

# **Utility Working Conference and Vendor Technology Expo**

Innovating for a Sustainable Nuclear Future

Knowledge Base Report August 4-7, 2019 Omni Amelia Island Plantation Amelia Island, FL

2019

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# Plenaries

# Opening Plenary: In the Face of Uncertainty, Be Innovative

Opening Plenary: Welcome and Status of the Organization (no slides) Marilyn Kray (ANS)

- Here is a brief status on ANS: It is not bright
  - As the constituent groups are downsizing that has a ripple effect on ANS.
  - o It has affected advertising which makes us thankful to our sponsors.
  - We have been operating in a deficit and our runway is running out.
    - When I became president in June I realized I have an opportunity/imperative of change.
      - With a show of hands it was recognized that a majority of the room are ANS national members.
        - ANS are the stewards of our technology. ANS has the role of ensuring that our technology is developed, and ANS meetings are an opportunity for your research to be presented and published.
        - Also, we're responsible for having our technology understood and used.
- Hallmark of ANS is Navigating Nuclear, the education program in middle schools. Discovery Education has reach in half of all the schools in the U.S.
  - This past year it was introduced and a \$1.2 million grant from DOE was awarded to ANS for the development of high school and primary school curriculum.
  - Please feel free to stop by ANS booth and visit Daryl Rizzo to get more information.
- This is ANS working on your behalf of federal policies for nuclear.
  - We also have a new SCARP (Special Committee on Advanced Reactor Policy) to develop easier regulations for advanced technologies.
- Talent pipeline and domestic construction, we need to maintain our domestic fleet.
   ANS has utility leaders that have taken this ball and run down the field.

#### Uncertainty as a Driver for Innovation

Steve Kuczyński (Southern Nuclear)

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- Steve spoke on Vogtle 3&4 and the path to completion.
- SNC implemented an outage management performance improvement strategy upon Steve's beginning.
- Applying overall learnings of the past few years to the Vogtle 3&4 construction.
- Everything we do at Southern Company revolves around the customer. Owners are subsidiaries of Alabama Power, Georgia Power
- Customer focus with rates and customer service.
- All plants have been renewed for extended license.
- They are involved in all technologies that are being innovated such as smart grids, natural gas, and coal generation which is down about 60%, under 30% total for coal output.
- Southern Company is committed to a low to no carbon strategy by 2050.
- Innovation by technology is the path to get there.
- The company is committed to the future of nuclear.
- Our core role is safety and reliability of our nuclear plants.
- We must staff our operators to preserve the plants.
- Industry Initiative to Control Costs
  - Delivering Nuclear Promise
    - Goal was to muster the industry together to look at inefficiencies in our industry
    - Looked at aspects of Ops and input new initiatives to impact our utilities
    - Some were mandatory that each plant implement such as Corrective Action, Supply Chain
    - SNC saved \$1M in an outage with in-processing
    - Deploying security
    - Value-based maintenance.
      - DNP was a very effective 'bridge'
    - SNC has introduced a Business Modernization initiative to improve our business
    - Accelerating Accident Tolerant Fuels (ATF)
      - Higher enrichments provide economic savings
        - Goal would be to move to 24-month fuel cycles in outages. Will be a challenge
        - High priority
    - Knowledge Transfer
      - SNC made an effort in Ops in how operators are trained and on-boarded
      - Commitments to expand facilities to increase training
      - Each site has a replica simulator to train shifts on JIT bases day and night
      - Provides hands-on experience for Ops trainees
      - Risk-Informed Performance based principles
        - How SNC evaluates certain systems
        - How often SNC does PM's on certain equipment
- Advanced Reactor Challenges and Issues

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- The goal is to find other options to deploy
- By 2030, can we have commercial options available?
- Molten Chloride Fast Reactor
  - Currently being developed by partners
    - Will have more options to compete in certain cost environments such as natural gas
- Vogtle 3&4 Challenges and Initiatives
  - SNC feels good where we are currently with our initiatives
  - SNC took over full control of the site due to Westinghouse's bankruptcy in 2017.

- SNC was tasked with moving project to halfway complete in the timeframe of about a year.
- They had to renegotiate about 60 contracts from scratch.
- Bechtel is the prime contractor on the project
- 2 years left on unit 3 construction
- 3 years left on unit 4 construction
- Project is on track as of today
- Various milestones to meet by the end of next year
- May of 2021 for unit 3
   May of 2022 for unit 4
- Regulatory approved schedule for each site is about 6 months (November of '21 & '22 respectively)
- Ways that other utilities & vendors can help
  - SNC has offered that other Engineers, Operators, Planners for those who are interested to help advise on the plants
  - Less than 100 key individuals that know how to test, operate equipment
  - Need input from expert individuals.

## Regulatory Perspective (no slides)

Annie Caputo (U.S. NRC)

#### **Presentation Notes**

- Change is happening in the industry and NRC sees the need for transformation and must adapt to these changes.
  - Independence does not imply isolation. NRC is independent institution but has to change as the industry changes but also influence changes in how NRC executes its role as the regulator.
    - Transform how NRC operates and embrace innovative thoughts and practices
      - Striving for innovation and improvement is a challenge
        - The NRC transformation effort means different things to different people and differing views of what it can mean. Mission and goals don't change, but improving efficiency is a must.
- NEIMA passed in late 2018 for improvements in licensing for advanced reactors and ATF
  - Requires NRC to be responsive, proactive, and efficient
    - New ground for NRC and is being closely monitored by Congress large focus area for NRC
  - New Areas:
- Construction on Vogtle 3/4
  - More time to plan, prepare, direct resources, etc.
  - Testament to others regarding NRC's capability to execute responsibilities to ensure plant starts up safely under NRC watch SMR
    - Goal: Complete review of licensing review in 42 months
      - o Using strategies for how NRC approaches SMR licensing to influence how advanced reactors are looked at
  - Need to not be seen as an impediment to construction and progress but rather a complement
  - Agency position should be readily understood
    - Reliability: ongoing challenge with room for improvement to remain on task to enable improvement with regards to how NRC runs its business
- Accident Tolerant Fuels
  - o Important advancement for industry and safety
  - The NRC plan has new regulation approach to licensing to engage earlier during R&D period to facilitate efficiency throughout the process.
- Transformation

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- Expand use of Risk-Informed decision making
  - Foundation for ongoing endeavor to better utilize risk insights and focus time and resources on improvements that have largest benefits based on risk insights
    - 4500 combined years of data to look at
    - Communicating risk is still a challenge
      - Innovation still brings uncertainty
      - Communication is more important than ever to understand safety benefits of new reactor designs and improvements
      - Public perception of nuclear is still fragile ensure that both regulator and utilities continue safe operation
      - Safety mission must remain the foundation for which all improvements are made
  - Zero risk not achievable decision making must be based on improving risk
- There must be a culture change
- Embrace risk insights as a way of improving safety

#### Key Learnings, Recommendations, and/or Best Practices

- NRC is in period of transformation with the passing of Nuclear Energy and Innovation Modernization Act (NEIMA) and the utilization of riskinformed decision-making for fleet improvements and new ground to be covered.
- NRC is in flux for new licensing (advanced reactors and ATF are examples) and evaluation and are still trying to adapt to how to operate and still maintain independence and principles for regulating a safe industry for the future.

#### Q&A

Q1. Public perception – what is associated with current fleet with respect to environmental impacts, etc. and any learnings from the Hill or the public with regards to current fleet vs. new advanced designs?

A1. (Caputo) Bases for bipartisanship around nuclear (members and senators that had not embraced nuclear before started to see the benefits of nuclear). (Kuczynski) Interesting dynamic – existing nuclear not so much, advanced reactors are seeing more support from environmental community to meet climate challenge. Helping propel interest in advanced reactors, different from support for existing fleet. Recognize that all current energy production can help accomplish green energy goals. (Kray) NEI trying to get her voice out there and ANS adds to that voice to promote sustainability of current fleet.

Q2. How do you see the regulators and supply chain and how do you see us innovate as other countries move forward?

A2. There's a minor policy role by the NRC and to make sure we review licenses as we can.

- We have to make sure that we continue to develop relationships based on what we can do.
- We support INPO on trying to get the best operating practices where we can and limit the risk.

Q3. Address idea of 50% no-carbon/renewables – hybrid applications on how nuclear can co-exist with renewables and not just power generation A3. (K) question that comes across is where is energy future? We have a role to play and lead strategies – we don't know exactly where this is going to go, can only look at trends but can only try to predict. SNC plays in both existing and new nuclear. Not a unilateral change but also has to be changed in regulatory environment. SNC tries to forge a pathway to get there. Central power stations – can be integrated but there is a point that is too far one way or the other. Advanced reactors may open up new paths to areas outside of power generation. Current demand slowed/stopped/declined and companies have to adjust. (C) Tough to determine where to place regulatory resources; need to balance. Advanced reactors – don't have resources to cover everything, how NRC places resources depends on how the regulator is approached with business plan so NRC can develop capabilities which has resource and planning challenges, but need to be adaptable to change for how nuclear is changing. (KR) Be there when you need to be there to make sense with economics – lengthen fuel cycles to improve base-load capacity. Nuclear has to be the backdrop to renewables to get them through volatility period. Hybrid approach and how they can work together. Divert steam to other processes, etc.

Q4: What are best practices on an international scale for regulations? Can the U.S. accept best practices from other countries and not further the stereotype that regulations are such a burden in the industry?

- A4:
- Huge challenge by all. An international effort to get a group of companies to agree to enable vendors that approval would be accepted in other countries. There are differences in how regulation agencies carry out their processes in other countries. There is a constant effort to look for best practices and learn how we can approve on what we do based on other regulators. This is ongoing. There is a more focused effort with Canada at this point. There is room to do more here, and room for improvement. Like our fellow regulators we have to operate with the laws that we have.
- It's very important that our regulator is seen as competent. The agency should look to improve processes, but there are dangers in looking at
  another country that may not have as rigorous standards as ours. SNC was able to prove how the tests were conducted to 'our' standards but
  that we more so a leadership change than the environment.
- Our credibility is on the line and we have to make these decisions for ourselves and maintain our independence for ourselves.
- Based on our current fleet, it is from our American design. More of a shared aspect of it. Other countries get their designs from other countries as opposed to internal.

# Tuesday Plenary: Unlocking the Power of People

#### American Nuclear Society Utility Working Conference

Margaret Doane (NRC Executive Director for Operations)

- The NRC has undergone a lot of changes over the last few years and they want to make sure they retain all of their good capability.
- The NRC is undergoing a transformation to become a more risk-informed commission.
- Going to give an overview of what topics other NRC employees are working on and what the general direction of the commission is headed.
- Bob Dylan sang, "The Times They Are A-Changin'" but for nuclear power things have mostly remained the same until now.
- We've had mostly the same technology since the 1960s and 1970s.
- Things that have changed however, are that some plants are now closing.
  - The NRC was doing license renewals for many years, but for the first time in many years there are not any pending license renewal requests.
- This means that the NRC workload is decreasing even though the commission had staffed up for the "nuclear renaissance."
   3,500 people to 3,000 people (~21% decrease over the last five years to accommodate less work)
- Workload is now increasing again because of the number of plants working to decommission
- There are now three subsequent license renewals in front of the commission for 60-80 year lifetimes
- The NRC knew they were going to need to innovate because of the number of new reactor types and innovative designs
  - A platform is being put in place to spearhead innovation and prioritize things that will have the largest effects
- The NRC is also working to evaluate their decision-making process
  - First, technology is being used to get through decisions more quickly such as using data to help facilitate decision-making
    - The agency is now also becoming more and more risk-informed
      - The NRC has always been risk-informed, but now that is being taken to another level
      - Trying to really concentrate on the issues that are truly safety-significant
    - o Also making sure that those decisions are communicated well both internally and externally
    - When these risk-insights are taken in consideration to make a decision, adequate communication both externally and internally is important to build trust
- Work continues to shift, but hopefully in the right direction
  - To illustrate this, a picture of Shipping Port 1 transitioning to a picture of NuScale
  - o Other advanced things like accident tolerant fuel and new infrastructure to evaluate non-light water technologies
  - An enhanced infrastructure will hopefully breed better applications
  - The NRC has done a number of strategies taking to prepare for the future
- To work smarter the NRC has to work more efficiently
  - Nuclear Reactor Oversight and Nuclear Reactor Regulation will merge
  - The new reactors office and nuclear reactors regulations will also merge
- All rulemaking staff have been rejoined to get better collaboration and stability in decision-making
- Environmental staff are also going to be brought together as a center of expertise
- "The Dynamic Futures for NRC Mission Areas" on ADAMS was an assessment of the NRC to see what scenarios the NRC could need to deal with in the future:
  - Four stages: Nuclear Takes off, In between, IN between, and Nuclear totally dies
  - These four scenarios were used to help the NRC figure out how to plan and stretch their mind
  - They are based on both demand for power and innovation in the U.S.
  - o It's all about scenario planning but also putting signposts in place for the future
- NRC staff are talented incredible staff

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- The strategic workforce planning that the NRC went through has been the most thorough that the commission has ever undergone
  - For now, for the most part the NRC currently has the skills they need to get the job done

- Over the next 3 years however over 50% of staff will be eligible for retirement
- o Because of this, the strategic plan was worked to include turnover and hiring for the future
- Looking at all competency modeling

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- How positions are qualified in the agency
- o A whole new model on how to qualify resident experts
- There are whole new ways to learn
  - Technology has brought the site into the classroom
  - Learning online
  - Different kinds of simulators
  - The time it takes to get qualified can be drastically reduced
- Also have a learning transformation initiative underway
  - This would allow employees working on one thing to get the skills needed to work on something entirely different quickly
  - An example of this would be someone with a career based in light water reactors could transition to advanced non-light water reactors quickly and efficiently
- Wanted to make sure everyone knows the NRC is hiring!
  - Haven't hired more than back-filling here and there for five years
    - Even under the most pessimistic views by 2030 there would still be 74 plants in the U.S., which would still be the largest fleet in the world
  - Had to make sure the staff was brought down, but not to the point that work can't get done
    - Only 2% of the agency's staff is under the age of 30
    - Government average is 6%, which still is very low
    - Going to be hiring this fall from colleges that graduate in May
    - A new candidate development and apprenticeship program has been developed for new graduates
    - Also hiring into particular positions of need
- The NRC has reevaluated its leadership model as well
  - May not have been necessary, but wanted to formalize the behaviors that were important to transform the culture to protect safety and health of the public going forward
    - This is a big cultural shift
    - o Because of lack of resources, new technologies have not always been adopted promptly, but now they are being looked at
    - o The agency is holding voluntary sessions for staff to attend to talk about the new behavior model and cultural change
  - The new theme at the NRC is that everyone has a voice
- The "NRC Futures Jam"
  - o This is an online virtual chatroom
  - Talked for three days online
  - All staff participated
  - o For any one of the above scenarios, what should the staff do
  - Over 70% of the staff participated
  - Had over 4000 posts and hundreds of likes for each topic
  - Used Yammer for discussion
  - o Have now trended data for the Futures Jam to see where the most energy was and what topics excited people the most
  - Now the NRC staff know they all have an individual voice in the transformation of the agency

#### Unleashing the Superhero in All of Us (presentation slides not public)

Captain (U.S.N. Ret.) David L. Marquet (Author of Turn the Ship Around)

- Unleashing the power of people is consistent with my theme of unleashing the superheroes in all of us.
- · Your job as a leader is not only to unleash your own superhero, but instead to recognize that your people can be superheroes.
- People don't get ordered to be superheroes; greatness comes from within.
- Believe in people, even the people who let you down, and the most horrible of people, the people who take the last cup of coffee but don't refill the pot.
- Recognize that every human being has a superhero inside them, and it takes the right kind of environment to unleash it.
- Capt. Marquet grew up in the 1970's during the conflict with the Soviet Union and believed in the principles of the U.S. Constitution were worth
  defending, not because they were perfect, but because they were better than what the Soviet Union had to offer. He wanted to join the Navy
  and serve on Submarines.
- He attended the U.S. Naval Academy, a school that prides itself on developing leaders and was told that leadership was: "directing the thoughts plans and actions of others so as to obtain and command their obedience, their confidence, their respect, and their loyal cooperation."
- There is more to leadership than what I was taught.
- On submarines we sometimes bring seal teams on board, and we don't' keep them onboard because they simply aren't tough enough to endure the harsh conditions of submarine life.
- When brining seals onboard a junior sailor is responsible for a very demanding job of holding the rope as the seals come down the helicopter. As the captain, I can't see what is going on from the bridge, I can't talk to him because it is simply too loud. If as a leader, I can't create a team that knows what to do without being told the system doesn't work.
- Telling people what to do suppresses the inner superhero.
- Capt. Marquet shared an abbreviated story of his time on the USS Santa Fe:

Capt. Marquet was scheduled to be the commander of the USS Olympia and he and other colleagues all the while were snickering at the USS Santa Fe who was the Enron of the submarine fleet at the time. Days before taking command of the USS Olympia, he was directed to take command of the USS Santa Fe. The ship was entirely different than familiar ships, his previous training, and study. Everything was different, different reactor, different sonar room, etc. He was terrified because on this ship, unlike every other ship, where he knew everything, he didn't know any of the buttons. When he realized that his crew didn't know the answers either he became the most scared he had ever been on a submarine. *If you can't admit you don't know the answer, then your team doesn't know the answer, then you can't learn anything.* First time at sea the ship ran a SCRAM drill and while the main engine was unavailable, the captain ordered ahead 2/3 on the electric motor and the helm did nothing. And after the captain asked the helm why he took no action, the helm responded there is no head 2/3 on the motor, it's a one speed motor. At first the captain was embarrassed and then realized he could blame the Navigator, an experienced officer on the

ship, because he was the one that actually gave the order. The captain asked the Navigator, "riddle me this: why did you order it?" The Navigator answered "because you told me to". Ask yourself: Is safety really first in the organization or is hierarchy first? The overwhelming weight of the organization was on compliance and doing what you are told.

