 reviews are taking a little longer than expected
- I want to mention FLEX for a moment
  - I'm very passionate about FLEX because I think it's a huge untapped resource
  - How do you credit the defense in depth that's now been built in to our models?
    - I would encourage folks to take a look at that when working on mods
  - A few creative types like in OPS might be able to get some margin out of it
- There's a lot of work going on in the risk community, but there's also some good work being made outside of it
  - We can build processes like 805 and 50.69, but if we don't communicate with other, more traditional engineering, we still lose out
  - We need to bridge the gaps
- I've seen too many programs that started in the agency, but we didn't do a good enough job in change management to actually move things along
- In my opinion whenever you have NRC visitors coming to sites that don't know too much about FLEX, do yourself a favor and tour them around, educate them, and show them all you've done
  - Show them your equipment, its reliability, and your defense in depth
  - Show management, regional folks, and headquarters as well
- As I remember it, the original plan was to implement 4B and then 50.69
  - The coordination of submittals is important to timeliness

Improving Risk-Informed Application Review and Implementation

Greg Krueger *(NEI)*

- When risk-informed submittal comes in, review is focused on the tool.
  - The PRA is not the determiner of the results of the NRC review, rather the effectiveness of the tool – this needs to change
- PRA is a confirmatory tool, not a basis.
  - It should not be difficult to ask in License Amendment Request (LAR) for a process change in another application based on the numbers
  - Lots of focus on numbers and models with literal interpretations of the results
  - Learning through seismic alternatives
    - Seismic PRA spends $6-10M and looking at insights – not worth the expenditure because the insights did not identify very many new HSS SSCs
- The PRA is a tool to represent the risk
  - Going beyond the numbers is not recognized

Risk-informed Regulations - Oh what a difference a decade makes!

Andrew Howe *(EPM)*

- We're here to talk about risk-informed applications and risk-informed tech specs
- In the risk-informed TS world we were in our infancy
- In 2007 the NRC encouraged and endorsed peer reviewed risk-informed models because they didn't have the manpower to handle thousands of models themselves
  - The process seemed/seems to work

Industry View of Difficulty in Achieving Efficiencies Using Risk Informed Regulation

Joe Donahue *(Duke Energy)*

- Obviously, the PRA quality is defined by RG 1.200
- I know at Duke facilities, virtually every model is unique to every plant
- Remember, its about the insights, not the exact number
- Our models are based on both internal and external issues
  - Just the standard model runs you $1MM per site
  - You can spend up to $25MM on fire/seismic models
- It's amazing the technology in other industries that are extremely high risk and high cost that cannot have a fire occurring, but we are not those facilities
  - Fire CDF is just not close to realistic (it's too high)
- In summary on my part, and I appreciate Mike and your recommendation of workshops, I do believe if we can get together and have an open discussion with stakeholders, the industry and vendors and stakeholders can get to a good place

- We all have the same goal of protecting the health and safety of the pubic

Tornado Missile Protection Risk Informed Application Challenges

Ken Lowery (Southern)

- I've been working on this with several of you in the room since June 2016
- We're working to put up a Tornado Risk Evaluation Predictor
  - We have several pilot plants that we're working on
- Some of the challenges we've run into is the pilot plants and others have identified non-conformances and the pilots used the TMP model that came up with results ~1E-8
- I want to leave you with an acronym I made up
  - MRAGA
  - **Make Reasonableness Great Again**

Q&A and Discussion

Q For NRC, tactically, how do you enact your vision and measure success?
  A Management challenges – tactically, look at "3 prongs" for strategies moving forward. RIDM action plan is accomplishing a strategic objective but accomplishing it tactically. Requires chronic and constant applied leadership to put out these messages that using RIDM is part of process. NRC uses RIDM as a key facet of the overall objective. Metrics for measuring success – how often are they using the RIDM teams for previous non-RIDM submittals.

Q Key to making substantive change is the first line supervisor. What have you done to engage them at the NRC?
  A Sensitive to amount of burdens on branch chiefs. Pilot course to introduce PRA for the Office of New Reactor Regulation (NRR) and almost all branch chiefs attended. Executive Director gave opening remarks about how important risk approaches were to gaining efficiency as an organization. Imparted the message regarding alignment and the direction the org is moving in and that the branch chiefs are the bridge to the technical staff.

Q Why is it that there is a mistrust of PRA models? What can we do to dispel that myth and get confidence in our models?
  A Supplier response – time to get a new model that is correct and technically correct. Time delays have allowed suppliers to spend more time getting models more accurate and getting the best quality work and inputting that information into the model.
  A When you use the model all the time, the model input needs to match "gut" feeling of other orgs, especially ops. The leadership teams use the model and that brings respect in the model when it is questioned based on valid gut feelings. When something is elevated, that brings more mitigating actions and PJB discussions
  A Within the industry there are a lot of analysts but not a lot of interpreters of the insights. If you understand the insights and why a delta is the way it is, then it allows a discussion to take place. Need to spend more time looking at the basis of the models.
  A Myths about perception that models are only producing numbers but the understanding from outside groups isn't there. Perception is that PRA is only granting relief and bending requirements, but that is not correct. Can help bridge the gaps. Has added to safety in a very positive way. In the development of new methods, that was a volatile time and methods were potentially unorthodox causing some distrust if it doesn't meet gut check reality. We may know how peer reviews are done, and models are becoming more complete, there is another education needed. When there are a lot of uncertainties in models then other groups lose confidence in the model
  A Process works very well. But based on letter from NEI which prompted formation of RISC, complaints about how NRC staff imposing new regulations. Somehow find a way to balance new methods and experience, use RG 1.200 new rev to address
  A TMRE RAIs – 5 orders of magnitude between NRC safety goals and plants. Why are questions necessary that offer no benefit for the small positive change in results? We need to change fundamental review

The risk exists whether you have a model or not – some people lose sight of that. Changing the model doesn't eliminate the risk. It's just a representation.
Residual risk – trying to use that to inform, not to challenge quantitative objective. Get decision makers to understand that this is a representation of the actual risk.
Key driver for GSI-191 was the commission. Door is open for more over-arching policy and guidance about lower level programs, but without their imprint it's difficult for the agency to go alone. Without commission intervention, could have caused non-hypothetical risk to utility workers.
As far as resources, focus on efficiency. Need the right resources on the right things with finite resources. Need to utilize this tool to make a quantum leap in assisting with RIDM.

Risk Management

Session 1: PRA Model Maintenance, Complexity, Speed, and New Methods...Keeping Models Useful

Session Organizer: Owen Scott *(Southern Nuclear)*

As new PRA Standards have been developed and endorsed by NRC, the number (and type) of PRA models for plants have increased. Maintaining those models up to date to reflect the as-built as-operated plant, in support of risk-informed applications, has increased accordingly. Improvements in current processes, planning, and infrastructure are key to managing and maintaining the pedigree of models as well as a robust PRA support organization. As more complete data sources and improved methods become available, decisions on upgrade of the models (along with independent reviews) must be made. Model speed becomes an issue, along with computing power. This session will examine current requirements and drivers for PRA model maintenance, the challenges in keeping those models up to date and useful, and some best practices to meet those challenges with limited resources.