The captain realized he had to stop everything. There were now two timelines progressing on the ship:

1) The captain learns everything as fast as possible

2) The crew will do exactly what the captain tells them and it will be wrong and everyone would die.

Hopefully one timeline would progress more rapidly than the next. At a meeting of the officers to discuss the problem a junior officer recommended: "Let's skip the part where you give the bad order and then we have to fix it." The captain thought about that and thought "I only give orders I think are good, so the only way to not give bad orders would be to avoid giving any orders at all." The junior officer responded: "Yes, don't give any orders." So the captain tried it and responded: "I swear I will not give another order, but I won't give permission either."

- In most organizations the default is no. If you have to ask for permission the bias is for inaction.
- Instead, bias for action, people automatically have permission unless the authority says "no, that's scary."
- You say "I intend to ..." and explain and the authority will acknowledge. It's a trick to get people to think.
- You need a can we think organization instead of a can we do organization.
- Leaders need to give up control
- An exercise to give up control: Next time you go out to lunch ask the waiter to pick the meal the drink, and also add, "don't play it safe."
- Leaders must learn to manage the anxiety of not knowing what you are going to get until you get it.
- The reason people don't speak up is because it is not safe to do so in the environment leaders have created.
- Like a modern wire nail, the industrial revolution designed for conformity and to minimize variability from the way you work to the way you sit.
- The industrial revolution separated the world into two categories: the worker or the doer, and the thinker or the foreman.
- The world cannot work this way.
- A study where researchers asked a husband and wife what percentage of the household chores were yours and then added them. 130% is the answer illustrating the principle of overclaiming.
- If you send two people out to do a job and they come back and ask them to split the bonus relative to how much work they think they did on the team they will each overclaim.
- This mindset is toxic on teams.
- The theory for this natural mindset is that the mind searches for the easiest retrievable data to answer the question, and what you do is easier to retrieve than what others do that you don't know about.
- In the example of Warren Beatty reading the wrong winner at the Academy Awards, he demonstrates error propagation. We show signs of hesitancy, reluctance, multiple checking, body language when we know something is wrong. When we know there is something wrong, we sometimes pass it off.
- What is in the way of correcting the error? Fear of being wrong about the error, stress, job expectations no decisions just follow the instructions, actions of colleague or boss, separation of authority from information.
- We often correct information separation problem by pushing the correct information to authority, but we need to push authority to the people that natively have the correct information.
- We often focus on self-preservation justifying doing something we know is wrong.
- To create a resilient organization, you need to ask questions differently to make is safe to speak up.
- When the CO of the Greenville sunk the Ehime Maru during an emergency blow demonstration he said nobody told me it was there.
- Avoid binary guestions and instead think in probability.
- When making group decisions write down answer first to encourage thought.
- Avoid questions like: does that make sense? This is a teaching moment. Why? Have you thought about safety?
- See the book for more details and recommendations.
- Treat your organization's people like superheroes.
- Leadership is believing that everyone has an inner superhero.

# Wednesday Plenary: UWC Takeaways

#### UWC 2019 Takeaways

No notes are included with the slides as this plenary was a highlight summary of the conference and makes reference to many session takeaways.

# Business/Economic Performance

# Session 1: Value Modeling to Optimize Capital Investments at TVA

Session Organizer: Tim Schlimpert (MCR Performance Solutions)

Licensees are consistently challenged to meet restricted or reduced capital budgets while maintaining improved plant performance. Pragmatic capital investment is the key to extended safe and reliable nuclear plant operation. The challenge licensees face is implementing the highest value investments at the optimum time to make the best use of limited capital funding. This session will examine approaches used by TVA and others to identify the portfolio of projects which adds the most value while reducing the most risk over the life of a plant, fleet and company. Value modelling considers multiple risk factors, opportunities and investment cost to develop a comparative cost-benefit analysis for each project. These analyses support project portfolio development and optimization across the enterprise.

## Copperleaf Introduction & Solution Overview

Brent Lindsay (Copperleaf)

- Copperleaf started their utility asset value solution in 2008 with Duke and since no customer has stopped using the solution.
- Started in generation and expanded to transmission and oil & gas with industry proven capabilities and best practices built into the product.
- \$650 Billion in assets are managed by Copperleaf technology.
- Provides investment planning comparisons to help understand the value in pursuing asset replacement or upgrading entire systems considering budget, making efficient use of available resources, renewable targets, asset replacement targets, etc.
- Uses computing power for decision analytics to optimize investment decisions, manage investments, and predict long-term needs.
- Incorporates ISO 55000 best practices to maximize the value out of the assets in the organization.
- Considers asset needs, candidate investments, and business needs to assess value and create an optimal investment plan.
- Integrated investment plan also includes management of investment projects as well as prediction of future investment needs.
- Copperleaf value framework creates a common level playing field for all investments by aligning value with the organization's strategic objectives.
- Over 250 best practice value models proven by leading organizations over 11 industry segments implementing national standards in risk assessment.
- Integrated into IT Ecosystem to provide decision analytics. Not meant to replace existing systems but complement.

#### Project Evaluation & Portfolio Optimization

John Alfultis (Tennessee Valley Authority)

#### **Presentation Notes**

- This was started six years ago when a significant issue arose with a TVA dam requiring a reallocation of capital to address the issue. In order to better asses project priorities TVA pursued a decision analytics solution.
- TVA began implementing Copperleaf C55 with power operations and transmission and recently implemented it in nuclear for the past year and are pursuing using the model across the enterprise.
- Needed a way to value projects across abstract dimensions, such as public perception, radiological safety, nuclear safety, bulk transmission, regulatory margin, environmental, physical security, cyber security, compliance, customers not served, power quality, or personnel safety.
- Wanted a way to compare nuclear projects with power operations or transmission projects effectively comparing apples to oranges.
- TVA has implemented C55 across all business units to level the playing field for all projects
- To promote implementation, CFO established the Enterprise Competition Funding (ECF) process and set approximately 5% of the annual budget capital investment budget aside. C55 was used to compete with other business units to value and select projects for the best benefit of the company.
- C55 requires significantly more detail and analysis of subtle information than obsolete LTAM or HTM versions
- Helps to proactively identify vulnerabilities and stabilize investment portfolio over the years. TVA has been able to transition from a one year investment portfolio to a three year investment portfolio.
- Evaluate value for radiological risk or nuclear risk by creating a scale from negligible consequence to catastrophic consequence and assign a financial value to each risk category. This is done for each abstract dimension of value.
- Copperleaf provided a framework for many categories. TVA developed a custom value for regulatory margin in the reactor oversight process.
- A potential consequences scale was developed around risk in cornerstone performance indicators and values were assigned to each.
- In some cases, had to reevaluate actual values because it conflicted with data of actual costs of real-world consequences.
- The process is transparent and highlights assumptions and requires justification against historical data to prevent gaming the system by overestimating cost of consequences to win funding. The process shows inputs clearly and methodology challengeable.

#### Q&A

- Q1. When you consider nuclear safety, how are you considering it?
- A1. As an example, we evaluate for value of decreasing core damage probability.
- Q2. How did you evaluate the dollar values to assign to each category of consequences?

A2. We used input from Copperleaf and evaluation of historical real-world impacts to determine actual values of real-life consequences.

Q3. Do the project value models sum to a total value?

A3. Each value calculated across the multitude of dimensions is summed in a total value model in a clear method demonstrating sources of value for each project.

Q4. Do you get push-back along the lines of industrial safety or reactor safety from criticism for putting a dollar value on loss of human life? A4. There was criticism but as a company we agreed to common values for loss of human life that was consistent across all business units.

Practical Applications of Project Evaluation through Value Modeling and Project Portfolio Optimization John Crawford (Tennessee Valley Authority)

#### **Presentation Notes**

- Watts Barr main feed pump filters represent single point vulnerabilities which can result in a unit down power evaluated with C55.
- Evaluated the project and determined it was a positive value project.
- C55 was also able to predict that delaying the investment a few years would improve the value returned by the project.
- Browns Ferry had a computer security system upgrade to replace system main computer.
- Two possible solutions: replace just the computer or upgrade to fiber optic cables to support simple, off-the-shelf camera replacements.
  - Was able to value the cost of security system downtime as well as the value of simpler repair costs for the fiber optic system.
- Able to go through and value multiple projects and then do a sensitivity analysis to determine what projects to do when. Using a ratio of value-to-cost the model shows where you can get the most bang for your buck.
- Negative investment value projects may still be on the investment portfolio but may be delayed for an optimal time.
- Setting budget constraints can create situations where you don't get as much value because the optimal funding portfolio may defer large high-value projects in favor of less expensive projects with poorer returns to fill out the budget.
- Biggest driver for C55 optimization is the value to cost ratio calculated from total value including quantitative detailed risk/benefits and project duration as well as total project costs including generation loss and scope control.
- Important to consider value of contingent work that is necessary to complete the project and included in cost.
- Hard to optimize more expensive projects than smaller projects.
- TVA Enterprise Competition Fund (ECF) was a training exercise for the enterprise to compete for funds across business units using the new C55 value framework.
- 2018 and 2019 ECF completed.
- Expanding the scale for 2020 into a five year portfolio.

#### Q&A

Q1. Is the point of the time curve to schedule the investment at the peak of the curve? And why does the curve fall over time?

A1. Yes, the target investment time is at the peak of the curve when the maximum value will be obtained from the investment. The curve declines over time because the life of the plant is built into the model and the investment is closer to end of life span which is less impactful.

Q2. Output is in "value units" so does that mean it is not actual dollars?

A2. Right, some of the value categories produce actual hard dollar savings in efficiency gains but others are just an approximation of present value.

Q2. It looked like you are seeking license renewals are they already in the plan?

A2. No. Subsequent license renewal is not yet in the model but we will get it incorporated into the 20 year plan to consider the cost of the modifications required to obtain the license renewal.

Q3. Does the model have a way to evaluate for savings from reducing staff?

A3. Yes. The Browns Ferry security model includes potential for reducing staffing requirements and the tool is capable of modeling staffing changes although, this is not typically used for nuclear projects.

Q4. Have you evaluated projects in progress that had very questionable value that you wanted to stop?

A4. Yes, we had a project in progress that we considered doing on another unit and upon analysis determined it would not add value. It is difficult sometimes to model single point vulnerability projects for which there is no historical data of the vulnerability

#### Group Q&A

Q1. Means to incorporate an overlap between two projects that produce the same value for example

A1. Model the two alternatives separately or could model two projects to be incorporated simultaneously.

Q2. What if two objectives are in the plan but they share the same value. Are you double counting?

A2. We haven't encountered that problem yet.

Q3. Is there a way to priorities faster return of cash even if the project might produce less long-term value?

A3. You could scale hard dollar savings to priorities them over other estimates of value. You can also weight the individual value models. The default is 1 for all, but you could weight, for example, industrial safety higher if you are having a problem there.

Q4. Is there a way for the software to model a partial project?

A4. This is more difficult to model but you could just create an alternative partial project to evaluate the value of a subset of a larger project.

Q5. Are you reviewing past evaluations to determine if you are obtaining the value from projects that you had modeled? A5. Yes, our financial services has created a group to specifically look back and evaluate whether we are actually getting the value back that we said we would.

#### Session Takeaway

Modeling the value of capital investment projects is complex when considering the hard dollar gains and more abstract value from nuclear safety, especially when comparing projects across business units. To effectively compare projects, the Copperleaf decision analytics tool has been used at several utilities to determine total project value and build optimal investment portfolios.

# Session 2: Innovations Improving Operational and Financial Performance at Duke Energy

Session Organizer: Maria Hernandez (Duke Energy)

While the utility environment in the United States is rapidly changing in response to low natural gas prices and regulations, Duke Energy is taking a lead role in creative use of innovations to achieve key financial metrics while meeting shareholder expectations for reducing cost. In this session, we will see the latest use of innovative approaches to reduce spending while improving overall company operations.

Our first presentation will examine the financial balancing act utilities must manage in meeting shareholder expectations and managing key financial metrics. The presenter will discuss the key financial metrics used in managing utilities and the challenges of keeping all metrics in a healthy range despite conflicting objectives associated with growing earnings, maintaining liquidity, minimizing debt and paying dividends all while reducing O&M costs, making investments and managing rate case lag. The presentation will also discuss the Duke Energy Nuclear Fleet and the cost cutting measures Duke nuclear has undergone over the last few years to contribute to meeting the company's financial objectives and operating in a more efficient digital environment. Lastly, the presentation will also touch on the impacts and current events related to the decommissioning of the Crystal River 3 plant and the impacts of Coal Ash Clean Up.

Innovation is a term used broadly in nearly every industry expressing the desire, and often ability, to demonstrate relevance improving cost efficiency in our technological age. Applying technological solutions offers an array of opportunities to make efficient step-change improvements. As electric utilities holding nuclear generation look to extend operations with existing assets, sustainability will undoubtedly require improved efficiencies for mid-century operations. Competition with renewables, natural gas, emerging technologies and independent producers has created very real disruption for existing nuclear generation. But innovation may not be enough to create a competitive edge with a business that has significant regulatory requirements, safety and reliability infrastructure and high operating and maintenance costs that must be confronted. Even when innovation can provide some of these improvements, can enough inefficiencies be removed that will reap a harvest of savings that can create a sustainable and proactive competitive position moving forward? What else may be needed to capitalize on innovative opportunities that can create a formula for success? In this presentation these topics will be explored sharing some learnings from the nuclear industry and Duke Energy's efforts to apply and sustain a business model that will position nuclear operators for long-term generation.