Introduction

Owen Scott *(Southern Nuclear)*

- Monitor PRA inputs and collecting new information
  - Procedures and guidelines
    - What documents and who owns it
  - Pending changes
    - Document everything
    - Use a model maintenance tracking database to track technical details like modeling, data, etc.
- Documentation
  - If it's not documented, how do we know that something was changed?
  - Document everything
  - DocAssist
    - Keep it simple, mobile, and consistent
    - Difficult to set up and get initial formatting but once set up, is a very useful tool that can be updated by anyone
    - Easy to transfer for peer reviews, etc.
    - Terabytes of data
- Moving forward and issues
  - Don't have to be right, just have to document why you did it
  - Must enforce document migration
- Computer codes
  - Updates to software can sometimes bring up challenges, but better software allows for faster reponses
- Applications are driving us to update our models

PRA Model Maintenance

Michael Corbett *(Southern Nuclear)*

- Monitor PRA Inputs and collecting new information
  - Procedures and guidelines
    - What documents and who owns it
  - Pending changes
    - Document everything
    - Use a model maintenance tracking database to track technical details like modeling, data, etc.
  - Documentation
    - If it's not documented, how do we know that something was changed?
    - Document everything
    - DocAssist
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  - Must enforce document migration
- Computer codes
  - Updates to software can sometimes bring up challenges, but better software allows for faster
- Applications are driving us to update our models

PRA Working Models

Glen Lawson *(Duke Energy)*

- Complicated to update and maintain models
  - Just one portion of the model requires several steps and inputs and can take months to collect before the model work begins
  - Massive time and resource requirement
  - Difficult to keep up with plant modifications
  - Outdated models are inadequate to support plant applications
    - Loses time in small updates
- PRA Inputs
  - Data from groups like Ops is being used in the PRA – very important
- Working Models
  - Model between the model of record and need to update it – most updated version
    - Tracks changes of CDF and LERF
    - Able to be revised quicker
  - Once working model reaches a level of change, then the model of record is updated
  - Issues can be partially resolved using a simplified method (like a point estimate)
    - Avoid a formal peer review
    - Appendix for new working model to document changes

  - Documentation
    - Appendix for each working model lists everything regarding the operation of the model
    - Calcs will list official results to ensure consistency when starting new work on it
  - All hazards
    - Must document the status of each model to know what model of record it's based off of
  - Remaining and new issues
    - Misaligned hazards
    - Fire PRA cannot currently be incorporated
    - Documentation carry-over – new engineers with a lot of time (potentially) between updates – results may not come out as expected

PRA Model Update - efficiencies and burden on the backend

Gene Kelly *(Exelon)*

- Facing a lot of challenges in PRA – lots of models, new standards, update vs. upgrade vs. methods
- SDP really challenges model resources including the people
- Models are not built to do the things we're asking them to do now
- Models are large and complex and take a lot of time to run
  - Synchronizing is also an issue between dealing with potential fire, internal events, flooding, etc.
- Documentation is over the top and is a lot to go through
  - Peer review documentation
  - F&O closure
  - System notebooks
- Models become a challenge as far as sequencing and managing across a large fleet
- Have to figure out why we have models
  - Used for number of licensed activities
  - Making decisions in the plants everyday based on this information – but only one part of the decision-making process
  - No such thing as a perfect model
- Keep track of the as-built, as-operated plant
  - Maintain more than one version of a model for various things, including a working model, models for applications, and the "model of record"
  - All models are "living"
  - Burden of documentation
- Strategies for periodic review
- What does the PRA Standard require?
  - Must reflect as-built, as-operated plant but also must meet updates
  - New data, new information
    - Change data as statistical distribution changes
- Update vs. upgrade
- Backend considerations
  - Rollout affects so many programs and groups at plants
  - Many updates aside from the model that need to be reviewed for potential impact
    - MSPI, safety significance, MRule, time critical operator actions, training information
    - List is growing
  - Change management plans to assist with getting everything done and in a timely manner
- 50.69 vs. RICT
  - Still need to meet new regulations
- Ideas for efficiency
  - Still developing ideas on how to improve updates and rollouts
- No such thing as a perfect model
  - Represents reality
  - Human performance considerations give insights on human actions and training
  - Compensate for uncertainty by introducing conservatism – not intended to be bounding, meant to be realistic
    - Tendency in the face of the unknown to do that
- Need to address model speed – practical problems, especially with fire
- Models must remain useful

Q&A and Discussion

Q: What is going to be done for fire models because of their complexity and inability to join with other hazards?
A: It has been done before, but it is a lot of work and has mostly been done in a one top model (so this method would require either already having a one top model or developing a one top model). Also have to figure out what's good enough because of the excess amount of initiating events. Parts are doable but there is still improvement to be made. Also need to look at doing internal hazards and fire being built together – must keep fire (and seismic) engineers updated on any changes to internal hazards model.

Discussion

- New ANS standard revisions may impact how we approach model maintenance and updates
  - Trying to achieve better clarity
  - Standard and RG 1.200 do not currently match, updates to standard hope to

Session 2: New Standard: Methodology, Upgrade versus Update, Impact on Models and Licensees

Session Organizers: Gerry Kindred *(TVA)*, Rick Grantom *(CRG LLC)*

This track consists of presentations focused on the upcoming new edition of the PRA Standard, which is expected to be endorsed by NRC in 2019 via RG 1.200. The scope of the Standard, major changes and the potential impacts on licensees with respect to existing PRA models, applications and future license amendment requests will be discussed. Clarification of the terms 'methodology,' 'PRA maintenance' and 'PRA upgrade' will also be discussed. A panel discussion will provide the audience the opportunity to ask industry experts questions regarding significant changes and potential and expected licensee impacts, as well as clarifications. This track is geared towards PRA practitioners and licensing staff.

The New Edition of the PRA Standard

Gerry Kindred (TVA)

- Design our PRA models to support applications
  - May vary in supporting requirements as far as rigor and robustness
    - Can be interpreted differently depending on the reader and their level of expertise
    - Goal of the new standard is to take out subjectivity and reduce ambiguity and improve clarity
  - Have to figure out what is really needed to support the applications
- Need a new edition of the standard to help achieve a best estimate
  - Monumental task with many volunteers
  - Eliminate CCIII where possible and edit words in remaining CC's
- Major Changes
  - Two capability categories instead of three
    - CCIII has mostly gone away or has been included in CCII
  - Systematic process for how hazards are looked at
    - Will identify and consider secondary hazards
  - Newly developed methods
    - Upgrade vs update may or may not require peer review
    - New methods require focused scope peer review
- Suggestion of change management/transition plan – potentially look at PWROG to look at rollout of standard and how to implement.
- The Standard should address the difference between what constitutes an update vs. an upgrade.