#### Duke Energy Overview Danny Wiles (Duke Energy)

#### **Presentation Notes**

- Key parts of Duke's strategy are to modernize the energy grid, generate cleaner energy, and expand natural gas infrastructure.
- Stakeholder engagements are a new part of the strategy that is necessary to accomplishing the strategy.
- Transformation of the customer experience is increasingly important to the company.
- Financial expectations matter even in regulated utilities because markets are rewarding utilities with expectations of long-term EPS growth with high EPS multiples.
- Customer electricity usage has not been growing over the past few years due to improvements in energy efficiency and so earnings growth opportunities don't come from revenue growth but instead must come from improving costs.
- Duke is targeting flat O&M costs over the next 5 years, a difficult undertaking considering the effects of inflation and the imposition of new costs such as cyber-security costs or environmental costs.
- Nobody wants to be the first in the industry to step away from this trend and claim that the cost reductions can't be met.
- Rate commissions are required to re-evaluate total base rate case every time a new cost from regulation is added. Can't recover the individual cost as an independent rate case. May require annual rate cases to justify real time cost recovery.
- Seeking rates that are lower than the national average while also increasing earnings growth.
- Retiring coal over time; energy mix decline from 61% coal in 2005 to 31% in 2018 and projecting 15% in 2030.
- Maintaining nuclear at approximately 30% of mix and replacing coal with renewables and natural gas generation. Nuclear represents 17% of total capacity but runs nuclear plants as often as they possibly can.
- Nuclear strategy is to optimize reliability and operate cost effectively to justify continued operation.
- Some examples of nuclear cost savings include: focus on contractor oversight, staffing reductions of 25% over past 3-4 years, outage durations shrank by 1/3 in past 4 years, process improvements, technology initiatives, transition focus from time-based to condition-based maintenance, improved physical security measures.
- Recently announced decontamination and dismantlement of Crystal River Nuclear Unit by ADP.
- The future is cloudy, and the industry is changing.

#### Q&A

Q1. I understand you had some tough decisions in order to remain competitive. You talked about condition-based maintenance instead of time-based maintenance and staffing reductions, they seem risky, have you evaluated these decisions to ensure you remain safe.

A1. Yes, we have a risk management team with us to make these decisions. We are taking more risk but it is a measured risk within acceptable risk tolerances. It is part of our culture and we are taking more risks than we have in the past.

Q2. How much are you considering electrification of direct fire processes?

A2. We are seeing more self-generation and we are trying to partner with them to do co-generation. We also have a long-range planning group that is incorporating analysis from the future of electric vehicles, CNG vehicles, and other energy demand predictions. Five years ago, we thought there would be more electrification today than there is.

Q3. What are using as goals is to be competitive?

A3. Our PJM dispatch price model estimates what target we would need to achieve if we were not a regulated utility.

#### Q4. Are you having a discussion on ACP?

A4. We are lagging tremendously the industry in the markets because of ACP and other negative regulatory issues and uncertainties.

# Innovation and Digital Transformation at Duke Energy Dale Holden (*Duke Energy*)

#### Presentation Notes

- There is no silver bullet in innovation, but it is a very important mentality. Enable the value from innovation.
- Utilities in general don't innovate very well, especially in a regulated space.
- Until the last 3-5 years there weren't many drivers for innovation at Duke.
- Need to gain efficiency from innovation, reap it, and sustain our operation competitiveness.
- We have had targeted focus on labor or other areas and when we lost focus the costs grew again, demonstrating the need to create a sustainability.
- · We must maintain safety, reliability, and predictability while creating competitiveness, sustainability, and vitality.
- We were over conservative now we are conservative in our risk approach.
- We define innovation as something new, an idea, method or device and also about adopting new behaviors, practices and processes.
- Must understand where you are, what must be done to clean up your process and where you need to put in the guardrails.
- Duke has an innovation organization that includes 2 main paths for innovation including a digital focused group and a group focused on nuclear business processes.
- Direct link from innovators to the CNO to ensure recommendations make it to the key decision makers.
- We use Agile and Scrum methodology.
- Examples initiatives include WiFi coverage in the plant power block, advanced remote monitoring of equipment including additional sensors and analytics to predict equipment health and replace manual monitoring
- Held workshops to identify pain points and sett of eight weeks sprints to develop an enterprise roadmap.

- Demo days every 2 weeks to capture leadership feedback, lock in vision, and move rapidly.
- Agile approach to develop an MVP (minimum viable product) with high engagement from customer over rapid experimentation and iteration. Scale successful MVPs with funding focus on strategic objectives and projects with high ROI.
- Culture change to a software type mindset which makes fast failure okay.
- Building business agility into nuclear is necessary.
- We build teams using the Agile team approach including product owner, product analyst, design lead, tech lead, and supporting resources.
- Nuclear needs a mindset that can envisions a safe pit stop in the Indy 500 taking a mere 4 seconds.
- Waterfall approach low uncertainty, stable requirements vs. Agile approach is high uncertainty with changing requirements.
- Build, measure, learn strategy.
- Assess desirability, feasibility, and viability at each stage of a project to determine if continuing the project is necessary.
- Change management requires awareness, desire, knowledge, ability, and reinforcement
- Must evaluate value added and non-value-added activities.

#### Q&A

Q1. You focused a lot on process but what about addressing culture. How to you get people on the front lines to be innovative when their focus is on other metrics?

A1. There is no question that the culture we have built is command and control, if I generate a new idea and it is shot down then the idea dies. If you are doing a top down innovation it just does not work. What it really comes down to is a leadership fortitude piece where we don't have the right accountability in place from the supervisor level up tied to moving the organization in a different direction. All of our nuclear leadership is going to get together in two weeks and we are going to teach these concepts. We don't utilize people very much, and in effect we devalue them by telling them what to do and have never given them the opportunity to share their cognitive ability. The complicating strategy is that we have attacked everything from a top down approach and that has moved zero needles. Instead we are starting at the base and that is going to add value to the worker and build them into the future.

#### Q2. Can you give more examples of things you think will be successful?

A2. We are developing a mobile worker app that is slick and it will enable seamless signing of work orders and other things and we have had fantastic feedback, but adoption has been poor because the supervisors have not been enabled.

#### Key Learnings, Recommendations, and/or Best Practices

- From the perspective an innovator, a single innovation has only a marginal return unless the process for innovation spreads to the rest of the organization to create a sustainable innovative process.
- Innovation is all about process including the sustainable process change than goes with it otherwise the gains from innovation will be lost.

#### Session Takeaway

Reduced electrical demand from improving energy efficiency limits revenue growth in the utility industry leading the businesses to generate EPS growth from cost cutting measures and other innovations. Duke Energy is attempting to use the agile work method developed in the software industry to implement new projects and create a culture and framework for sustainable innovation.

# Session 3: Subsequent License Renewal Activities - Past, Present, and Future

Session Organizers: Emma Wong (EPRI), Garry Young (Entergy)

In the past 20 years, the NRC has approved 94 license renewals for up to 20 years of additional operation. Despite these license renewals, five of the units with renewed licenses have permanently shut down and additional units are being considered for permanent shutdown prior to reaching the end of their renewed licenses. By 2040 half of the operating U.S. nuclear reactors will have reached the licensed limit of 60 years of operation, while electricity demand, according to forecasts, will continue to increase. At that time, the closure of a large group of reactors reaching the end of their operating license could lead to significant increases in greenhouse gas emissions and electricity costs while threatening the reliability of the electric system and reducing energy diversity and security. Subsequent License Renewal (SLR) activities to allow U.S. nuclear plants to obtain an operating license for up to 80 years of operation have recently reached a major milestone with the submittal of three SLR applications to the NRC in the last year. This session will include a summary of the efforts that led up to the submittal of SLR applications, the status of NRC review of the applications, and future plans for SLR.

#### Coordinated Approach to Subsequent License Renewal (SLR) Emma Wong (EPRI)

- 10 years ago, the question on everyone's mind was can the fleet continue to operate safely into the future?
- Building on research, experience, and inspection results to approach SLR
- DOE, Light Water Reactor Sustainability Program accomplishments and planning, NEI site renewal roadmap, EPRI, lead plants of Surrey and Peach Bottom active early on.
- Four key technical areas: reactor pressure vessel neutron embrittlement, irradiation assisted stress corrosion cracking of reactor vessel internals
- Conclusions from the research, technical bases have been established and incorporated into ageing management programs, now can move into modernization and other improvements
- Today 98 operating reactors, most of which have received a 1<sup>st</sup> license renewal
- Regulatory basis for SLR 60 to 80 is established
- 3 applications in review by NRC now

#### U.S. NRC

Eric Oesterle (U.S. NRC)

- 1995 refinements to the 1990 refined scope of license renewal and led to 94 initial license renewals to date
- 46 reactors are currently operating on a license renewal
- Firm foundation of renewal guidance was established in NUREGs in 1990
- 3 categories of renewals Pre GALL\*, GALL rev 1, and GALL rev 2.
- Interim Staff Guidance documents issued following new understanding.
- In 2018 3 SLR applications were approved on a new 18-month review cycle

• NRC committed to working together with the industry for continued SLR.

\*GALL: "Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report," (NUREG-2191), provides guidance to nuclear power plant licensees for developing their applications for subsequent license renewal. The report describes AMPs (Aging Management Programs) necessary for all nuclear plants during the 60-80 year operating period, as well as enhancements to existing AMPs implemented during the 40-60 year period. These AMPs focus on the effects of extended operation and high radiation exposure on reactor parts, concrete containment structures, piping and electrical cables, among other things.

#### Subsequent License Renewal Peach Bottom Atomic Power Station 2 & 3 Albert Piha (*Exelon Generation*)

- Exelon has extensive ageing maintenance experience
- Peach bottom is the BWR lead plant, first renewal application submitted 2001, new license issued in 2003.
- Approaching 2<sup>nd</sup> license renewal part 51 for environmental review and part 54 safety review.
- New work in the aging management program
- 2<sup>nd</sup> application submitted in 2018 and anticipated renewal in 2020
- Key topics for reviews include sacrificial shield wall, groundwater, copper > 15% Zn due to ammonia issues around, resolving EPRI chemistry revisions, structural stainless steel and aluminum cracking due to halides arising from an inspection technique confusion.
- New AMPs required for 2<sup>nd</sup> license renewal but not many more than GALL Rev. 2.
- Time limited aging analysis needs to be developed early because they tend to be time limiting factors.
- Challenges for TLAA include finding old documents, grey areas around regulations and governing documents, changing standards between 1<sup>st</sup> and 2<sup>nd</sup> license renewal
- Old fluence models may not be accurate enough above the beltline
- We didn't find any new ageing issues, but we needed to go through thousands of items to sort through.
- Project team has a member stationed at the site as a lead point of contact to coordinate all the onsite activities. Most on-site personnel are
  not as concerned about licensing in the distant future as they are about the priorities facing them in the near term.
- Exelon has not selected which plant is next for license renewal in the fleet.

#### Dominion Energy Approach to Subsequent License Renewal

Paul Phelps (Dominion Energy)

#### **Presentation Notes**

- It takes a significant budget, staff, and time to accomplish a SLR.
- Nuclear is important because
- In Virginia nuclear is 43% of base load.
- Carbon free cannot be accomplished without nuclear.
- Dominion, Exelon, and NRC collaborated on how to accomplish the SLR process in 2010-2013
- Dominion is pursuing Surry SLR to extend past 2032
- The SLR is only 1 leg of the stool, advance planning is required to modernize equipment.
- Very fortunate that many engineers who were involved with the first licensing still worked for the company and were available to prepare for the SLR.
- Surrey and North Anna are both on schedule and on budget for SLR.
- Seeking to submit application in 2020 or 2021.
- Everything is submitted in a portal electronically and they were able to review the documents pre-submittal.
- Once the application is through acceptance review operation past initial license is permitted while work is ongoing.
- Key lessons learned include benchmarking against other plants or other utilities that have gone through the process.
- Recommended clearing up the guidance to make the process more efficient.
- Plant improvements require significant upgrades and replacements including, digital I&C, condenser replacement, carbon fiber reinforced polymer upgrades, electric generator replacement, and steam generator replacement.

#### Q&A

Q1. How does the NRC review look at equipment upgrades in the application?

A1. The SLR application looks at the aging management program as part of the application. We use that as a tool to control equipment reliability and plan.

Q2. Will the upgrades allow you to operate the plant with fewer personnel?

A2. Yes. The number 1 cost of operating a nuclear plant is people and we will be able to reduce personnel.

#### Duke Energy Subsequent License Renewal

# Greg Robison (Duke Energy)

#### Presentation Notes

- Duke has 11 nuclear units over 6 sites in the Carolinas.
- We are trying to line up behind climate change and get nuclear to fit into that conversation.
- SLR is valuable to the energy portfolio, valuable to the customers as a proven stable reliable source of energy.
- Duke is a strong advocate for renewing the licensing.
- Oconee is a pre GALL plant and needs to move to a GALL solution in order to conform with regulatory standardization and meet acceptability rules to ensure a successful SLR process.
- Need a diverse team but not everyone is starting with a consistent depth of knowledge.
- Past reorganizations made it to easy for many people to leave and retire and the company lost many of the wise people and their wisdom to the golf course.
- Varying styles of design records across sites and backgrounds biases the team challenging fleet process standardizations.
- Environmental department was restructured and so we have to outsource the environmental report for the SLR to a contractor but still have to find supporting records.

#### Q&A

Q1. What is the NRCs perspective on how SLR and 5069 relate?

A1. A principle of SLR is that you can continue to operate under current licensing basis during the review cycle. We want to incorporate the work from 5069 into the process for SLR. 5069 allows us to leverage capital projects prior to SLR so that we can license more equipment as non-safety related.

Q2 Why can't we as an industry tell the story of how nuclear power in the total cycle is the best solution for environmental impact? A2. In many ways the political environment is seeking projects that can be online in 9 months when the nature of nuclear is to be careful and cautious and the political winds many change but now, we are faced with competing on near term solutions.

Q3. It seems like the plants picked for the early renewals were quick but there were many plants in the Northeast that took a very long time to obtain the renewal. Do you think the 18-month review cycle will be sustainable?

A3. The first plants were pre-GALL plants and what helped was deciding to start with a Delta review or just use the SLR guidance. Regarding the 18 months revised timeline the NRC plans to demonstrate they can meet the timeline for what is under the NRCs control. The NRC can't control hearings and contentions, but they will accomplish a timely review.

#### Q4. How are the current SLR projects coming with respect to budget?

A4. Duke and Dominion are coming un under-budget but when contentions come in they can be expensive and that comes right out of the budget. If you spend the time and have a quality application the review cycle takes less time. From the NRC perspective staff support to respond at hearings does not get charged to the project.

#### Key Learnings, Recommendations, and/or Best Practices

- It is essential to plan early and prepare a high-quality application for license renewal as the work involved can be greater than expected.
- Taking a fleet wide approach has many advantages but can have many challenges as a diverse team does not start from the same knowledge base requiring more work than expected to synchronize the team.
- Though independent from preparing an SLR application it is important to work together with the preparation of long term maintenance and improvement plans.

#### Session Takeaway

Since the first license renewal at Peach Bottom in 2003 the process has improved and is working well on a 18 month review schedule. The NRC and industry are both committed to continuing appropriate license renewals into the future.

# Session 4: Aggregate Risk Associated with Backlogs of Work on What Was Critical Equipment That is Now Non Critical

#### Session Organizers: Jon Anderson (ACA Proactive), Frank Nelms (ScottMadden)

This topic started with one Operator who asked, "Why are we inflicting maintenance on the plant?" He asked, "Why did we take apart a perfectly operating pump and then have it fail shortly after return to service?" The topic expanded with the Equipment Reliability Working Group (ERWG) concern that we are growing the aggregate risk to the plant by not completing work on Non-Critical equipment that used to be called Critical, before Revision 5 to INPO AP-913. Participants will take away a better understanding of Operations perspective on equipment reliability, actions we can take to improve our reliability and a factual understanding of the concern with this aggregate risk.

Equipment reliability has become a major focus for the nuclear industry, where Maintenance, Engineering, and Work Management all play key roles. Bruce Power addressed recurring equipment reliability and performance challenges by launching the Equipment Performance Division (EPD), with the goal of achieving EXCELlence in equipment reliability and performance. EPD combines Maintenance, Component Engineering, and Work Management into a single team, who are responsible for troubleshooting, planning, scheduling, and executing work (online and outage) across site for the components they own. This session will examine the drivers for change, how Bruce Power structured the new organization, efficiencies and improvements achieved so far, lessons learned, and expectations going forward.