Update vs. Upgrade

Rick Grantom *(CRG LLC)*

- Update
  - Periodic PRA maintenance activity
  - Specific scope
    - Data updates
    - Implemented modifications
    - Procedure changes
  - New edition of PRA Standard should be considered an update by definition of update and upgrade
- Upgrade
  - Substantial change in methodology (technical approaches are changed) across a technical element
  - Same requirements for review as an update plus a focused independent peer review
- Cost impacts
  - Peer reviews are not cheap regardless of type
  - Incorrect or over-designations has financial consequences for utility
- Divergence of opinions
  - PRA engineers may believe something different regarding the same situation.
- Need improved criteria

Acceptability of PRA Models for Regulatory Use

Sunil Weerakkody *(US NRC)*

- NRC will compare PRA model and SPAR models – if results are very different, will start a discussion
- Guidance varies based on the application
  - PRA acceptability consists of 3 elements that have to work together to demonstrate PRA applicability, but all three need to be updated
    - PRA Standard
    - RG 1.200
    - Peer Review (NEI 17-07)
  - Updates need to address Lessons Learned and Emerging Realities
    - Current process requires the regulator to rely very heavily on peer review process, which still have questions related to methods and updates vs upgrades
- The number that comes out of the PRA model is used and relied on to address applications that are subject to additional scrutiny from the NRC
- Internal discussions then expand the discussion with licensees regarding the standard and the NRC's endorsement
  - Expedite alignment on key issues regarding the standard and other documents
- Key: plants are not required to have PRAs. However, when any programs that utilize PRA to assist with decision making process, the PRA is open to scrutiny and the requirements of having a PRA

Q&A and Discussion

Q: For all peer reviews done before the new standard comes out, how do we explain the 3 CC's in the new language?
A: New RG 1.200 will endorse new standard with some exceptions. Licensees will have one year to adjust to new standard. PRAs need to do a gap analysis to ensure CCII is met. CCII won't change too much, so most plants will be "ok". Not combining the current three CC's into two, just eliminating CCIII. Regulator has to be clear about what expectations are for new standard (NRC speaker will take question back to NRC for follow-up)

Q: Is there going to be something agreed upon ahead of time prior to the new standard coming out regarding gap analyses?
A: There are a lot of issues – these need to be answered upfront. When the new edition comes out, all questions should be answered. There will be a review period to ensure that there are no surprises

Q: What is the schedule?
A: Originally scheduled for end of 2018, but now pushed into 2019, but maybe later due to some newly identified issues. Goal is to have a standard that is fully endorsed by the NRC with no exceptions. Look out for RG 1.200 rev. 3 for more clarification on current standard with a public meeting on 9/6 – future revs will address new standard once it comes out.

Q: If insights are changed due to a major modification, would that be considered an update or upgrade?
A: The response is mixed. If a major modification eliminates or greatly reduced CDF, some believe that should be considered an update, but the scale of change may make some consider this an upgrade.

Q: What is the main objective of eliminating CCIII?
A: The cost benefit of going from CCII to CCIII is very little with large effort and financial burden.

Q: What are thoughts on incorporating NUREG issues?
A: It depends on the NUREG coming out. Unless it really helps on identifying improvements or provide some kind of benefit, then it probably isn't a methodology change requiring an upgrade.

Session 3: Using PRA Approaches (Without Models) to Resolve Regulatory and Design Issues

Session Organizers: Anil Julka *(NextEra)*, Bill Webster *(Dominion Energy)*

Risk-informed insights and decision making are being used to ensure that adequate resources are focused on those activities which are most important, thus ensuring nuclear safety is maintained. The nuclear industry has been successfully developing and applying risk-informed solutions to various issues without necessarily using PRA models as the basis. PRA techniques and case-specific risk insights from models have proved to be more cost-effective and timely solutions in certain instances. This session will share how industry is successfully implementing such solutions for questions about BWR Post-LOCA debris potential effects on reactor core cooling, seismic and fire alternative considerations for 10CFR50.69 categorization, risk-informed structural questions, and tornado missile design justifications (i.e. TMRE). A panel discussion will provide the audience the opportunity to ask industry experts questions regarding their experiences with these more efficient and nonetheless rigorous solutions.

BWROG ECCS Suction Strainer Risk Informed Evaluation

Larry Naron *(Exelon Corporation)*

- A couple of events with BWRs that caused clogging/fouling of ECCS suction strainers which caused issues with safety system reliability
  - Initial response to install larger strainers and control of materials in containment to limit what could clog the strainers
  - PWRs were able to evaluate the strainer reliability in a more detailed manner than BWRs
  - NRC issued 12 questions to BWROG to determine risk significance
  - BWROG tried to resolve the questions deterministically – figured out this was very difficult and determined a risk informed approach
    - RG 1.174 – used to evaluate modifications for risk insights
- Risk informed strategy
  - Needed to build an analytical machine, similar to what the PWRs had been using, to evaluate the safety significance and relate that to RG 1.174
    - Could modify the model to simulate other plants to do sensitivities on other types of plants and equipment
  - Apply simplifying conservative assumptions
- Risk informed project plan
  - Determine possibility of the evaluation
  - Pilot multiple types of BWRs
  - Extrapolate insights for BWR fleet
  - Look at vessel internals and fuel
    - Had to evaluate financial cost of risk informed strategy
- Overall Risk insights
  - BWR design is robust
- Project takeaways
  - Risk insights provided unique perspective on industry concern
  - Many groups outside of PRA worked together

Alternative Approaches for Fire and Seismic Considerations in 10CFR50.69

Bill Webster *(Dominion Energy)*

- Insights for internal fire requires either a fire PRA model or FIVE methodology
  - FIVE was not practical, and the plant did not have a fire PRA
  - Alternative was needed
    - Use of Fire safe shutdown method SSEL
- Fire SSEL provides a conservative approach compared to both fire PRA and FIVE
- Seismic Alternative
  - NEI 00-04 requires IPEEE SMA, SPRA risk insights, or SCDF < 1% if internal events CDF
  - Some plants had none of these
  - Does seismic considerations provide unique risk insights to the 50.69 categorization process
- Premise
  - Sensitivity done on plants that were required to develop an SPRA
- 50.69 Trial studies
  - Limited number of components that provided unique insights
- Proposed method recommends 3 approaches
  - Low, Medium, and High
  - Tier 2 (medium)
    - Select system and associated SSCs for 50.69
    - Screen out SSCs in seismic evaluation
    - Walkdowns
    - Use method similar to CCF
      - CCF = 1E-04 or other value to simulate the impact of a failure at the seismic hazard frequency
    - Quantify LOOP/SBLOCA
    - Use NEI 00-04 thresholds to determine HSS SSCs
- Can apply PRA techniques even when there isn't a model
  - Can be used as a short term solution until full models are developed, but sometimes simple is the better solution

Use of PRA Insights in RIDM without RG 1.200 PRA Models

Sunil Weerakkody *(US NRC)*

- PRA models may be used to make technical decisions quantitatively or qualitatively by the NRC
- NRC uses RIDM in a number of areas
  - OE, regulations and guidance, and oversight Relies on PRA info generated by staff
  - Licensing and certification relies on PRA information provided by the licensee
    - When quality improves, NRC efficiency in implementing processes increases

- Multiple tools and processes are used
  - Credit FLEX strategies that would enhance PRA and bring it above violation threshold
  - Calculations done internally to help improve risk significance
- LAR reviews
  - Relies on licensee provided PRA information for type 2 and 3
  - NRC looking at using internal risk insights
- NRC is using PRA insights more than the industry realizes to input to decision-making
  - Promoting use of risk insights at NRC for RIDM
  - NRC has finished phase 1 of RIDM tasks 1 & 3 for license review teams and the development of a graded approach for licensing reviews
  - NRC plans to use PRA models more in decision making processes to be risk informed
- Industry PRA models have improved greatly over the last decade, but not all types of models have been peer reviewed

Tornado Missile Risk Evaluator

John Caves *(Duke Energy)*

- Simplified method using same concepts as high winds PRA to address an old design issue and non-conformant conditions
- TMRE developed by the industry, based on initial evaluation at Calvert Cliffs
  - Does use internal events but not in the same manner as high winds PRA
  - Does not change plant design basis – cannot be used to support not abiding by plant safety analysis
- Strategy
  - Site specific tornado hazard must be determined based on location and NUREG/CR-4461 probabilities for F2-F6
  - Exposed Equipment Failure Probability = # missiles * missile impact parameter * target exposed area * fragility
    - Sites with multiple units that may be separated may need to use different area in calculations
  - Risk Calculation
    - Assume tornadoes cause LOOP and have to determine that no other events are initiated
- Project Status
  - 3 pilots
    - On track for October 2018 approval
    - Implementation potential to use under 50.59 process
      - Current version of methodology may not meet what is needed
    - No peer review required at this time, will know more after safety evaluation

Q&A and Discussion

Utilize a risk informed approach to issues that are potentially plant life-ending or require very pricey modifications.

Session 4: Realizing the Promise of 50.69 Risk Informed Component Categorization (see Engineering and Equipment Reliability)

Session 5: Risk Informed Decision Making (see Executive and Leadership)

Session 6: Extracting and Applying the Insights from Fire PRA Models (see Engineering and Equipment Reliability)

Session 7: Solutions for Licensing Risk-Informed Initiatives (RICT, 50.69, TMRE) and Incorporating FLEX into Regulatory Activities (see Regulatory Relations)

Supply Chain

Session 1: Total Cost of Ownership: How Supply Chain Can Move from Provider to Partner to the Business Unit

Session Organizer: Bill Fry *(Duke Energy)*

"To provide for", that is how Webster's defines "supply". Traditionally, that is exactly what Supply Chain has been, a provider. In this session we will be challenging that notion and focusing on moving from "provider" to "partner" with the business unit. In a provider mentality, the customer is always right. In a partner mentality, partners are champions for the business unit on some days, and challengers other days. But in the end, as a partner, the overall value to the business enterprise is in mind. Specific discussion will include how this partner model and decrease the overall Total Cost of Ownership (TCO) for the enterprise.

Supply Chain Provider to Partner

Mark Teague *(Duke Energy)*

Session Notes

- Business Unit Alignment
  - Need to define common goals between business units and supply chain
  - Co-locate supply chain personnel with business personnel in order to build relationships
  - Establish credibility through experience
  - Build trust through common goals, relationships, and credibility.
- Mobilizing One Supply Chain
  - Consolidate supply chain business units to eliminate common work
- Evaluating Total Cost
  - Initial investment, present value of ongoing cost, present value of efficiency gains, contract strategy, and contract management
- Risk Management
  - Work together with business unit to define enterprise risks and protect against exposure

Key Learnings/Best Practices/Recommendations

- **Key Point -** Supply chain needs a seat at the table early in the process in order to move from a "provider" to a partner role.
- **Insight from Utility (Duke Energy)** - Consider local and diverse vendors with higher scores during bidding process. Considered for both prime and sub-contractors.
- **Insight from Utility (Duke Energy)** – It is important to make an effort to eliminate multiple contracts with same supplier. We were told one of our vendors that "Duke Energy is 7 out of our top 10 customers." We need to work with contract companies to eliminate redundancies. Group contracted jobs by pay grade and not by job title (as an example – one company that Duke Energy used for contract work had over 150 internal job titles, but only 15 pay grades).
- **Recommended Book:**
  Team of Teams: New Rules for Engagement for a Complex World
  General Stanley McChrystal
  https://www.amazon.com/Team-Teams-Rules-Engagement-Complex/dp/1591847486

Q&A/Discussion

Q1 – In your presentation you referenced "de-budgeting" at Duke Energy, can you explain how you were involved in that process?
A1 – Supply chain at Duke Energy was tasked by the CFO to find $30 million of savings that had already been removed from the budget

Q2 – Can you explain Duke Energy's supply chain structure?
A2 – Real estate purchases, fuels purchases and legal services are all procured by separate groups. All other purchases are managed by the supply chain organization. There is some segmentation within the supply chain organization based on business unit, but they all report up through the same executive.

Q3 - How do you handle budget uncertainty? Do you take credit for reducing uncertainty as supply chain cost savings?
A3 - Make sure to treat estimates as estimates (estimates can be bad to begin with). We only count as supply chain savings if supply chain provided added value to contribute to the cost savings (beyond "three bids and a buy"). Supply chain has the expertise to bring additional companies to the bid beyond what is requested by the business unit.

Session 2: Right Contract; Right Project; Right Time

Session Organizer: Bill Fry *(Duke Energy)*

What exposure are you opening yourself up to by using a T&M model instead of a cost plus model? Are you leaving resources on the table by going fixed price instead of target price? This session will dive deep into the weeds on the various commercial arrangement types, the pros and cons for each and which ones are right for which project type. The discussion will include real-life examples where the wrong commercial arrangement was used and how things could have been different. It will be beneficial for contract owners and CPO's alike.

Right Contract; Right Project; Right Time

Sam Campisi *(Southern Nuclear)*, Markley Ward *(AMS-PAR)*, Brandon Zimmerman *(Southern Nuclear)*

Session Notes

- Special considerations for pricing models:
  - Firm Fixed Price – Need to have a defined scope of work (95% or higher)
- Target Price – Need to clearly define rate structure
- Unit Price - INPUT FROM AUDIENCE: Be careful, as change orders that change quantities can impact unit price

Key Learnings/Best Practices/Recommendations

- We need to stop repeating the contract mistakes we and others have made in the past

- Technical team engagement
  - Weakness - contract turnover
  - Best practice – one-page abstract for contract
- Don't be creatures of habit
  - Southern Nuclear uses ~10 different contract templates based on the type of work being contracted
  - Don't rely on previous contracts as a template going forward

Q&A/Discussion

Q1 – How do you manage timeframe for resolving change orders?
A1 – You can use dispute resolution if terms cannot be agreed upon. The most important thing is that the work continues on during the dispute.

Q2 – How do you deal with rework? Who is typically responsible to cover these costs?
A2 – There are differing opinions on this, and this can be a contentious issue. The utility view is that rework is at the contractor expense. This should be identified in the contract up front. You need to communicate costs associated with rework including damage to existing equipment and communicate with contractor.
Utility Insight – Regarding service work (warranty), be careful when implementing staff augmentation contracts, as vendor may not warranty installations that are installed under site supervision. If the owner wants to direct the manner and method that the work is being performed, this is staff augmentation. It is important to understand when you are working within this space.

Q3 – What is the process for letting the non-successful bidders know what the selection criteria were for the winning bid? How do contractors figure out what they did wrong on a bid?
A3 – Often times, communication is made once a contract is awarded and accepted. Suppliers often ask questions which can be answered by contract team members. The utility has to be careful to not share confidential information from other businesses. Utilities want to see as many competitive vendors as possible.
Utility Insight – Best practices for project scope: Vendors need to clarify assumptions up front. Questioning attitude is valued during scope development. Vendors need to involve supply chain/sourcing early in the process (they are the ones that will be signing the contract). If you have been working for an extended time with a business unit on project scoping/development and supply chain has not been involved, make sure you start asking questions.