#### Equipment Reliability and Maintenance: The Operations Perspective Dan Randolph (*Farley Training Director SNC*)

#### **Presentation Notes**

- Major gaps found from setting up for maintenance or testing in operations were due to operators not understanding or knowing why these
  activities were taking place.
- Understanding why a clearance is being hung or why a clearance is written a certain way will help give the operators a better perspective and engagement with activities they are setting up for.
- Establish training or job shadowing for cross discipline groups to see the challenges operations faces when setting up systems for maintenance or testing
- Placing operations personal in other functional groups to bring an Operations point of view to the processes.
- Look at surveillance frequency control programs and see if all of the commitments still exist
- Look in to placing your ROs and AOs in positions to gain exposure to the work management process

#### Q&A

Q1. Are you having operators go through training with engineering to help understand the basis for work in the plant?

A1. No, currently do not have a program setup to do that at Exelon. Process is working for other companies.

Q2. Do you rotate operators (NLO and ROs) through work management to see the process? (Some plants rotate operators to work control positions for a temporary basis for cross training)

A2. Clearance writers get some exposure. Troubles with the union in accomplishing some of those things at Exelon to get rotations.

## Are We In Control of the Plant or is the Plant In Control of Us?

Rich Weisband (Exelon Generation)

- We have functional equipment groups for planning maintenance. Software can update many FEG items at once, unlike older systems.
- Make cycle managers able to make changes in FEG
- Have tools for effective monitoring of plant reliability dashboards
- · Link functional equipment groups to system outage windows and long-term plan
- In the CMS system able to tie FEG with system outage and when system outage plan changes can automatically update all work tied to the FEG
- Tool ties manpower resources to work to determine if cycle plan changes will overwhelm resources
- Pulling plans together across multiple sites can produce a detailed fleet cycle plan that ensures no specific resources are double booked
- Plant reliability dashboard with four areas including events, degraded equipment, monitoring, maintenance strategy issues
- Dashboards automatically populated from other systems where data is entered and can be sorted in any way
- The dashboard is part of work management function instead of under engineering so that all parts of the organization are speaking to the same data, and can be accessed by multiple groups
- Software can help measure the effectiveness of maintenance strategies.
- Review why corrective maintenance is identified and determine whether it was self-identified or identified through a plant failure. Use this information to assess the effectiveness of maintenance strategies.
- Some organizations measure effectiveness by ability to go from maintenance window to window without interruption.
- We use FEG analytics to review spending, system health, cycle plan strategy, and gauge maintenance strategy effectiveness. Attempting to
  incorporate machine learning into the analytics to help identify what is preventing moving from window to window and review the viability of the
  cycle plan.
- Success looks like all PMs and CMs aligning with scheduled windows and also being able to stretch windows in the plan.
- We need to find our own issues before the plant finds them for us and stay in control of the plant.

#### Equipment Performance Division: Improving Equipment Reliability & Performance

Jordan Marshall, Div. Mgr, Equipment Performance Teams (Bruce Power) & Frank Nelms, Manager (ScottMadden, Inc.)

Bruce Nuclear Power Plant is the largest nuclear power plant in the world. This station has 8 units and employs 4200 people. Many of the units require major refurbishment, but as part of an agreement with their regulator they could not increase head count. The station underwent an organizational change focused on improving equipment reliability. Bruce currently does not have as much financial pressure as American nuclear plants face. Their driver was more geared towards maximizing station reliability. The driver was to lower average forced loss rate from 3% to 0.5%. They need to change behaviors to have station employees to take more ownership. In summary, the work load at Bruce is going to increase, but they are not going to get more resources. Therefore, the workload issue will have to be resolved through increasing efficiency.

One of the issues was alignment and accountability. Different departments had different goals and the goals did not align to a common goal. They needed to reduce finger pointing between disciplines. They needed to standardize processes between Bruce A and Bruce B. These are basically two different stations at the same site.

So how did they resolve these issues. This was through re-organization. It took about a year to implement. Several options for the organization were considered. They ultimately went with a performance team concept. One key to the implementation of the reorganization was communicating early and often with transparency and opportunities for feedback.

Performance Teams are cross functional teams that are grouped by components. They have ownership for the components and set the course for the maintenance that is performed. They set their schedule (both short and long-term planning) and answer corrective actions. This team specialization has resulted in faster responses to equipment issues. The teams have resulted in better informed and more through resolutions. Long standing issues are getting resolved because the team can be more through in their analysis. Schedule adherence and scope survival has dramatically improved, went from 50% schedule adherence to 80%. The culture has changed such that more equipment failure investigations are performed and more re-work is being identified. In other words, the station has a culture of wanting to improve.

#### Q&A

- Q1. If you could go back and do this re-organization differently what would you do?
- A1. Better communicate to the individuals exactly what their role would be ahead of time.
- Q2. Who do the teams report to?
- A2. The Senior Vice President of Equipment Performance, who reports to the Chief Nuclear Officer, not to site plant management.
- Q3. What kind of turnover and attrition do you expect?

A3. Minimal since the Bruce workforce is younger. They have created a maintenance pipeline, where they expect more retirements in the near future. This ensures maintenance remains staffed and knowledgable.

- Q4. What drives your refurbishment of the units?
- A4. The site has to perform so the regulator and stake holders will continue to authorize resources to refurbish the units.

#### Key Learnings, Recommendations, and/or Best Practices

- Job shadowing can expose and help align organizations. It helps maintenance have an OPS perspective or OPS to have a maintenance perspective. You could substitute any organization into the former statement.
- Everyone looking at the same reports can yield dividends in alignment on where is it best to expend resources.
- If you align Functional Equipment Groups with Maintenance Rule Functions then you can have automated maintenance rule data for effectiveness review.
- Cross discipline team ownership of the components benefits equipment reliability.

#### Session Takeaway

Explain 'why' maintenance is being performed to operators. Use Functional Equipment Groups and cycle plans to maximize efficiency. A reorganization focused on equipment reliability and out of the box thinking can deliver results.

## Session 5: 50.69 - Road to Savings

Session Organizer: Preeti Furtado (Exelon)

"Where is the road to savings?" This combined session – with Engineering and Risk Management perspectives - will include an informative presentation about 50.69 business plan development, implementation considerations, alternative treatment processes, and articulation of savings. The presentation will include examples of savings realized due to the exemption of various special treatments. The session will also explore change management challenges associated with this fundamentally new approach to expanded categorization of systems/components, reduced scope/treatment of certain Part 50 programs, and "graded quality". Participants will have the opportunity to ask panel members questions on their actual experience with the program, examples of some "early wins", and what to expect during the licensing process and implementation of 50.69.

#### Regulatory Activities on 50.69 Implementation

Mike Franovich (U.S. NRC)

- 50.69 has been around since 2004 looking at risk informed regulation and promoting more use of PRA in classification
  - Looked for a better grading scale of SSCs
  - There was a pilot at STP that preceded 50.69
  - Part of DNP: bulletin NEI 17-09
    - Coded blue not urgent but savings available
      - Better effort to achieve it by standardizing and optimizing treatment of SSCs
- NRC anticipates full industry implementation as program is refined and improved
- Categorized based on safety significance and allow a risk informed (more than PRA) evaluation using endorsed guidance to classify into
- RISC-3 for relief from special treatment requirements (QA, EQ, MRule, etc.) and apply alternate treatment for savings
- Find that very few SSCs migrate up in significance
- Performance based requirement
  - Performance declines use CAP to address issue
  - o Integrated Decision Making Panel similar to MRule expert panel for categorization and status progress
- Will need a License Amendment
  - NRC will inspect initial overall program to ensure process was followed
    - o If there is an observable trend in degradation for RISC-3 SSCs then additional inspections may be necessary
- NRC PRA and inspectors need to be brought together to gain level of awareness of what program entails internal training conducted
   Lessons learned
- Lessons learned
   Cuidenes is 1
  - Guidance is 15 years old heard from PWROG that more should be done in categorization process when considering Defense in Depth and shutdown/low power conditions, etc., to enhance guidance
  - What is a forward fit?
    - o Use risk insights/principles when you don't need to adhere to strict deterministic requirements for design changes

#### Road to Savings

Lance Sharrett (Arizona Public Service)

- Practical application information
- Not every system at every station has same savings capacity or opportunities as others look at factors to pick right systems to scope
   Apply 50.69 where it will save money on things like ISI, IST, LLRT, MR etc.
- Alternative treatment plans are where the money is saved
  - Will be in debt when starting due to needed updates to support program
    - May have to spend money to develop Alternative Treatment, but will save money in the long run
- Will have widespread effects outside of direct 50.69 processes such as procedures
- Do tabletop exercises to identify needed changes to process
- Success is gained when depts like operations take on program and help with its development
- Use 50.69 to meet production cost savings
  - Might not be able to show right now, but if it can be shown where opportunities of 50.69 going, then have a better chance of approval and more resources, money, etc.
  - o Show owners you can produce savings that will show return on investment

#### Vogtle 1&2 50.69 Alternative Treatment (AT)

Dan Monahon (Southern Nuclear Company)

- Working on 50.69 from an operations perspective
- Pilot for the industry in 2011 approved in 2014.
- Started out quick and designated a couple systems then slowed down other than some maintenance
- 2018 got involved again and discovered that we really hadn't done the best job.
- What we had done is created IST "light" for many components instead of a true alternative treatment because people didn't want to do things
  differently and go through the AT process.
- Had to start by learning the programs first then define the AT process to get some savings
- No two systems are identical and so not everyone is going to get the same savings out of an AT process.
- It is possible to get a component out of IST but because of other commitments to INPO or some other licensing document you are unable to show any savings.
- Remember that the component is still important, just not as important as we once thought it was.
- Program owners need to be educated and aligned with 50.69 implementation team. Must get program owners onboard with the process especially when there are little organizational incentives for them to take on the work of going through the AT process.
- Must dedicate resources to go through the AT process to prevent overburdening resources.
- Example Original supplier for a new diaphragm for a valve stopped Appx. B program cost for replacement reduced from \$22,968 to \$40
- Example 1" SS drain valve replacement cost \$20,414 reduced to \$1,556

- Example: Radiation Monitoring sample pump/motor cost reduced from (\$219,000/\$2,500) to (\$14,561/\$383) and a modern superior product
  with the same form, fit, and function.
- Cut a contract labor cost for inservice inspection (ISI) 20% per outage.
- Inservice testing scope for categorized systems reduced by 42%
- Containment full spray flow test avoided during an outage saving \$200,000
- Over 1000 ops/main/eng man hours saved per year.

# 10 CFR 50.69 Implementation: Lessons Learned & Alternative Treatment Preeti Furtado (*Exelon*)

- · We started the project before we got a business plan or project plan together because executives had seen efficiency bulletins published
- Got through 8 systems at Limerick and then decided to put together a business plan to roll this out to the fleet
- Decision made to just do a pilot project at Limerick and get a proof of concept in place and then proceed with other sites.
- Developed a business case around categorization results, material savings, AT, ancillary savings including contract services (paint/lagging), full time equivalents (FTE) maintenance activities, did not consider big wins.
- Could not capitalize the project and instead had to use O&M budget for the project
- Initial estimates were for 50% of safety related components would end up RISC 3
- Estimated 5% of the reclassified components were not commercially available as a RISC 3 component
- Expected 10% of plans to be approved by the site.
- Used an integrated project team at the corporate level including a procurement engineer and other backgrounds to get the project to be successful.
- You would think that people would be open to the idea of lifting burdens but it doesn't always work out that way.
- Need a good tool to perform categorization. Tried Microsoft Access but it was too limited, and we switched a better system
- Need a formal change management plan for initial implementation because it can be an uphill battle when approaching the people who are
  impacted by the process.
- Need to learn the programs from the program experts and then learn how to adapt the program to 50.69
- Even if you do education and training in advance people don't quite realize how it impacts them until its time to put their signature on a page or implement the idea.
- Avoid the creation of new processes like a new sub program for 50.69, instead use existing programs to transition for example using an existing change request program for preventative maintenance.
- Try to standardize savings metrics with those reported by other initiatives to communicate clearly.
- Examples: Standby liquid control system Relief Valve Test and Replacement extended from 8 to 15 yrs resulting in an annualized savings of \$29,400/yr
- Example: Primary containment instrument gas relive valve test extended 8 to 15yrs annualized savings \$16,200/yr
- Example: Extended Drywell HVAC motor replacement saving \$260,000/yr
- For 6 systems evaluated so far PM savings for material is \$368,000/yr and labor \$115,000/yr
- For 3 systems evaluated for material savings for corrective maintenance \$107,000/yr for 10 years projected
- Also many other "soft" savings to consider including PM frequency inspections, elimination of pressure tests, removal of supplemental position indication requirements, elimination for repair and replacement plans, no EQ testing, no QC, short lead times, reduced installation and testing times leading to reduced exposure to radiation, less inventory costs.

#### Q&A

Q1. What happens if fraudulent material makes its way into the nuclear supply change and what does that cost the industry in terms of regulatory margin, public perception, other consequences.

A1. Must evaluate component for reasonable confidence that it will meet safety function. Look for data and gather information. It's still a RISC-3 component and low safety significance. We use available data on commercial parts in other existing applications and we have to remember that it will be used in a non-safety related, non-high-risk application. There is a feedback and performance monitoring system for these conditions.

Q2. Is there a RISC 3 component that could later be revaluated up and if you have AT in place would you have to change that. A2. That could come up but we have margin in place to resolve that when a component is considered for AT. There are measures in place to deal with components that are discovered to be out of specification that could be used to upgrade a component back to safety related if that was required.

#### Q3. Can you step through a process of essential chilled water scoping?

A3. Not modeled in PRA. Go through categorization process, still required to perform analysis for treatment to ensure that component will still meet safety function, just on different testing frequency, etc. We evaluate the component or the system on many dimensions including PRA, defense in depth, and many other factors are all evaluated producing a very large document detailing the basis for that decision

Q4. Does the NRC perform inspections of ATs?

A4. The NRC uses performance and outcome-based methods for evaluating ATs put in place.

Q5. Do you have inventory where even if there could be savings the inventory is already there and so the savings might not come until the future? A5. We don't have many safety related components in inventory and when we do have parts, we will use some repair parts to rebuild components that are now non-safety related. Also, in many cases we are still required to maintain inventory of a component that exists across the plant and maybe only half of them are now under AT. If we need to replace a component under AT we can leave the item in inventory and replace it with a less expensive component. In other cases, if all the components are no longer safety related, we can use the inventory part and the immediate savings now comes from reduction in inventory warehousing costs and future savings comes from future replacement costs.

Q6. Does 50.69 address technical specifications?

A6. No. 50.69 does not address technical specifications. The component must still meet all original design requirements.

Q7. Will there be standard AT plans to be used across the industry?

A7. There will be generic alternative treatment plans proposed. No two systems are identical but there is room for common justifications across many sites. More AT examples can be shared to collaborate.

#### Q8. Is the impact on the equipment database considered as part of your process?

A8. Yes, once the IDP approves the categorization and we now have a new component newly classified on our common database of components. That common database is the starting point across the site for all other processes including procurement, maintenance, etc.

Q9. What is the impediment to taking a plant wide approach to do it all at once to get and realize all the savings sooner?

A9. Dependent on site and level of initial support. May take small implementation or detailed business case to show results before full buy-in. Just like going to PHC with mod proposal. It takes time to demonstrate we are going to get the savings we are looking for first. We need to bring a model with priorities to focus on. Exelon is taking a larger approach with a business case and a dedicated team.

Q10. Even if it is classified as RISC 3 do you consider if the component is exactly what you are intending to procure when ordering through a commercial process?

A10. We still do receipt inspection to ensure you get what you order to build reasonable confidence in the component. We still employ some principles of quality augmentation and other processes to form the basis of our saving.

Q11. With all these new processes how are you sure you still have a component that meets the specification?

A11. You still need to get design people involved in the process to ensure that you are remaining within the design specifications.

#### Key Learnings, Recommendations, and/or Best Practices

- Get operations involved in the 50.69 process
  - Use an integrated project team with diverse backgrounds to get the project to be successful. Valuable to have maintenance engineer, procurement engineer, operations on the team.
  - Do not create new processes to address 50.69, use existing processes and programs to deal with implementations.
- Procurement under 50.69 is not like commercial dedication, instead we start at a conventional plant and start at that level of equipment and then step up requirements until we find the right component that meets the function with reasonable documentation to ensure it meets the appropriate criterial. We do not start at safety related and work down.
- Components eligible for 50.69 alternative treatment must still meet original design specifications and are still considered safety related components just with alternative treatments.
- Procedure and process assures level of reasonable confidence
  - Have to get DE involved to ensure you remain within compliance for testing, design
    - Can relax design control, not changing design requirements if RISC-3

#### Session Takeaway

50.69 process is a long-term view project requiring buy in and collaboration from many groups for implementation but can significantly reduce overall procurement, labor, and time costs in the future.

# Session 6: No Business/Economic Performance Session 6

# Session 7: Preparation and Implementation of Work – A Solid Action to Increase Productivity and Efficiency

#### Session Organizer: Jon Anderson (ACA Proactive)

This session includes a very effective approach to increasing productivity and efficiency. In this approach Work Management plays the schedule preparation role and then turns the schedule over to Maintenance. Maintenance owns and is responsible for getting the scheduled work done. This session will allow us to add to our list of actions we can take to improve productivity and efficiency. The group will discuss the actions they are going to implement to increase productivity and efficiency. Participants will receive an email with the actions identified through this track to increase productivity and efficiency.

#### INPO Presentation

Pete Arthur (INPO)

#### (INPO presentations available through INPO member website)

- You won't have the same level of ownership when you don't communicate with workers in advance
- Use available technology and innovation to improve performance
- If you don't have enough notice to plan then you can't talk to the people who did the job last time for guidance
- · Workers demonstrate better performance when they have ownership
- Industry gaps include I&C maintenance technicians who don't properly apply maintenance fundamentals, resulting in adverse events due to lack of proficiency due to significant and recent turnover within the department.
- Need to do real walk arounds to understand the work for every job, perform a table-top review, review procedure and prints and ensure you
  really understand what you are about to go do.
- When viewing things only electronically, they don't do as good a job of understanding the whole picture.
- Maintenance technicians inadequately address as-found conditions. Maintenance front line managers are not sufficiently intrusive to ensure
  adequate preparation made before work execution.
- Department managers and supervisors failing to fully engage the work force to reinforce an environment where fundamental worker behaviors and established roles and responsibilities
- There are challenges when people work outside their roles and responsibilities for example when preparers attempt to do work.
- Shop coordinators being misused to do work for which they are ill prepared.
- When assigning shop coordinators good at what they do, when selected they need to stop doing what they used to do.
- Shop supervisors over reliant on shop coordinators. The shop coordinators need to own their week less so they can focus on work
  preparation.
- Lack of ownership of the work week leads to lack of preparation. If you don't know what is coming next week you don't prepare well.
- Simple model is to define two key roles the preparers and implementers.
- Need deliberate turnover between preparers and implementers.
- Builds accountability when transparent schedules are well known throughout the organization.

- The preparers role is to prepare an executable product of schedules, work packages, logistics, interface, support
- The implementer role is to take turnover from preparer, understand scheduled work, own the work, assign workers, prepare for work, attend work update meetings.
- Need to get shop coordinators thinking away from time zero and focused on 8 weeks ahead.
- 75% of the time workers see the work packages they are doing the day of the work.

#### Maintenance Ownership of the T-Week Process Troy Main (*River Bend Station*)

• River Bend was identified by INPO as the worst maintenance organization in the country

- Started at 40% completion in a week
- Thought it was behaviors driving the problem but it was more complex because the people didn't know what was going on.
- Managers and supervisors not intrusive into work details.
- The craft not brought into walkdowns.
- Started with a document to breakdown who owns what when starting at T-16 through T-0.
- Built a how-to guide with pictures and links to show how to use the T-process and prepare for work.
- Started a weekly lunch and learn with supervisors, Front Line Supervisors (FLS), and coordinators to walk through the entire process and how-to guide
- Removed all meetings from FLS schedule except 3 weekly meetings.
- Created a T-11, -7, -5 meeting to set up the FLS as the owner and implementer of work, and the coordinator as the preparer of schedule and logistics outside of T-5
- Got craftsmen assigned to work early in process to allow for proper preparation.
- FLS did not take well at first because they were used to the coordinator owning the week.
- In order to make the transition work, the department managers and superintendents attend the weekly meetings
- Had to teach craftsmen how to do good walkdowns.
- The T-11 used as initial look for the FLS, work scope, man hour loading, review parts, assign craft names
- The T-7 FLS review all work for their crew to ensure work is, levelized, workable as scheduled, vacation, quals, tagouts, support tasks scheduled. After T-7 workers begin walk downs.
- The T-5 is a final conversation between FLS and on-line coordinator using checklist. After T-5 FLS 100% responsible for the week through implementation and the coordinator returns focus on T-16 to T-5.
- The preparer / implementer model achieved FLS ownership of work and success of maintenance. FLS upset if day doesn't go as planned.
- Craft level ownership of parts, packages, tooling, and problem resolution.
- Quality of life for maintenance personnel improving allowing work to be completed as scheduled without overtime.
- Completion rose from 40% to 55% in first half of year and rose to 92% by year end with daily adherence 87%.

#### Key Learnings, Recommendations, and/or Best Practices

Worker preparation cannot be achieved unless workers have sufficiently advance notice to build ownership of work. This can be achieved via the preparer and implementer model to develop executable and detailed weekly plans resulting in a tremendous success at River Bend station in 2017.

#### Q&A

Q1. In my experience walkdowns had often been useless because some of the work has been done so many times before.

A1. Sometimes the walkdowns help raise standards for PMs

Q2. How much time do you allow for walkdowns?

A2. We were using 1.5 hours but now we use 4 hours and it is scheduled every Monday morning as assigned time for walkdowns. A controlled evolution of dedicated time to work on work packages and preparation.

Q3. Is there a lesson in why it has taken 30-40 years of industry operations to finally get this right?

A3. I didn't have this process idea but instead implemented it to be successful. In some cases, we have been very trusting when people claimed they did a walkdown but in practice, a walkdown didn't have the fidelity it should have. Now the superintendents drill the supervisors at T-2 on the details of the work to be done.

Q4. If management stops pushing the process it will probably go right back to the way it was done. Is there any innovation or technology tools that can be used to help drive these behaviors?

A4. Not that we know. It does depend on the leader and if the leader doesn't have the right drive it can fail.

# Decommissioning

# Session 1: Decommissioning Funding

Session Organizer: Jim Byrne (Byrne & Assoc., LLC)

Decommissioning Funding: A Broad look and the funding, reporting, and expenditure processes. Insights and lessons learned on the regulatory and practical frame work of decommissioning financial assurance. Changes to trust fund financial rules, access to funds, commingling of funds, and hypothetical examples of improper fund use will be examined.

Financial Management and Assurance, Decommissioning Trust Funds John Mathews (Morgan, Lewis & Bockius LLP)

- NDTs are protected from bankruptcy collections
  - MidAtlantic National Bank v. New Jersey Dept of Env Protection
- Investment restrictions
  - FERC (18 CFR 35.32 & 35.33)
    - "Prudent Investor" standard
      - Restriction against investments in utility that establishes the fund
  - NRC (10 CFR 50.75(h)(1))
    - Only applies to merchant plants
- "Qualified Fund"

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- Eligible plant owner may elect to receive accelerated deduction timing tax benefits
  - Must be a state law trust
  - Exclusive purpose is to provide funds for decommissioning a nuclear plant
  - Allows income from receipt of rates from customers marked for future decommissioning costs
- Payment subject to owner-level taxable income
- Nonqualified Fund
  - Treated as a grantor trust for federal income tax purposes
    - Subject to 21% owner-level corporate income tax
  - Does not provide accelerated deduction tax timing benefits
- DoesTax uncertainty
  - NRC's position if that spent fuel management costs are not "license termination costs"
  - Treasury regulation allow payment of spent fuel management costs
  - IRS rulemaking issuance in Dec 2016 to address costs affiliated with spent fuel management

#### **Decommissioning Funding**

Nicholas J. Capik (ABZ Incorporated)

- Decommissioning cost types:
  - License termination
    - Necessary to permit restricted/unrestricted release of the site
    - Legitimate decommissioning expenses
  - Spent Fuel management
    - Cost for storing spent fuel until accepted by DOE
      - Wet or dry fuel, on or off site
    - Certain costs recoverable from DOE based on delays
    - ISFSI Decommissioning 10 CFR 72.30
      - Following removal of all spent fuel
      - May be recoverable from DOE based on delays
  - Site Restoration
    - Scope not included above
    - All non-radioactive remediation
    - Includes all site restoration
    - Activities governed by EPA and/or State
- NRC NDT Use Restrictions:
  - · Amount may not be reduced below amount necessary to place and maintain reactor in a safe storage condition
  - Full amount available after submittal of site-acceptance DCE
- Cost recovery from DOE based on delays:
  - Litigation
  - Settlement
  - NRC does not allow reliance on litigation amount
  - Risks & Concerns:
    - Delays
    - Scope
    - Underestimate of waste volume
    - State involvement not addressed

# Decommissioning Funding Assurance

Richard Turtil (NRC)

- 10 CFR 50.75 Decommissioning planning, reporting, and record keeping
- "NRC Formula Amount" = "Minimum Funding Amount (MFA)"
  - Calculation using 10 CFR 50.75(c)(1) & adjustment factor (c)(2)
    - Not site specific
  - Varies by reactor type
- Site Specific Cost Estimate (SSCE)
  - Provided 5 years prior to reactor end of life
  - Must be greater than/equal to the NRC MFA amount
  - Required for SAFSTOR
  - Decommissioning Funding Life Cycle
    - Initial certification of financial assurance
    - Maintain NRC MFA throughout the life of the reactor
    - Use one or more funding methods specified by regulations
      - Monitor and update decommission funding
      - Every 2 years to NRC
- Categories of decommissioning funds:
  - Radiological decommission
  - Site restoration
  - Spent fuel management
- Potential Impacts to DTFs:
  - Power Reactor early site termination
  - Commingling of assets
  - NRC potential rulemaking
  - Low level waste compacts and burial alternatives

#### Regulatory Framework of Decommissioning Financial Assurance & Allowable Decommissioning Expenditures Thomas E Magette (Talisman International)

- 1992 First premature shut down of a large nuclear reactor
  - Changes in the Decommissioning Financial Assurance since 1992:
    - 2006 NRC directs staff to review formula to estimate assurance funds and adjust, if necessary
    - 2012 NRC proposes revision to NUREG-1307 to increase LLW disposal price
    - 2013 NRC issues NUREG-1307 Rev 15
    - 2019- Energy Solutions submits petition for rulemaking to permit use of decommissioning trust funds at operating reactors
    - 2019- NRC publishes Energy Solutions' petition for comment
  - Key milestones for decommissioning:
  - Decision to shut down
    - Permanent cessation of operations
    - Permanently defueled
    - Fuel in dry storage
    - Partial site release
    - Note: Each milestone allows for staff reduction = reduction in costs
- Decommissioning cost accounting fundamental different from operating costs accounting
  - 3 categories of Decommissioning costs allocation:
    - License Termination
      - Site restoration
    - Spent fuel management
- Traditional decommissioning cost estimate does not prepare for detailed cost accounting, project management, cost management, or audit/reporting preparation
- 10CFR50.2 definition of Decommissioning:
  - "Remove a facility or site safely from service and reduce residual radioactivity to a level that permits release of the property under restricted/unrestricted use and termination of the license"
- 10 CFR 50.75
  - Requirements to demonstrate reasonable assurance of funds for decommissioning operating reactors
  - Provides formula to calculate minimum funding requirements
  - Defines acceptable methods of funding
- 10 CFR 50.82
  - Identifies permissible uses of decommissioning trust funds
  - May not withdraw funds below amount needed to maintain reactor in safe storage condition
  - Annual reporting requirements:
    - Amount spent of decommissioning
    - Remaining balance of decommissioning funds
    - Estimate of costs to complete decommissioning
    - Required to NRC every 2 years
- Case Studies:
  - Vermont Yankee Expenditures challenged by NRC for decommissioning funds
  - NRC challenges Exelon on decommissioning planning costs allowed under 10 CFR 50.82(a)(8)(ii)
  - Energy Solutions filed Petition for Rulemaking permitting use of decommissioning trust funds at operating power plants
- IRS regulations on decommission costs are much broader and not as strict as NRC

#### Q&A

Q1: Are licensees required to refill the NDT with the money recovered from the DOE due to delays? A1: Not required, it may be utilized as profit. Also dependent on state regulations.

Q2: May the licensee withhold the remainder of the NDT funds as profit if they are not exhausted? A2: The budget and planning of a site decommissioning is designed to exhaust all funding.

# Session 2: Decommissioning Planning, Estimating, and Assumptions

Session Organizers: Rich St. Onge (7th Factor Services), Dustin Miller (Chase Environmental Group)

Speakers will provide insights on managing Decommissioning Cost Estimates and the challenges that owners face as they defend those estimates against an increasing critical public and private audience. Best practices will be highlighted based on lessons learned in the industry. Insights into potential decommissioning cost reductions through the application of technological advancements will be discussed.

#### Understanding Cost Estimation for Decommissioning

Joe Carignan (Carignan & Associates)

- DCE = Decommissioning Cost Estimate
- First guidance prepared in 1986 (AIF/NESP-036), still referenced today
  - DCE Process maturing for over 40 years
    - As technological abilities increase, the process becomes more transparent, easier to update, provides more detail, and more "whatif" scenario capabilities
- Purpose of a quality DCE:
  - Identifies the funds needed to decommission a plant at end of life
  - Risk management
  - Used in developing plans, strategies, and schedule
  - Satisfies regulatory requirements
  - Basis for evaluating contractor bids and a comparison of approaches
- DCE reporting every 2 years to NRC; annually once plant ceases operation
- Must estimate minimum amount needed for decommissioning 10 CFR 50.75(c)
- Site specific estimate may be used but must be greater than decommissioning estimate
- Importance of accurate DCE:
  - Estimator obligated to report expected level of accuracy
  - Estimator challenged to ID the class of estimate
  - Licensee, regulator, and contractor decisions based on DCE
- AACEI (Association for the Advancement of Cost Engineering International) classification of cost estimates:
  - 5 classes with corresponding levels of accuracy
- Cost estimates developed using 3 methods:
  - Level of effort
    - Used when previous experience is not available or when work tasks are not well defined
    - Most difficult method to defend to regulators
    - Parametric
      - Utilized for order of magnitude estimates
    - Definitive unit cost factor
      - "bottom up"
        - Considered most accurate
        - Based on site specific data and work breakdown structure (WBS)
        - Greatest level of transparency for regulators
- Elements of Quality DCE
  - Basis of Estimate (BoE)
    - Assumptions/exclusions
      - Legal & technical boundaries
    - Decommissioning strategy
    - End point state
    - Stakeholder input
    - Risk basis
    - Facility description
  - Structure of Estimate

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- Activity dependent costs
  - "hands on" clearly defined tasks
  - Productivity factors (i.e.: heat stress, security, accessibility, etc.)
- Period dependent costs
  - Project duration/tasks
  - Staff Composition
  - Program management functions (engineering, administrative, QA, etc.)
- Collateral costs
  - Costs not captured elsewhere
    - Site prep
    - Contracted support
    - Construction rental equipment
    - IV surveys
    - Insurance, taxes, etc.
- Contingencies/risk costs

- Scrap/salvage
- Risk, Allowances, & Contingencies
  - Known unknowns = allowances and contingencies
  - Unknown unknowns = risks
- International Structure for Decommissioning Costs (ISDC)
  - International approach to standardized decommissioning costs
    - Permit comparison of costs from different companies and countries
    - Benchmarking
    - Applicable to any facility
  - Present costs in a uniform manner
- DCE Conflicts:
  - Scope changes
     Differences in cost estimating methodology
  - Inaccurate/incomplete data
  - Contingency levels
  - Risk factor allowances
- Take Aways:
  - DCE continues to improve w/ industry experience
  - Comprehensive DCE will include review and input from affected organizations
  - Assumptions, allowances, contingencies, and risk play significant role in DCE
  - · Cost estimates should be updated during operations and routinely during decommissioning process

## **Decommissioning Assumptions**

Nicholas Capik (ABZ, Inc.)