Session 3: Craft Labor - How to Reduce Costs Without Impacting Operations and Outage Schedules

Session Organizer: Bill Fry *(Duke Energy)*

The nuclear industry spends billions on craft labor every year. Challenges regularly face utilities at every outage to continue to shorten the outage duration while at the same time reducing labor costs. This is contrary to intuition which would dictate that to get something done faster, we need to throw more labor at it. This session will focus on how utilities can reduce their craft labor costs and still shorten their outage duration. This can be achieved through active partnering with the craft labor providers and real-time engagement with the generation facility and site management to address things like crew mix, scope of work vs. applied resource, etc. These and several other best practices will be discussed.

How to Reduce Costs without Impacting Operations and Outage Schedules

Mike Newell *(Duke Energy)*

Session Notes

- Utilities tend to struggle with analytics. Supply chain has the unique opportunity to gather cost data and trend/compare across business units.
- There is a need for supply chain to adopt new technologies to track and trend purchase metrics and contract performance.
- Best practice is to use a "total cost of ownership" model for considering project cost. Do not rely on a simple "3 bids and a buy" methodology for contracting projects.
- Outage duration has created challenges with attracting labor talent. Craft workers can find more consistent work at similar pay with less volatility in other industries.

Key Learnings/Best Practices/Recommendations

- Supply chain is unique within a company because supply chain interfaces with virtually every other business unit.

Q&A/Discussion

Q1 - How do you track "rogue spend"?
A2 - Power Advocate is a spend tracking tool that can be used to catch these types of expenditures on the back end (reactive). What really needs to be addressed is the process. We need to be asking why we aren't empowering people to push back if they feel they cannot work within a contract.

Q2 - You mentioned that the utility push for shorter outages has the potential to lead to a craft labor shortage. What can be done on the utility side to combat this trend and convince people to keep working on our outages?
A2 - We need to work with our vendors to try to solve this problem. We our currently exploring options with fixed price, fixed scope contracts for outage labor. We are also working on partnering with other business units who use contract labor. We need to work to build trust and transparency between utilities, contract vendors and contract employees.

Utility Insight (Duke Energy) - The P6 scheduling tool has allowed us to view work scopes across all plants for outage and online, as a way to manage resource allocation.

Vendor Insight - Flexible time frames are helpful to contract vendors.

Vendor Insight - Vendors are starting to lose workers due to cost constraints (i.e., one vendor was being limited to 4, 10 hr days).

Q3 - How much benchmarking have you done in terms of analytics?
A3 - It has been done in some instances, but not as a partnership. We need to work better with our business units and partners to realize best practices.

Utility Insight - Consistency and partnership is key in building a productive working relationship with a contractor. Care should be taken at the beginning of the contract scoping phase to align goals using incentives.

Utility Insight - Contractors tend to leave the site after the "per diem" period expires (i.e. after 1 year) regardless of project status.

Utility Insight - Duke Energy is working with community colleges to creating training programs for a craft labor pipeline.

Session 4: One Site's Trash is Another Site's Treasure

Session Organizer: Greg Keller *(Rolls-Royce)*

Inventory reduction is once again a popular topic, but unlike many past efforts to reduce inventory, sites do not have budgets available to write off excess inventory. The ideal solution to reduce inventory at one site is to find another site willing to pay book value for that inventory. There are several industry databases, and each was created to fill a particular niche. These databases are being retooled to assist with inventory sharing across the industry. Forward looking demand data can help identify excess inventory as well as potential buyers of that inventory. This session explores several approaches to helping connect sellers and buyers of existing parts and equipment.

On the Importance of Seeing (and Being Seen)

Josh Bartlett *(Curtiss-Wright)*

Session Notes

- Curtis-Wright's "Seer" program analyses inventory data from the RAPID database.
- About 2/3 of US nuclear plants are using Seer.
- Seer is designed to address the excess inventory problem within the nuclear industry.
    - Provides enhanced transparency into internal and external warehouse stocking information
    - Identifies similar or identical parts that may have different part numbers, titles, or descriptions
    - The Key Capability of the Seer program is matching one utility's needs with another utility's excess

Q&A

Q1 - What does Seer stand for?
A1 - Seer is actually not an acronym or an abbreviation.

Q2 - Are people using Seer in lieu of *palms* or in addition to?
A2 - Not entirely sure. The differentiator is that the Seer tool does not only include obsolete parts.

Q3 - Do we have the capability of looking outside of the "safety related" designator? Can we use this tool to investigate other industries that may be using similar parts (i.e. fossil)?
A3 - A large portion of the parts in Seer are non-safety related. Nuclear plants that have joined Seer have also included their non-nuclear inventories as part of the deal. Seer can be a useful tool in helping companies

Q4 - Southern has recently added a lot of gas generation. Is there any work being done to expand Seer to the gas industry (lines and distribution)?
A4 - Most certainly for the transmission and distribution. The gas industry has not been a primary user of the RAPID database. The tool can be used for any parts regardless of end use.

Catalog Consolidation

David Mueller *(Paragon Energy Solutions)*

Session Notes

- Paragon Energy Solutions – "We solve the nuclear industry's cost and replacement challenges"
    - Average 5-10 phone calls per day from utilities during outage season
- Paragon assisted Exelon in consolidating duplicate inventory stock following nuclear generation acquisition (13 generating stations).
    - Project has enabled Exelon to realize an increase trend in inventory transfers between stations
    - Project enabled Exelon to view total inventory of a given part using one consolidated CAT ID

Q&A

Q1 – How did you update historical documentation to reflect any changes in CAT IDs due to the consolidation project?
A1 – Using the Passport tool you are able to make notes and add information to Passport that serve to notify the user to the change. Entering an old CAT ID will notify the user of the updated CAT ID.

Q2 - How can you help the utilities to adjust the min / max values based on changing lead times?
A2 – this project was not aimed to address min / max stock values, but we did make recommendations if we saw something that seemed

Q3 - How quickly did Exelon realize ROI on this project?
A3 - Exelon very quickly realized a return on the project based on internal transfers of internal inventory

Q4 - What type of pricing arrangements are we using when transferring parts between utilities using Seer?
A4 – we are not able to sell it for cheaper than the system average price. If sold below this price the selling utility will have costs that they would need to cover internally.

Session 5: Inventory Reduction: Best Practices and Lessons Learned

Session Organizer: Bill Fry *(Duke Energy)*

Like many other industries, cost pressures continue to mount for the utility industry. This is especially true for regulated utilities like Duke Energy where regulatory oversight permeates every aspect of what the regulated utility does. Whether it's nuclear, or fossil, or renewable energy generation, every action a regulated utility takes must be prudent and contribute to keeping energy rates low for ratepayers. The managing of inventory is no exception. In fact, this is an area that for most industries can often be neglected and end up being an area with many millions of dollars in stranded assets. This session will not only focus on what a utility can do to reduce inventory, but also what governance process can be put into place to optimize those inventory levels going forward to ensure generation plant readiness while minimizing financial exposure in the warehouse.