- Lessons Learned:
  - Soil removal
    - Unique groundwater models
    - Site permitted landfills
    - Soil removal from adjacent buildings
  - Foundation removal
    - Most estimates assume foundation removal 3 feet below grade
    - Additional removal possible due to tritium contamination
    - Concrete waste volume potentially substantial
  - Use of fixed-price contracts
    - Does not mitigate all risk due to:
      - Scope growth
        - Unexpected 3<sup>rd</sup> party requirements
      - Poor execution
    - Potentially more expensive than self-performance
  - State involvement:
    - Limited experience with decommissioning
    - Release criteria more limiting than NRC
  - Cost estimate challenges:
  - Schedule
    - Critical path through reactor vessel & building
    - DECON schedule
      - Schedules often challenged
    - Staffing
      - Varies based on decommissioning approach & rate regulation
      - Schedule delays directly affect staffing costs
    - Waste volume
      - Amount depends on decommissioning approach
        - "rip and ship" = largest waste but less effort
          - Waste volume reduced with more effort
          - Soil and concrete volumes often under estimated
- Best practices:
  - Scope
    - Characterize early and often
    - Work with state to address specific needs and rules
    - Include allowances for unknown contamination
  - Schedule
    - Consider delays with fixed-priced contracts

#### Decommissioning Costs: Experiences & Reduction Strategies Rich McGrath (EPRI)

- 2011 EPRI study on US nuclear plants experiences with decommissioning costs
  - Limited data and conclusions
    - No standard method used for categorizing costs of decommissioning
    - Published costs did not include breakdown of costs or were confidential
  - Results published in EPRI Report # 1023025 "Decommissioning experiences and lessons learned: decommissioning costs"
  - Cost categories with detailed data;

- Removals
- Radwaste
  - Plants that disposed of above ground RCA structures had much higher radwaste volumes; plants that released RCA structures intact had lowest radwaste volumes
- Staffing
  - Highest portion of total decommissioning costs
- Other (final status survey, site restoration, etc.)
- Final status survey costs directly correlated to plant size
- Spent fuel storage & ISFSI operating costs (compared separately)
  - Spent fuel storage costs directly related to plant size

Potential Impacts of Historical DCE Assumptions on actual decommissioning costs Richard St. Onge (Black & Veatch)

- 3 buckets of money:
  - License termination
  - Spent fuel management
    - Site restoration
- Major cost areas for decommissioning projects:
  - Regulatory requirements
  - License condition
  - Condition of land use
- Historical DCE concerns:
  - DCEs vary significantly
  - Commingled spending
  - DCEs not suitable for project plan development
  - DCEs vary dependent on the site restoration
  - Performance gaps in crucial areas
- Actions to close estimate vs actual cost gap:
  - Revalidate prior assumptions in DCE
    - Use current OE to update DCE
    - 3<sup>rd</sup> party check validity of DCE assumptions
    - Assess risk of state/local intervention at site
    - Evaluate cost vs risk assumptions against management plan

#### Q&A

Q: How do you work past NRC versus State requirements?

A: Educate the state during the decommissioning process. Plan for the state requirements to be required ahead of time. Document the License Termination Plan prior to decommission decision.

Q: Have you noticed a correlation between the release criteria and the costs with decommissioning? A: Yes. OE: Connecticut Yankee LLDs for the EPA were lower than the NRC which resulted in additional removal and additional costs.

Q: Is there a plan to create a more aggressive staff reduction during decommissioning to reduce costs? A: No, the idea of pre-decommission planning needs to utilize the staff efficiently. It is costlier to shut down prematurely in order to begin reducing staff.

Q: Does HP support cost fall under Support Costs or Radiation Removal?

A: It may be either, it depends on the removal material and the decommissioning scope/strategy

Q: Has there been a comparative study of dose between plants with planned and unplanned shut downs? A: Yes, depends on plant conditions at the time of the shutdown, efficiency of the planning, and volume of removals.

Q: Do the "contingency" cost estimates include the "unknown unknowns"?

A: Ideally, we want to separate the contingencies from the unknown unknowns (risk).

Q: How much confidence do you have in the cost reports data when most are kept confidential? A: The plants that were included in the reports contained consistent data, current and historically.

# Session 3: Regulatory Perspectives and Updates on the Commercial Decommissioning Process

Session Organizers: Jim Byrne (Byrne & Assoc., LLC), Rich St. Onge (7th Factor Services)

Regulatory perspectives and updates on Commercial Decommissioning processes. Perspectives on current state of affairs on regulatory changes past, present, and looking forward. Also explored is the role of the Corrective Action Program as it applies to permanently shut down facilities in both Safestor and Decon.

#### Decommissioning Reactor Inspection Program Rhex Edwards (NRC)

- Definition of decommissioning:
  - Safely remove a facility from service and reduce residual radioactivity to a level that permits release of the property for restricted/unrestricted condition and terminate the license
- Decommissioning categories:
  - Transition
    - Spent fuel management needs
    - Determine systems no longer needed for decommissioning or spent fuel management

- Abandon systems that do not require prior NRC approval
- o SAFSTOR
  - Minimal changes to work occurring on site
- Active decommissioning
  - Safe storage of fuel
  - Rad protection
  - Effluent and environmental monitoring
  - Managing radwaste
  - Shipping radwaste
  - Final status surveys
  - Confirmatory surveys
  - Inspections lessons learned:
    - Strong project management needed
    - Over-communicate
    - Understand regulatory requirements
    - Follow procedures and processes

#### What does CAP look like in Decommissioning? Rhonda Felumb (Entergy)

- Consolidate CAP (corrective action program) procedures
- CRs on plant equipment cannot be closed until Tech Specs & DSAR have NRC approval & system has been taken out of service permanently
- Manage CR backlog to a minimal and acceptable level
- Management to maintain a low threshold for CR creation
- CAP required until all fuel is removed from site & site is properly remediated

#### Zion: The Industry Standard for Radiological Dose & Project Cost

Gerry van Noordennen (Energy Solutions)

- Zion decommissioning largest in US History
  - Lessons learned:

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- Rip and ship method = shorter project schedule & less staff costs
- Radwaste volumes higher than DCE
- Challenging to manage multiple waste streams
- Demoed clean buildings before rad buildings to avoid cross contamination
- Stockpile areas contain sacrificial asphalt
- o Lidar and building information systems (BIS) used to gain better waste volume estimates
- o Develop method that eliminates hexavalent chromium welding cuts
  - Diamond wire saw
  - 80% reduction in dose
  - No need for respirators
  - Find methods to get aux building available for open air demo earlier in project
  - Surgical removal of components labor intensive and restricts open air schedule
- o Institute "top to bottom" & "front to back" strategy for aux building demo
- o "cold & dark" in aux building minimizes plant circuit usage
- o Install temp air circ systems earlier to retire installed circ systems
- o Install tents over waste streams to prevent cross contamination from env elements
  - Dust suppression
  - Negative air flow
- Strategic Focus areas:

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- MARSIM (Multi-Agency Radiation Survey and Site Investigation Manual) Rev 1 eval = cost impacts to commercial decommissioning industry
- FSS/Construction interface = create "rub" areas in schedule
- Explosive demo
- o Standards for risk protection during decommissioning cycle
- License termination plan (LTP)
- Decommissioning cost models
- Fuel ownership

# Power Reactor Decommissioning Program Issues and Challenges Jack Parrott (NRC)

- 2000 NRC directs staff to take action to prevent future legacy sites
- 2004 decommissioning meeting with industry
- Decommissioning plan rule (DPR) effective December 2012
  - Applicable to operating and decommissioning sites
    - 10 CFR Part 20 Rad Protection Standards revised
      - Operations minimization of contamination to environment
      - Conduct surveys including subsurface
- 2014 NRC directs staff to move forward with decommissioning rulemaking to improve efficiency of transition from operating to decommissioning
  - License amendments
  - Emergency plan exemptions
  - Security plans
  - Evaluate the roles of the state and the 60-year requirement to complete decommissioning

- Goal in effect by 2021
- Graded approach to decommissioning:
  - Level 1 docketing of certifications
  - Permanent cessation of operations
  - All fuel in dry cask storage
  - All fuel offsite
  - Highest stakeholder interest:
    - EP

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- Role of local advisory boards
- Env reviews
- Decommissioning trust funds
- Decommissioning GEIS = general environmental impact statement
  - Published in 2002
  - Used for partial site release & license termination plan
- Decommissioning business models:
  - Licensee self performs
  - Licensee manages decommissioning contractor
    - Temporary license transfer to decommissioning company Return land and spent fuel to utility
  - Asset sale & license transfer
  - Decommissioning issues of stakeholders:
    - Funding and adequacy
    - Prompt vs deferred
    - Economic losses to local community
    - Future use of site
    - NRC approval of post shutdown plan
    - Safety of spent fuel pool vs dry casks
    - Long term spent fuel waste storage
    - Security of facility
    - Emergency response reductions

#### Q&A

Q: When is the best time to engage with the utility company to assist with decommissioning?A: Meet from the decision to shut down in order to gain agreement on plans and strategies

- Q: Is Zion free releasing their containment concrete?
- A: Yes, the outer layer has been evaluated and is clean.
- Q: Is Zion leaving any equipment above grade?
- A: No, only subsurface structures will remain.
- Q: What has been the largest disagreement as an inspector?
- A: As long as proper communication is utilized, it opens the dialogue channels to gain clarification and agreement among the parties.

# Session 4: Transitioning to Permanently Defueled Status

Session Organizers: Noah Featherston (Omega Counsulting LLC), Lynne Goodman (Goodman Nuclear Consulting)

End of Plant Operations: Where do we go from here? Speakers would provide experiences and lessons learned from facilities having made the decision to permanently shut down and provide insight into why they chose their post shutdown USNRC Option (License Transfer and immediate Decon, Immediate Decon, or safstor); lessons learned throughout the decommissioning phases including transition of the site to the decommissioning entity.

#### **Decommissioning Processes**

Trevor Orth (Exelon - Three Mile Island)

- Decommissioning Project Plans (DPPs)
  - Structured evaluation of all functional areas
- DPP-01 Strategic Plan
  - o Establishes "base case" for decommissioning
  - Able to modify as new info is available
  - Strategies:
    - Cost-effective planning & project performance
- Scoping & Screening Process
  - Grouping of Structures Systems Components (SSCs) combined according to functions defined as DEGs (Decommissioning Equipment Groups)
    - DEGs functional group of equipment designated for convenience of scoping, screening, and evaluation
    - DEG development –initial review performed to place related SSCs into DEGs using anticipated need during decommissioning
  - Scoping process to determine if DEG can be immediately classified as Not-Required for phase 1
  - Screening review of each DEG to determine if a configuration change can be made to reduce amount of required equipment
     Determines if a modification can alter required scope of the DEG
- Expected Plant Requirements (EPRs)
  - Plan that reflects expected requirements in phase 2
  - o Allows decommissioning planning, engineering, and work package development
  - Key communication tool for:
    - Plant staff and management

- Key external stakeholder
  - Decommissioning staff
- Innovation
  - Electronic group mark-ups of drawings save time and costs

## Crystal River Nuclear Plant decommissioning

Ivan Wilson (Duke Energy)

- Strategy SAFSTOR July 1, 2015
- Timeline
  - Decommissioning decision February 5, 2013
  - o Dormancy August 1, 2019
  - Plan to use 60 years allowed by regulation
  - Cost \$895 million in 2017 dollars
    - Trust fund sufficient
    - No increases to customers
  - Dry Cask Storage Project Timeline
    - August 2014 Board of Directors approves project
    - August 2015 construction starts
    - June 2017 construction of facility completed
    - January 2018 crews complete project
- Current Plant status
  - Dry cask storage facility in-service
  - o All original plant systems & components abandoned
  - Long term dormancy conditions established
  - Approximately 50 employees
- Accelerated Decontamination & Dismantlement (D&D)
  - o Sufficient trust fund
  - o Benefits:
    - Mitigates future regulatory changes
    - Mitigates costs escalations
    - Identifies excess trust funds
  - Risk transfer to counterparty
  - Technical expertise of vendors
  - Defined end-state conditions
  - Spent fuel management
  - Regulatory approvals
- ADP awarded decommissioning contract in May 2019 asset transfer
  - Fixed price contract
  - License termination scheduled for 2038
  - Unused NDT funds returned to DEF customers and shareholders

#### Magnox SafeStore Bradwell Learning

Presenter – Bob Nichols (Fluor)

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- Strategy decided in 2008
  - Safestore "box model"/ Care & Maintenance
  - Close site except for minimal C&M/Security
  - Remove Intermediate Level Waste (ILW) & ship to UK GDF (Geologic Disposal Facility) when open in 2045 followed by demo of ISFSI
  - o Final site clearance after 85 years of ceased operation
    - Benefits = reduced dose, cost, and ILW
    - Goal operate all sites in C&M via central remote monitoring hub
  - Bradwell first UK nuclear site into C&M (2018)
    - Valuable lessons learned:
      - More asbestos than expected
      - Infrastructure degradation "cold & dark" exceeding predictions
      - Seismic upgrades needed to support new weather cladding
      - Cladding more expensive and time consuming than predicted
      - Unexpected ground contamination and underground utilities found
  - Extra cost to achieve C&M, Safestore strategy revisited
    - Study concludes little cost difference between reactor dismantling 30-40 years after shutdown & deferred project commencing 85 years after shutdown
  - Challenges for continuous decommissioning
    - o UK ability to process bulk waste

#### Transitioning to Permanently Defueled Status

- Michael Lackey (Energy Solutions)
  - 5 focus areas:
    - Establish new direction
      - Environmental restoration
      - Develop project baseline
        - Utilize industry Operating Experience

- Determine execution strategy
- Reset annual goals and incentives to promote progress ٠
- Develop new organization 0
  - Create a decommission mentioning-focused organization
    - Significant HR involvement
      - Honest communications on staff reductions
        - Outplacement services and job fairs
  - Reduce facility risk
    - spent fuel management
      - permanently defuel reactor
      - transition to dry storage
    - hazard reduction
      - deactivate unnecessary systems
      - combustible materials
    - incremental decommissioning projects
      - early removal of legacy waste/components
        - clean area building dismantlement
      - large component removal
- Step-down regulatory requirements 0
- Simplify processes 0

# Session 5: Decommissioning Project Overview

Session Organizers: Mark Kirshe (ReNuke Services), Noah Featherston (Omega Counsulting LLC)

Participants: Wayne Norton (3Yankees), Richard Sexton (AECL), Bob Nichols (Fluor), John Sauger (Energy Solutions), Bruce Hinley (EnergySolutions)

Overview of the Decommissioning Projects in progress and completed to date. "If you had to do it over again, what would you do differently?"

## Nuclear Decommissioning Common Challenges & Success Factors

Richard Sexton (AECL)

- Canada's Nuclear Decommission Landscape 0
  - Canadian Nuclear Lab (CNL)
    - 3 areas of focus:
      - Decommissioning & waste management .
      - Nuclear Science & Technology (S&T)
      - Revitalization of Chalk River Infrastructure
- The GoCo Model

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- AECL 0
  - Delivers mandate through contracts with CNEA & CNL
  - Sets priorities for CNL
  - Oversees overall performance
  - Owns assets, IP, and liabilities
  - Canadian National Energy Alliance (CNEA)
    - Owner of CNL
    - Develops vision for CNL
    - Monitors CNL's performance & earns fee based on results
    - Appoint CNL's leadership
  - Canadian Nuclear Labs (CNL)
    - **Operator & licensee** 
      - Enduring entity & employer
        - Access rights to AECL's assets/IP
- **CNSC** Regulator 0
- Case Studies:
  - Fort St Vrain 0
    - High temp gas cooled reactor
    - First of its kind to be decommissioned
    - . Decommissioning over characterized
    - Final survey required extensive data points
    - In-situ disposal
    - Only took 4 years and was unconditionally released
  - Rocky Flats 0
    - Plutonium processing plant
    - Culture transition from operating plant to decommissioning strategy proved very challenging
    - Decommissioning was completed under budget and ahead of schedule
  - Connecticut Yankee 0
    - Contamination creates high level of completion conflicts
    - Required vast soil & groundwater monitoring
  - Magnox 0
    - "Lead & learn" site
- Important Take Aways:
  - Technical rarely the biggest challenge 0
  - Financial understand cash flow and strive for stable funding 0

- o Schedule delays are inevitable
- Regulatory expectations need to be understood
- Stakeholder management commonly the trickiest part
- Waste management need a disposition route for all waste materials
- Radiological & industrial safety needs constant attention
- Common decommissioning challenges
  - o Understanding the end state
  - o Understanding decontamination regulations
  - Cultural & organizational transformation (operating to decommissions)
  - Effective regulators & stakeholder engagements
  - Utilizing the right contract structure (risks vs rewards)
  - Waste management
  - Staff capability and retention
  - Surprises that result in cost and schedule delays
  - Key items to decommissioning success
    - Understand full scope
      - Robust schedule & cost estimate
      - Accurate project performance reporting
      - o Comprehensive risk assessment & mitigation plans
      - o Understand regulatory requirements
      - Stable funding
      - Experienced contractor
      - Strong radiological/industrial safety
      - Flexibility to deal with the unexpected

#### Magnox decommissioning lessons learned

#### Bob Nichols (Fluor)

- Transitioning workforce to decommissioning
  - Issues:
    - Workforce not good at first time evolution activity planning & execution
    - More than 100 Project Managers but many lacked practical training/experience
    - Shifts still manned 24/7 after site defueled
    - o Solutions:
      - Reduced staffing to force shift towards project focus
      - Moved off of 24/7 shift operations, rotated functional staff onto projects
      - Initiated project delivery improvement training
      - Instill decommissioning mind set
    - o Learning:
      - Need to move more quickly & drastically
      - Need for more parent companies over incumbent workforce
      - Training should have begun before end of online operations
  - Waste
    - Issue:
      - UK policy enforces waste minimization & is not designed for decommissioning
      - Solution:
        - UK policy requires change to reduce costs of decommissioning significantly
  - Fuel ponds

     Issue:

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- Long schedule, high dose, large amounts of waste
- Large volume of high density concrete sludge
- Complicated operations = added cost and dose
- Solution:
  - Nuclear divers deployed to clean ponds
  - No concrete scabbing or shaving needed
  - Significant cost savings
- Inter-site waste consolidation
  - Issue:
    - Plan to build interim ISFSI at all sites
    - Multiple sites designing, planning, and building waste treatment for same waste streams
    - Movement of waste between sites not popular with stakeholders
    - Solutions:
      - Negotiated with regulators
      - Consulted with stakeholders
      - Made business case for consolidation
      - ISFSI consolidated at Berkley & Bradwell

## Decommission project overview

- Gerry van Noordennen (Energy Solutions)
  - Zion project:
    - All building demo completed
    - Final status survey in progress

- o Class B/C waste offsite; class A waste load out complete
- Partial site release of 214 acres
- License transfer back to Excelon by 2020
- La Crosse:
  - License termination plan approved
  - Demo completed
  - All radwaste shipped offsite
  - FSS underway
  - License transfer back to Dairyland in 2020
- Fort Calhoun
  - Staffing in place
  - Fuel transfer o ISFSI September 2019
  - Legacy large component removal in progress
  - Asbestos abatement
  - Reactor internals prep
  - Three Mile Island Unit 2
    - Terms & conditions signed
    - o Different approach needed
- Sefor
  - Completed at less than half of DOE cost estimate
  - Cleanup completed
  - License termination in 2019

#### Q&A

- Q: What is the status of the graphite from the Magnox Reactors?
- A: It is still in the core and will be left there for 85 years. The scope after 85 years is not defined. There is not a permanent storage solution in UK presently. The long term radionuclides are easily mobilized in an open air environment
- Q: What is the subsurface plume situation at Lacrosse?
- A: The reactor building ventilation leaking onto the ground. Caused a tritium plume to be concentrated into the groundwater.

# Session 6: Optimizing Safety, Security and Safeguards for Decommissioning

Session Organizer: Mark Campagna (DESD)

Achieving a major contribution towards optimal DDER Cost profile/ project results by application of an integrated and therefore optimal Safety, Security and Safeguards approach. This panel of speakers will explore 21st Century methods and tools available that would optimize project planning and performance now; these methods would be deployable during both NPP operation and transition to DDER. These techniques are simultaneously being developed with increased pace/urgency benefiting from recent progress in the Advanced Reactors and SMR sector.

# Security Posture Optimization during DDER

Mark Campagna (DESD)

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- Transitional security phases
  - Operating power reactor
    - 10 CFR 72.212(b)(9) leads to 10 CFR 73.55
    - Initial Transitional Period
      - Outer Vehicle Barrier System configuration changes require VBIED (Vehicle-borne Improvised Explosive Device) blast effect analysis on reduced target sets
    - Wet storage
      - Further outer VBS configuration changes
      - Stand Alone (ISFSI) Independent spent fuel storage installation
        - Regulatory requirements currently undefined
          - Plant specific additional security measures related to ISFSI

Historical Perspective of Security Improvements Implemented by the U.S. Nuclear Regulatory Commission following the World Trade Center Bombing

Skip Young (NRS Ret.)

- TMI intrusion (1993)
  - Vehicle drives through security boundary and wrecks into TB (turbine building)
  - Driver exits vehicle and walks into TB
  - o Required a major response from local police, state troopers, FBI, EOD, etc.
  - NRD findings:
    - Protected area barriers and stand-off analysis needed
    - Communication systems increased
    - Interface between operations, emergency response, and physical security should be seamless
    - Effect of security on licensee emergency response and EP implementation should be a hindrance
- World Trade Center Bombing (1993)
  - Blast disabled diesel generators, buildings lost power
- NRC actions
  - o Draft rule issued "Protection against Malevolent Use of Vehicles at nuclear power Plants" Nov 4, 1993
    - Final rule NUREG/CR 6190 issued Aug 1, 1994
      - Implemented Feb 29, 1996

#### NRC actions in response to 9/11

- Issued more than 60 advisories
- o Nov 2001 Thorough review of safeguards and security programs against attacks that exceed design based threats
- Nuclear Regulatory Research (NRR) began study to assess mitigation strategies for aircraft attacks
  - Study provided preliminary info to address:
    - Key vulnerabilities to terrorist attacks
    - Adjusting plant prioritization to aircraft attacks
    - Mitigation of attack consequences
- October 2002 Regulatory Issue Summary addressed changes to descriptions of various threat advisory conditions
- Force on force exercise suspended until November 2004
- Security enhancements:
  - Upgraded physical security plans
  - Enhanced training
  - Increased patrols
  - Increased physical barriers
     More restrictive site access
  - More restrictive site access controls
  - Greater stand-off distances for vehicle checks
  - Enhanced coordination with law enforcement & military authorities

#### DDER – "Evolution of the Roles and Responsibilities" Tome Behringer (Sergent & Lundy)

- SAFSTOR:
  - "Deferred Dismantling,"
  - Allows the radioactivity to decay
  - Kept intact and placed in protective storage for an extended period of time
  - Main components of the plant remain in place
  - Fuel is removed from the reactor vessel and placed in fuel pools or dry storage
  - NRC continues to inspect and provide regulatory oversight
  - Property decontaminated once radioactivity has decayed to lower levels
- DECON:
  - "Immediate Dismantling"
  - Equipment, structures, and portions of the facility removed or decontaminated to NRC limits
  - DECON can take five years or more.
  - Most plants use a combination of the two approaches
- ENTOMB:
  - Radioactive contaminants are permanently encased until the radioactivity decays to a level permitting restricted release of the property.
  - No NRC-licensed facilities have requested this option.
- Key owner's decisions
  - Decommissioning studies/analyses
    - Cost Estimates
    - Sensitivity Analyses
    - Methodology & Approach
    - Licensing Assessments & Impacts
    - Organization & Management Structure
  - Security reconfiguration
  - Decommissioning Power & Auxiliaries
  - o Fuel Characterization, Dose & Licensing Compliance
  - Spent Fuel Pool Island Development, or ISFSI
  - Accident Analysis
  - ISFSI Selection
  - Licensing
  - Decommissioning QA Program
- Innovative tools to utilize:
  - Laser Scanning
  - 3D Modeling & Simulations
  - Virtual Reality for planning and training
  - Risk Management software
  - o Powerful Enterprise Management & Scheduling software
  - Ground Penetrating Radar

#### Holtec's Fleet Approach to Decommissioning Corey DeWitt (Holtec)

- Decommissioning strategy
  - Fleet approach
    - Based on nuclear industry fleet model
    - Drive lessons learned across sites
    - Maximize standardization
    - Drive technological innovation

- Qualified & experienced personnel
  - Existing nuclear experienced personnel
  - Additional nuclear experienced personnel
  - Integrate site organization at LT
  - Industry vendors
  - Procedures and processes
    - Adopt NRC approved site programs, processes, and procedures
    - Maintain compliance with site license & NRC regulations
    - Maintain, protect & control spent fuel
    - Ensure environmental & personnel protection
- Accelerated project timelines

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- Typical D&D process = approx. 7 years
- Decommissioning Organization
- Holtec International
  - Spent fuel management and nuclear services
  - Spent fuel cask/storage vendor
  - Permanently Shut down Plant ownership
  - Holtec Decommissioning International
    - Holtec subsidiary
  - Comprehensive Decommissioning International
    - Jointly-owned company by Holtec/SNC-Lavalin
    - Extensive decommissioning project experience

#### Q&A

- Q1: When is the best time to transfer the license from utility to contractor to prevent additional risk?
- A1: Utilizing open communication with the licensee, proper understanding of goals, and agreement of the end state
- Q2: Is it more efficient to wait until after the fuel is in dry storage to transfer the license?
- A2: No, Holtec would prefer to own the process from the beginning and manage decommissioning openly and efficiently.
- Q3: When is an opportune time to reduce security after the LT?
- A3: It is best to follow the decommissioning phases and coordinate with the spent fuel management.

# Session 7: Innovation to Achieve Success in Decommissioning

#### Session Organizer: Jim Byrne (Byrne & Assoc., LLC)

Speakers will provide insights on means and methods to reduce the foot print of permanently shutdown nuclear facilities, with a focus on innovative approaches. The penultimate goal of decommissioning projects is to reduce on-site hazards below regulatory limits to protect the health & safety of its workers and the public. The ultimate goal of decommissioning is to complete the closure of the nuclear power lifecycle through the final closure and license termination of these facilities.

#### Canada's Innovative Approach to Achieving Site Closure

Richard Sexton (AECL)

#### Session Notes:

- AECL Mandate
  - Enable nuclear science & technology
  - Manage the government of Canada's radioactive waste & decommissioning responsibilities
  - Delivers through long term contract with Canadian Nuclear Labs (CNL)
  - AECL est as federal crown corporation in 1950s
    - Two main areas of focus:
      - Commercial business (CANDU)
      - Nuclear laboratories
      - Gov't decision to reduce risks & costs to Canadian tax payers through restructuring
        - 2015 implemented GoCo model
  - GoCo model: o AEC

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- AECL Delivers mandate through contracts with CNEA & CNL
  - Sets priorities for CNL
  - Oversees overall performance
  - Owns assets, IP, and liabilities
- o Canadian National Energy Alliance (CNEA)
  - Owner of CNL
  - Develops vision for CNL
  - Monitors CNL's performance & earns fee based on results
  - Appoint CNL's leadership
  - Canadian Nuclear Labs (CNL)
    - Operator & licensee
    - Enduring entity & employer
      - Access rights to AECL's assets/IP
- CNSC Regulator
- GoCo contract structure:
- Contractor contract
  - Site operations company agreement
    - WL closure target cost agreement
      - Est SOW
      - Share "Pain & Gain"
      - Encourage Innovation
      - Shorter timeline/lower cost
  - NPD closure target cost agreement
- Closure of Whiteshell Laboratories Keys to success:
  - o All Radioactive waste allowed to be transported and consolidated at Chalk River Site
  - Seeking formal change to EA to enable ISD of WR-1

# Key Learnings:

Innovative approach for reactor D&D

- In-Situ decommissioning
  - Demo all buildings above grade
  - Grout subsurface in place
  - Safe by design
  - Reduction of liabilities now rather than storage with surveillance
  - Eliminates transportation & temporary storage
  - Environment protected engineered protection
  - Continued monitoring
- Challenges:
  - Standpipes ILW retrieval
    - ILW mixed with fissile materials
    - Pyrophoric materials
    - Uranium carbide fuel pieces
    - Methane and hydrogen gases
  - o Engagement with stakeholders & indigenous engagement
  - Securing regulator approval
  - Final closure (end state) criteria

## EPRI Technology Innovation Projects to Facilitate Decommissioning Rich McGrath (EPRI)

# Session Notes:

- Program objective:
  - Provide technical R&D guidance for planning and conduct of facility decommissioning
- Strengths:

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- More than 20 years successful decommissioning
  - More than 20 years of R&D results
- Offers forum for utilities to share OE
- EPRI study conclusion;
  - o Costs of decommissioning in US highly influenced by staffing costs
    - Directly related to overall length of decommissioning
- Typical decommissioning conduct
  - Executed largely by manual labor
  - Organization for Economic Co-operation & development (OECD) concluded that nuclear industry has not fully utilized current technological capabilities
- EPRI robotics/automation project overview
- Focus:
  - Perform decommissioning work in safe & ALARA manner
  - Reduce costs
  - Approach:
    - Evaluate tasks for potential automation and use of robotics
    - Review existing automation and robotics technology usage
  - Current EPRI project
    - 2018-2019: Conceptual design for coordinated semiautonomous system for reactor internal segmentation
    - 2020-2021: work with industrial partners to fabricate, test, and demonstrate system
- EPRI Study: Concrete Characterization & remediation
  - Worldwide approaches vary
    - Europe/Germany
      - Clearance exists for release of concrete
      - No disposal option currently
      - Small amounts managed as radwaste, large amounts cleared
      - The United States
        - Low-disposal cost; acceptability for bulk/large packages
        - Concrete cleared at time of license termination but remediation and release survey very expensive and time consuming
        - More cost to dispose of radwaste concrete
        - Typical approach:

- Removal of highly contaminated concrete
- $\circ \qquad \text{Open air demo}$
- Radwaste debris removal
- Current remediation techniques slow, labor intensive, costly
  - Little innovation deployment
  - Primary & secondary waste generation key concern
- Concrete remediation techniques
  - Nitrogen blasting
    - No secondary waste
      - Remaining aggregate generally clean
    - Leaching
      - Can remove contamination from surface
      - Lengthy time frame
    - o Laser

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Lab scale testing performed

## Key Learnings:

- EPRI project: Automation of Radioactivity characterization
  - SSCs and land area surveys usually performed manually
  - o Goal: develop field ready automated radiological survey system
  - o Focus on using existing autonomous navigation systems from other industries, adapt to deliver rad monitor devices
- EPRI report # 3002010599

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- Substantial benefit for:
  - Worker safety
  - Exposure reduction
  - project costs and schedule reduction
- o make systems to be used in multiple applications useful and allows distribution of deployment costs
- selected tasks with high benefits:
  - reactor internals segmentation
  - concrete decontamination
  - site characterization & final status survey

# Innovation to Achieve Success in Decommissioning - Dry Cask Storage

George Vaughn (NAC)

### Session Notes:

- Success factors for dry cask storage
  - Fewer systems loaded
  - Improved safety

- Reduced worker dose exposure
- Fewer heavy loads
- Reduced operations
  - Schedule flexibility
  - Less impact on resources
  - Less ISFSI real estate
    - Less monitoring and maintenance
    - Fewer backend and decommissioning costs
  - Less oversight
    - Operations
      - Fabrication/construction
- Fewer systems to transport
- MAGNASTOR

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- o Provides "ultra-high capacity" capabilities
  - Weights and dimensions similar to lower capacity systems
  - More fuel stored without challenging existing infrastructures
- Challenge:
  - o Accommodate all fuel types and non-fuel contents
  - Meet defueling requirements
  - Reduce risks
- MAGNASTOR Solutions:
  - Higher heat capacity
  - Structurally robust design
  - Increased capacity
  - Accommodates more non-fuel contents
  - o Maintains system diameter and weight
  - Maximize shielding without adding weight
  - Easy to operate

### Key Learnings:

Kewaunee Power Station Lessons Learned:

- Understanding decommissioning atmosphere
  - Negative community effects

- Maintain safety stewardship mentality
- Procedure & process reconciliation
  - Agree on robust procedure review criteria
  - o Est change review and approval paths with end resolution and contract reference
- Pool to pad is sacred
  - o Driven by multitude of skills, equipment, and procedures
  - o Ensure each step is clearly defined with contingencies in place
  - o Standardization, minimization, simplification of equipment (drive efficiencies)
- Emphasize early investment in design input collection
  - Important for planning and implementation
  - Consider of life cycle of spent fuel storage cask
- QC and fabrication resiliency is key to large hardware delivery
- Routinely optimize cask transfer ancillaries
  - Drive processing times without putting demand on site
- CAP differences
  - Implement effective program for opening/closing CRs
  - Electronic system for tracking, assigning owners, due date reminders, etc.
- Include complete RP Participation in Training
  - Crew should be integrated team -plan for mock up dose rates and survey interruptions
  - Set clear obligations during training and solicit for ideas

# Innovation in D&D: An Engineered Approach

Sheldon Lefkowitz (Pentek)

# Session Notes:

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- Management objectives in D&D Activities:
  - Reduce time, waste, exposure, & labor
  - Engineering Objectives in D&D Activities:
  - Focus on:
    - Productivity & reliability
    - Removal of surface contamination & package volumetric waste
    - Containment & collection of radioactive materials at the source
    - Application of automated devices where sensible

# Key Learnings:

Innovation priorities in D&D activities

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- o Simplify approach
- Adopt/adapt methods gained from site/industry
- Invent only when necessary
  - Robust construction
    - Test and gualify process
    - Test and qualify workers
    - KISS
- D&D developments from TMI-2 lessons learned:
  - Floor scabbling machines for removal of coatings & upper surfaces
  - High performance vacuums for waste collection
  - Electronics for remote monitoring of in-containment instrumentation

# Q&A

- Q1: Is the fuel debris being stored as ILW in Canada?
- A1: Yes, it is causing challenges for disposition due to the storage methods.
- Q2: What is the theoretical time frame for moving fuel out of dry storage?
- A2: As low as 2 years, goal is to one year. Dependent on getting fuel out of pool.
- Q3: How long does a GoCo contract last?
- A3: Six years with a 4-year potential extension.