Inventory Reduction: Best Practices and Lessons Learned

Jennifer Melvin *(Duke Energy)*

Session Notes

- Duke Energy was observing an increasing trend on inventory levels of approximately 10% annually prior to 2016.
- Duke Energy adopted a corporate Inventory Controls Policy over the course of approximately 6 months.
- More accurate demand planning was championed by material analysts.
- If a site falls off-color on Inventory KPI during any month, they are required to produce a recovery plan for how they will get back on track.

Q&A

Q1 - Was it easy to advertise this program from site to site?
A1 - One of the major obstacles we faced is that we were on 2 different supply chain systems. Once we merged systems we were able to have success in transferring materials between sites.

Q2 (from ABV) – Why is it that preapproved certificates of conformance headers do not include former Progress Energy plants.
A2- There are still 2 different QA programs within Duke Energy. The nuclear department is still merging procedures. I believe it is unlikely that we will ever see a combined QA program for all Duke Energy Nuclear Sites.
Duke Energy has committed to provide follow up on this item

Q3 (from ABV) - Do you ever put the onus on suppliers to hold items in consignment?
A3 - Yes that has been a part of the solution this is an ongoing initiative in our Inventory Reduction Working Group.
Input from Vendor (ABV) – these types of programs are favorable for suppliers.

Q4 - Does Duke Energy utilize a primary stocking location for multiple plants?
A4 - This is another ongoing initiative for our nuclear fleet (and beyond to other generating units) to establish primary stocking locations

Q5 - Did you see an increase in expediting costs due to inventory reduction?
A5 - No major increase. However, this is a data point that we monitor, especially during outages. So far it has not proved to be a problem.

Q6 – Do approval thresholds for material purchases only apply for safety related purchases?
A6 – No, these include both safety related and non-safety related purchases.

Q7 - Did you get any pushback from sites or business units
A7 - Yes, we got it a lot! This program has been a real culture change. We had to provide pushback when we were challenged by site management on stocking levels.

Q8 - Did you see less purchasing of contingent items?
A8 - We created a material request type for contingent items. We have seen an increase in contingent MRs issued by planners. We have been using the Seer tool to reach out to other utilities and "reserve" expensive spare parts in the event we need them during an outage. Contingency has always been a tricky problem for us.

Q9 - How often do you update your lead times? Do you have a programmatic way to periodically check them?
A9 - Lead times are updated every time we receive a purchase order. The tricky thing is how you account for expedition. Another potential issue would be for parts that are infrequently purchased, as lead times can change dramatically. The best way to get an accurate lead time is to reach out to vendors.

Q10 - Do you see more willingness between plants to share materials
A10 - Legacy Duke plants had an established culture of transferring material between plants. When we merged with Progress Energy, we found this to be a bit of a culture change for the legacy Progress Energy plants.

Session 6: Keeping the Lines Alive

Session Organizer: Greg Keller *(Rolls-Royce)*

Being a supplier in the nuclear industry has many high fixed costs. And for many products, the sales volume cannot support those fixed costs. Many companies that manufacture products for general industry have chosen to abandon their nuclear programs, finding the risks outweighing the potential rewards. Some of these manufacturers may not have high sales volumes but do have large installed bases and dropped nuclear programs can have significant adverse effects. Several third-party suppliers have steeped in and kept various product lines alive. This session explores the various strategies for maintaining otherwise obsolete product lines, as well as the challenges involved.

Keeping the Lines Alive missing presentation

Robert Cole *(Framatone)*

Session Notes

- Safety related product lines can be a very big headache for manufactures, while they often times account for a very small percentage of total sales.
- It is exponentially cheaper to dedicate a larger batch of items versus a smaller batch.
- One utility (not named) was challenged by the NRC after having not revised their commercial grade dedication program in many years. This led to increased scrutiny by the NRC and audits of other utility programs.
- Insight from Utility (Southern Company) - When we did the business case, we had a bias towards keeping the CGD business in house. The more we explored it, the more we realized that retaining the function did not make sense for us and we needed to look to outsource the function. Some of the challenges involved finding a new home for the 12 employees and lab equipment with high book value, both of which we were able to accomplish.
- Exelon has recently decided to outsource their CGD function.

Q&A

Q1 - Do you anticipate any issues with overseas clients being hesitant to purchase US manufactured parts (in reference to Schneider SPEC 200 card)?
A1 - No, the part we have assumed manufacturing of from Schneider Nuclear Automation is quite simple to assemble. Our main challenge is in procuring some of the original style components.

Q2 – Did Chesterton supply you with their customer base?

A2 – They did supply us with access to their entire customer base / accounts.

Continued Supply Chain for OEMs missing presentation

Julio Adame *(Curtiss-Wright)*

- Companies that do not rely on nuclear purchases for a large percentage of their sales will likely have a hard time understanding the demands of the nuclear industry (emergent parts needs to support outages, LCO's).
- Many suppliers are fearful of getting involved with the nuclear industry (reportability, Part 21, liability questions)
- OEMs with retiring subject matter experts with nuclear experience may consider forgoing future opportunities in nuclear rather than facilitating the knowledge transfer.
- The best way to understand how your nuclear supplier is functioning is to visit the manufacturing site.

Partnering with the OEM missing presentation

Frank Helin *(Energy Steel)*

- Quick Response Office Cells at Energy Steel include engineering, procurement, supply chain, etc. that are co-located to provide streamlined response to part needs for utility companies.
- Commercial Grade Dedication and the idea of obsolescence has evolved within the last 5 years. While obsolescence used to be defined as "no longer available", it is now often defined as "hard or expensive" to procure.
- When buying commercial grade material with the intent to dedicate safety related, Energy Steel has found it is often necessary to buy multiple units of a part in the expectation of dedicating one of the units (buy 4 to get 1).

Technology and Innovation

Session 1: Intro to Innovation and the Innovative Culture

Session Organizer: Vincent Williams *(Southern Nuclear)*

This 1st session focuses on how we approach innovation itself, what it means, and why it is so important within not just the nuclear industry but the power production business overall. How is the culture being grown within your company? What is 'innovation style'? How can we ensure we stay aligned within the US and the world with this endeavor? These questions and more will be considered and answered within this cutting-edge session!

Introduction to Innovation – Innovation Styles missing presentation

Vincent Williams *(Southern Nuclear)*

- Slides sufficiently convey information

Creating Value through Energy Innovation missing presentation

Jason Pastras *(Southern Company)*

Session Notes

- Innovation is performed at scale.
- Small scale innovation is Incremental innovation (process improvement).
- Medium scale innovation is sustaining innovation Ex: Toyota Prius, Market research showed Toyota Prius market would cut into Toyota Camry market, however Toyota chose to move forward with Hybrid to begin building a market in a new space.
- Two innovation terms to consider: breakthrough and disruptive.
- Breakthrough innovation: forward-thinking invention. Needs to gain traction in its space.
- Disruptive innovation is inferior to market, but gains traction based on convenience or cost (e.g., Uber, Amazon).
- Remember that culture eats strategy for breakfast.
- Moore's law (late 1960s) chip manufacturer can double IC's on board every 24 months. Computing power can double every 24 hours.
- Case for innovation:
    - Maintain growth, with demand falling flat, technology allows smaller players to participate in market
- Legacy of Innovation:
    - Energy innovation center, grow culture of innovation
- Culture:
    - SO Prize SO safe innovation contests 2013. Ideation competition
- Crowd source innovation at the employee level (e.g., online ideation challenges).
- iLab: incremental innovation
    - Innovation website internal to company instructs people on innovation strategy. right next to company values on web to show importance
- Smart city nodes 212 deployed in ATL with several sensors. Data to city (e.g., repurpose power poles). 8500 data point per node per day.
- When collecting data, analysis is needed.

Q&A

Q1. How do you deal with ideas that don't make the cut? How is it communicated back to submitter?
A1. We do not ask for ideas without sponsor and budget to maintain credibility. Communicate in advance level of engagement required to advance idea. Set clear guidelines for acceptance. add incentive.

Q2. industry struggles with business model. Smart neighborhoods with micro grid puts price of transmission on poor / hospitals etc.
A2. Distributed generation is coming. We need to learn how to be feasible in that market.

Session 2: Enhancement of Workers Through 3-D Modeling, Virtual Reality, and Augmented Reality (See Performance Improvement)

Session 3: Digital "Mobile" Workers

Session Organizers: Vincent Williams *(Southern Nuclear)*, Joan Knight *(Exelon Corporation)*

This session focuses on how the workforce is becoming more digital and increasingly mobile. The importance of rugged mobile devices, reliable and continuous network connectivity, electronic documentation (including Electronic Work Packages (EWP) and the ability to digitally sign documents), and access to data for monitoring and diagnostics is at an all-time high. These digital assets and options are now streamlining the amount of accessibility workers now to complete daily tasks. We will look at how these capabilities are being leveraged presently and how we can all make plans to use them in the future.

Digital Plant of the Future missing presentation

Randy Schmidt *(Exelon Nuclear)*

Session Notes

- Why do we use better technology at home than we do at work? The opposite should be true.
- 12 FTEs working on digital innovation
- Key is serving digital information to worker as fast as Google
- Google Street View is like Plant Virtual Tour
- 3D virtualization of entire plant to expedite getting information to workers

- Electronic work package will not allow work to start without “proving” they are on correct component to the iPad.
- Focus on the customer (worker) but with a focus on improving the bottom line.
- We cannot be afraid to fail.

Q&A
Q1. How do you deal with the cyber security aspect?
A1. Digital Plant viewer was vetted through nuclear IT and cyber team, also Security reviews all pictures for safeguards concerns.

Digitizing Our ‘Mobile’ Workers
Vincent Williams *(Southern Nuclear)*

Session Notes
- Utilize communications and wearable devices to improve work order closeout during outage execution.
- Help lightning software allows SME to be inside workers headset during work execution real-time.
- Pictures show outage deployment at Farley plant in Maintenance Support Center (MSC).
- Screenshot shows demo of connectivity form remote location to turbine building.
- [Video of project manager being talked through an Ops JPM by Ops SME validated CV/IV capabilities of device]
- Hardware is voice-activated in multiple languages.

Q&A
Q1. Do you have Wi-Fi throughout your plant?
A1. We are working on Wi-Fi expansion throughout the plant. Containment and Aux Buildings are still a challenge.

Q2. Is the SME logging this in eSOMS real time?
A2. That is future state. We are looking into the software integration.

Q3. Are you using the barcode on your equipment tags?
A3. Not at this time but this hardware has the capabilities to integrate a barcode scanner.

Q4. Are there concerns about obscured field of vision for the wearer?
A4. Yes, we are looking at specific use cases for safety

Q5. What is the ballpark cost?
A5. $1500 per device is the cost.

Q6. Are you using electronic work packages?
A6. Yes. We are currently working with IT to get the devices accepted on our network.

Q7. Has your IT department looked at this from a cyber security / CDA aspect?
A7. Yes, they are working on that now. Device is on the business network so no cyber security concerns on non-control network. The biggest concern is safeguards info that maybe shown in videos.

Transforming Field Services with Digital Mobile Technology
David Harper *(General Electric)*

Session Notes
- Important to bring industry knowledge to software design.
- Developed robots (snakes) can go inside turbine and take high-quality pictures.
- Using Drone pictures/ Lidar scans to map equipment. Then “teach” drone what a fault is through deep learning algorithms. Then the drone can determine inspection results automatically.
- Same drone methodology can be applied to borescope images.
- How to “liberate” operators from the control room? Use a mobile operator.
- A 500MW gas turbine run remotely from an iPad.
- Cyber Security: This is technologically possible, but we need to work through cyber challenges.
- We are a couple of years away from completely autonomous 500MW combined cycle plants.

Q&A
Q1. Have you flown these drones at a nuclear plant?
A1. No, not yet. We are working through regulatory and owner concerns.

Session 4: Drones and Robotics
Session Organizers: Joan Knight *(Exelon Corporation)*, Vincent Williams *(Southern Nuclear)*

This session focuses on how common work tasks, infrequently performed evolutions, and other types of work activities are now being performed with the use of drones (aerial, ground, and/or submersible) and other robotics. These feats of design and engineering are improving our safety cultures worldwide and allowing us to complete many tasks with higher efficiency.

Robotics/Mechatronics Initiatives

Strategy
David Julius (*Duke Energy*)

Breaker Racking Opportunity
Doug Durst *(Duke Energy)*

Solution Description
Steve Hinkel *(Duke Energy)*

Session Notes
All Duke Energy Slide shows were combined into one presentation notes follow below:

- Drone inspection of solar fields can complete inspections quickly. What used to take days, now takes hours.
- Begin with the end in mind. Autonomous robot action with no human interaction and work backwards. UAV, Rover, Humanoid, Autonomous (Evolution Slide).
- Incremental change breaker racking is 12 steps. Prototype completes the first three and is in the field now.
- Field test is positive while team works on subsequent steps.
- Used Google free AI robotic software.
- Cheapest arm commercially available for $30k, cost of Duke build is <$100k.
- 3D printing has changed robotics.
- Current state is Rover class robot, working on Humanoid.

Q&A
Q1. Are you working with EPRI or the National Labs?
A1. We are plugged in with EPRI, and will look into National Labs.

Q2. Are there personnel safety concerns with Robot power?
A2. That needs to be addressed based on use needs and experience of the techs using it.

Q3. Did you have to design the controller and build it?
A3. No, we bought the controller and repurposed a remote-control air plane) and the new controller is a play station controller.

Q4. Have you done a business case for reduction in O&M based on robotics?
A4. Yes, we have looked at business cases across the board: Substation, Fossil, Nuclear. etc. First customer is breaker racking, but other business uses are being explored. We need to apply technology where it makes sense

Q5. How would a project fund this? Does a department need to come with funding to your group?
A5. Yes and no. Funding inside the company can be discussed and some costs shared. Project is still at the seed level.

Q6. How are you structured? How many people, and will you be selling this product?
A6. In most cases we are looking to solve a problem, and not make money. Not exploring at this time. About 18 in group total. Not all working on the robot project.

Centralized & Shared Inventory: Drones & Robotics
Colby Ryan *(Exelon Aero Labs)*

Session Notes
- Exelon holds an employee innovation fair annually.
- Submersible robots pay for themselves with the first use.
- Shared fleet inventory of drones and robotics.

Q&A
Q1. Is shipping of shared resources covered in your O&M costs?
A1. Similar to M&TE costs. Shipping is covered for drones and robotics.

Q2. Is inventory refresh covered centrally?
A2. Yes, current depreciation for drones is 3 years based on the tech lifecycle.

Q3. Have you had a use case around storm damage assessment?
A3. We are working on vegetation management, looking at predictive analytics to determine which areas more at risk. To be proactive vs. reactive. Also deployed to Puerto Rico post-Maria to deploy stringer lines off drone.

Q4. Cyber security with Chinese made drones?
A4. Corporate vetted cyber security, all sensitive photos are reviewed.

Q5. Do you deploy pilots with the drones?
A5. Drone pilots are in business units. Drones are tools for workers, not new position for tools. Some pilots are available for commercial work.

Session 5: Blockchain and Energy – Let's Learn Together! (see Business and Economic Performance)

Session 6: Data Analytics – DIANA
Session Organizer: Jerrold Vincent *(Arizona Public Service)*, Vincent Williams *(Southern Nuclear)*

Using machine learning and artificial intelligence techniques, Palo Verde has developed several new tools that improve Condition Reporting processes. These tools include an Automatic INPO Performance Objective & Criteria Coder for Condition Reports, and the Data Ingestion and Network Analysis (DIANA) tool for automatic common cause analysis. The functionality of these tools will be presented, as well as the results of their use at Palo Verde. Additionally, the use of these tools external to Palo Verde will be discussed, including results of using the Automatic PO&C Coder on other Nuclear Industry data.

Data Analytics - Data Ingestion and Network Analysis (DIANA)
Bradley Fox (Arizona Public Service), Jerrold Vincent (Arizona Public Service)

Session Notes

- Identifying low-level issues through data analytics before humans can see trends.
- Knowledge transfer to data systems instead of human to human helps document tribal knowledge necessary to make decisions.
- First test case was INPO (ICES) events analyzed by 4 Analysts for 1 week DIANA provided similar results in a few hours.
- DIANA can apply cause codes to condition reports via algorithms at approximately 85% accuracy and much faster than 2 FTEs.
- Soft benefits of DIANA SPOC are that there will be greater consistency in future CR coding and it makes for better data sets available to workers who need the data.

Q&A

Q1. If DIANA is attached to people, does it track organizational changes?
A1. Organizational changes are an input to the tool and connections will track through changes.

Q2. What is the smallest dataset you can analyze?
A2. That is a tough question. In theory, no less than 12. In practice more is better.

Q3. Are the results weighted based on significance level?
A3. With enough data to analyze, weighting is not required.

Q4. Can you separate the data by unit?
A4. Yes, but it requires some extra work.

Q5. How far back in plant data can you go?
A5. In theory 1990. But for data fidelity it is better to stay in the last 10 years. For cause evaluation the best results are limited to the last 3 years.

Q6. Over time will DIANA be more or less effective as it codes more and more CRs?
A6. Machine learning process would be difficult for DIANA to affect outcomes because the analysis is still reviewed by humans. Industry test with Surry Data performed very well.

Q7. What is your threshold for probability on SPOC?
A7. Several strategies were developed, and the learning model reviewed which codes were kept and which were changed after the fact and adjusted the strategies used to apply the codes.

Q8. Have you looked at routine tasks list with this?
A8. No, not in this group. Our value-based maintenance group is looking at that.

Session 7: DOE Research Reports - Common Cause Failures and Embedded Digital Devices

Session Organizers: Richard Wood *(University of Tennessee)*, Suibel Schuppner *(US DOE)*

Concerns about Common-Cause Failure of Equipment with Embedded Digital Devices constrain the application of current technology to modernize plants. DOE is sponsoring research to contribute to the resolution of those concerns. Specifically, EPRI, industry, and universities are nearing completion of key projects focused on the underlying issue of assurance of CCF-resistance. The outcomes of these projects include definition of an extended, graded diversity and defense in depth analysis process, development of a model-based testing approach to provide objective evidence that test suites cover all postulated fault types, establishment of a simplified digital sequencer architecture suitable for verification by co-simulation, and generation of a hardware-based digital sequencer employing micro-logic implemented using Micro Electro-Mechanical Systems (MEMS) technology. The session provides description of the technical developments and discussion of opportunities to apply the resulting products and methods.

Advanced Sensors and Instrumentation

Suibel Schuppner *(DOE)*

Session Notes

- The DOE program for Advanced Sensors and Implementation does not have a set dileverable schedule and is therefore free to be more flexible and innovative.
- 3 focused work scopes
    - First of a kind nuclear demonstration readiness projects
    - Advanced reactor development projects
    - Regulatory assistance grants
- GAIN program provides access to DOE expertise and capabilities (including laboratories)

Q&A

Q1: Are there some good resources/examples available that we can look at for what excellence looks like in working with the DOE on these initiatives?
A1: Please reach out to us for feedback. We may be able to share some successful applications but I don't believe we have one posted right now. Contact DOE through the GAIN program to be pointed in the right direction.

Addressing Embedded Digital Devices in Diversity and Defense-in-Depth Analysis

Dr. Richard Wood *(University of Tennessee)*

Session Notes

- Other industries with safety critical aspects have been adopting digital instrumentation and control (including the airline industry).
- There have been many instances where equipment was provided by a vendor with no indication that a digital device was embedded.
- Many EDDs give a continuous response and therefore failure of the device will be self-revealing.

Q&A / Discussion

Audience Input - In some cases, suppliers don't know whether their device contains an embedded digital component.

Q: Do you think that there is a place here that we could great a topical that analyzes the control from a D3 prospective?
A: In the UK the nuclear industry is required to commit a large amount each year for research. They recently developed a tool to analyze vendor "smart devices" for common-cause failure modes. We have the potential to do this, perhaps through a third party qualifier. Currently our US system gives no credit to international qualification.

Development of a Model Based Testing Approach for Qualification of Embedded Digital Devices in Nuclear Power Applications

Carol Smidts *(Ohio State University)*

Session Notes

- The NRC is currently requiring 100% testability for digital functions. As devices become more complex this is less practical.
- Model based testing must begin early on during software development.
- Model based testing is referred to as a "grey box" approach (not all aspects of the software are known).
- Mutation testing can be very expensive. However, there is literature available that helps identify what operations to target for mutations.

Q&A

Q1 - What does "killing a mutant" mean?
A2 - Killing means that you have a test case that can distinguish between the two programs. This helps us identify specific faults.

Q2 - How do we analyze for the unitended consequences for the introduction of mutants into the code?
A2nswer - When you start early you can fix things very early as well.

Q3 - Have you considered modeling the devices and running mutation testing based on the models?
A3 - That's what we are trying to do

Q4 - Does the technique allow you to take an aggregate of sensors and detect when they migrate out of tolerance?
A4 - The sensor setpoint would be one of the variables you test for and therefore this could be detected. It is possible to model as a system to make these kinds of determinations.

Q5 - Are you looking for utility support/advisors?
A5 - Our project is concluding this year. The hope is that there is a follow-on program. The short answer is yes, we are looking for partners.

Realizing Verifiable I&C and Embedded Digital Devices for Nuclear Power

Dr. Carl Elks *(VCU)*

- SymPLe Concept – virtual machine overlay. The concept is based on trading computation power for verifiability.
- When we rethink I&C to focus on verifiability we have a much stronger case for building a qualification/verification that is much more cost effective.
- More costly up front to build the machine but the cost savings is realized during the testing and qualification process.