# Engineering/Equipment Reliability

# Session 1: Advanced Reactors

Session Organizers: Garry Young (Entergy), Amir Afzali (Southern Nuclear)

The most pressing set of national priorities are 1) generation of affordable, reliable, sustainable, resilient, and clean energy, 2) energy independence, 3) developing national human capital and infrastructure, and 4) protecting national security interests through global leadership. Nuclear energy is the only energy production option that consistently supports all these priorities. The future of nuclear energy will include advanced nuclear non-light water reactor (non-LWR) systems which promise superior economics, improved efficiency, greater fissile fuel utilization, reduced high level waste generation, and increased margins of safety. It is well recognized that it takes decades and significant financial investment to mature, deploy, and optimize nuclear energy systems. It is also recognized that an efficient and cost-effective licensing framework that facilitates safe and cost-effective construction and operation of such systems is a critical element for incentivizing private sector investment and enabling innovation. This session provides an opportunity to present and discuss the ongoing and planned activities to modernize US regulatory framework to enable innovation while protecting health and safety of the public.

# Innovation in Regulated Industry Maximizing Positive and Minimizing Limiting Impacts

Amir Afzali (Southern Nuclear)

- No industry can survive without innovations this is why we need to innovate
- Have to get three types of licenses, buy in from first customers/investors and provide a commercially viable reactor and plant. Second we
  need social buy in from the community and nation, third is a regulatory license.
- Sometimes we focus on regulatory, but we need the other two as well.
- It needs to strike a balance between the benefits of the regulator being save but avoid unnecessary burden leading to high cost of construction.

# The Evolving Use of Risk in the Regulation of Nuclear Safety

Jeff Merrifield (Pillsbury Winthrop Shaw Pittman LLP)

- Hard to innovate with plants on the NRC "watch list" so historically accepting risk was harder at a time when performance was cyclical.
- Now there is more acceptance of using risk informed tools.
- ROP allowed the NRC to focus on bigger risks like fire protection.
- New tools can be used in a more wholistic way.
- Avoid over conservatism and meet adequate level of safety with a consequence curve using existing data.
- Some SMRs (small modular reactors) are a hot bed of innovation with some far along and some new, they should be complimentary to
  existing operating plants.
- Goal of SMRs is to reduce operating and construction costs and be a major contributor to reducing CO2 emissions.
- Not just CO2 emissions but reduce emissions period.
- They can be used for desalination.
- Electric vehicles are only helpful to reduce CO2 as the energy source is.
- Coal plants powering Tesla's really doesn't help the environment.
- An overwhelming majority of Congress supports nuclear now versus just three years ago.
- Advanced nuclear is seeing more money and more support.

# The Urgent Need for Innovation

Doug True (NEI)

- We listen to how current reactors and new reactors will fit together.
- A debate on if climate change is real and important policy decisions are coming up in the next few years.
- Overall, we see goals to reduce carbon emissions.
- We've done a good job of proving we are relevant and safe, but now we need to show what we have to offer beyond the existing fleet that can be competitive.
- Next, we need to show that we can actually deliver cost effectively. The challenge is not how we can "first of a kind" it but how to get to "nth" of
  a kind which shows not that we can do it once, but we can have continuous fast growth by the 2030 timeframe.
- There are still sceptics we need to win over and we need more "nth" of a kind where we have more than just prototypes.
- He thinks we need large and small reactors to help prove we can achieve "nth" of a kind.
- If you add subsequent life renewal the picture of nuclear looks a little better.
- But if we want to retain the 20% of nuclear energy generation of the U.S., then we have a significant amount of new nuclear.
- We are talking about a very large opportunity.
- There are two things we need to be successful: advanced technology with regulatory approvals, and cost reduction.
- Good news is performance of existing fleet is very good. It can be said we are operating the best of any industry currently.
- The cost of new licensing keeps rising and we aren't turning it around. We need licensing and review costs to drop.
- Solution path for regulation. Needs to be actually demonstrated we can do this in a cost-effective way, and the burden of the work need to be proportional to the rigor.

# Advanced Reactor Regulatory Framework & Licensing Technical Requirements Jim Kinsey (INL)

- Focus on DOE and the national labs to make sure they are continuing to support the industry need.
- For years we heard the regulatory path is too hard, but we've turned a corner on that and we have positive momentum going now. We need to have a smoother path to navigate and move from a valley to a bridge.
- We've been firming up some of the rules with the NRC to make this a modern framework.
- The labs are working closely with various stakeholders to align with industry, congressional policy, and regulatory need.
- GAIN is managed at INL. There are a series of public and private partnerships. INL is also retrieving information from the past so that we don't have to re-create it.
- "The long pole in the tent" is licensing the new fuel and testing it.

- Early communication with the stakeholders firms up the requirements rather than hitting snags ten years down the road.
- Challenge going forward is to integrate and work as a village not individuals.

# Rightsizing Regulatory Processes for Advanced Reactors

John Monninger (NRC)

- Right now the NRC is climbing a tremendous peak on interest in Advance reactors.
- We need to convert to the appropriate size regulatory framework, right sizing the "why" lots of things apply to non-light water reactor types. The mindset is similar so there is need to update to include non-light water reactors.
- Congress is funding to allow for the right size NRC organization to accommodate the need.
- The regulatory process needs to provide predictability and not present a barrier. They are modernizing and rightsizing the regulatory framework now.
- IAT = implementation Action Plans came with the vision mission strategy as part of rightsizing.
- (integrated consideration of innovation slide) Graphically illustrate a power plant, what can go wrong and what is used to help overcome it.
   LMP = licensing modernization project
- The LMP has three major pieces and then there is a process for selecting structures systems and components (SSCs) and defense in depth from a programmatic and plant capability perspective. They are making the process more re-producible.
- Looking at how to modify the process to focus the content of the applications.
- Then environmental review change is mostly specific for micro reactors.
- Plan on going through a couple licenses through part 50 and 52 then use that experience to create a part 53.
- Trying to make their process changes universally acceptable for all designs.

# Q&A

Q1. The history is that we need to load follow or provide energy for batteries. Can you comment on what the optimum use is for future reactors? A1. Doug – I think we are going to need load following for grid needs and capabilities. It's generally more expensive to provide load following. He things what we will find is that developers will try to provide designs that can provide for both.

Jeff – If we can get batteries then it provides opportunity for renewables. The biggest beneficiary of renewables has been natural gas. Nuclear needs to look to batteries for energy storage. North Anna built a pump storage facility because it can pick up fluctuation. We need to think of these reactors in a different way. They may still operate 24/7 but might be stored for later.

Q2. We heard from Steve Kuczynski this morning that there are many aspects of regulation that we can adapt to, or do we need to revise instead? A2. Jeff – They got too many countries involved for regulatory harmonization lead to just everyone meets the highest standard rather than risk informed decision making. Maybe just include a few countries internationally that we can use a multilateral approach with.

Jim – They did a very extensive line by line review of regulatory documents. Only a very small percentage of the regulations need to be updated for new reactors. Adapting it can be easy.

John – I believe in the near-term adaption approach for regulatory reviews. We need to have a wholistic approach and re-focus the thought process on the higher-level safety goals.

Doug – In the context of innovation, we don't have time for regulatory revamping so we will have to get by with adapting to move quickly by using risk informed decision-making.

## Session Takeaway

This is not about wholesale changes. We can help innovation survive by adapting. The momentum for policy, regulation, safety, and monetary support is in favor of advanced reactors right now.

## Session 2: Digital Modernization Part 1: Myth-Busting Digital I&C Session Organizers: Ray Herb (Southern Nuclear), Pareez Golub (EXCEL Services)

Participants: Ray Herb (Southern Nuclear), Eric Benner (NRC), Pareez Golub (EXCEL Services), John Connelly (Exelon Corporation)

This first session is about the myths surrounding Digital Modernization. It is aimed at changing long-held beliefs related to digital modernization like problems related to platform maintenance, lifecycle issues, regulatory hurdles, and negative NPVs. This panel will challenge the myth that digital comes with unnecessary additional burdens over analog including cyber, obsolescence, software, and complexity. Hear about NRC initiatives that reduce regulatory burden and increase regulatory certainty in digital implementation. This session will also address the myth that digitization, including protection systems, do not provide a good return on investment. Busting these long-held digital myths will help change the perceptions and lead to implementing digital modernizations to support sustainability of the operating fleet. This is a two-part Modernization panel, stay around for Part 2: Closing the Deal.

# Modern Digital I&C Regulatory Approaches

Eric Benner, Engineering Director U.S.NRC

## **Presentation Notes**

- To use the oft-referenced road metaphor, "it's been a long journey, but the signs are now clear and we know where we're going."
- The NRC has come a very long way working with NEI on 10 CFR 50.59.
- Not everything can be handled under 50.59.
- Interim Staff Guidance ISG-06 establishes an alternate review process for mods.
- Strides have been made to reconcile differences between traditional review process and new ISG process.
- The NRC has minimized the number of instances where a license amendment is needed.
- (Presentation slides include table of misperceptions vs. realities)
- The truth is, it is complicated. However, NRC segmented guidance, at the request of stakeholders, makes it look more complicated than it needs to be.
- Thought is currently being put into how to consolidate that guidance.

## Key Learnings, Recommendations, and/or Best Practices

Digital upgrades are easier to do than they used to be. NRC is ready and willing to make improvements to the process going forward.

Economic Myth – Digital Protection System Feasibility Pareez Golub, Senior Consultant Excel Services

## **Presentation Notes**

Myth: Protection system digital upgrades aren't a good ROI and only address obsolete analog equipment. That has been proven to be false; has been known outside of the nuclear industry for a while. An extensive feasibility study was performed by Excel at a 2-unit Westinghouse PWR. The study was extensive and revealed that significant cost savings could be had through decrease in labor, decrease in testing, decrease in parts, etc... (Presentation slides contain most information)

### Key Learnings, Recommendations, and/or Best Practices

Digital upgrades presently have a good ROI.

## **Digital Myth Busting**

John Connelly, Senior Manager I&C analytical Group Exelon

## Presentation Notes

- Myth 1: Cost/benefit analysis doesn't work. A short version of Pareez' presentation. It has been proven with OE (operational experience) and data that cost/benefits analyses are effective, and the data shows that the ROI is strong for modernization.
- Myth 2: Digital goes obsolete too fast. Comes from a misunderstanding of digital systems. DCS doesn't go obsolete quickly. The user-
- interface/commodity stuff does go obsolete quickly, but there are proven methodologies to mitigate that (virtualization, etc.)
- Myth 3: Cyber security compliance costs negate any cost savings. Once you're in compliance, it doesn't cost that much to upkeep, but the
  problem is initial compliance costs are very high.
- Myth 4: It's just too hard to design a digital system. The SDP (Significance Determination Process) has been changed to be much more workable.

### Key Learnings, Recommendations, and/or Best Practices

Digital upgrades are worth the money. They're not as hard as you think they will be.

## Group Q&A

Q1 (John): Where can the rest of us start (since we're not Exelon) to get acquainted to the design process? A1 (John): We need to move to systems engineering model. We need to get people up to a common level of understanding. NEI is putting together a standard training for all aspects of the SDP.

Q2 (Pareez): How scalable was your study to the rest of the industry?

A2 (Pareez): It was definitely applicable to all the other Pressurized Water Reactors. The way the study was done conceptually binds other designs. So many conservatisms were included in the analysis that other built in savings that are universal will reveal themselves.

Q3 (Pareez): You didn't mention the life of the plant. How much life did this plant have left? A3 (Pareez): 2047 and 2049 before subsequent license renewal.

Q4 (Eric): NRC was considering writing guidelines for SQA. Tell me more.

A4 (Eric): Doesn't know enough to answer that question offhand. Aug 29, there will be a meeting about it, and will follow up later.

Q5 (All): How do you feel nuclear sites are reacting to this information? Have sites been informed and are they aligned?

A5 (Ray): At Southern Nuclear, we're forcing engineers to answer these questions at the Plant Health Level.

A5 (John): Exelon was tabling these issues as long as possible. The landscape is completely different today. To make sure management is getting updated correctly, they had a large alignment meeting. We have standardized everything. That's a good idea for everybody.

## Session Takeaway

There are a lot of myths surrounding the Digital / I&C upgrade process that makes it appear like an impossible feat, and part of that is due to actual past problems. But optimization and industry collaboration has broken down many of those walls, and the process keeps improving.

# Session 3: Digital Modernization Part 2: Closing the Deal

Session Organizers: Ray Herb (Southern Nuclear), Pareez Golub (EXCEL Services)

#### Participants:

Pareez Golub (*EXCEL Services*), Paul Phelps (*Dominion*), Chris Whitfield (*Southern Nuclear*), Rob Austin (*EPRI*), John Connelly (*Exelon Corporation*) **Room:** Amelia Ballrom 2/3

This is the second session after Digital Myth-busting. The utilization of digital technology is critically important to the sustainability of the current operating fleet and the next generation of reactors. The regulatory and technical framework is in place for largescale I&C modernization. Come hear our panel discuss strategies utilities are using to ensure their long-term modernization initiatives achieve the forecasted reductions in O&M costs. Specifically, panel members will address their modernization framework, plans to capitalize on digital enablers to fundamentally changing plant operations, and maintenance strategies to increase equipment reliability - all to reduce cost to maintain their nuclear asset. Learn how EPRI's plant modernization strategies support industry O&M cost reductions and increase collaboration amongst industry resources (e.g., INL and other labs, NEI, etc.).

# Southern Nuclear, Developing a Digital Modernization Culture

Chris Whitfield (Southern Nuclear)

- Want to focus on breaking down myths and closing gaps related to digital modernization.
- Doing more with less was important, have better preforming equipment to help operators and thinking about the workforce of tomorrow.
- Southern Company is between steps 2 and 3 from the digital modernization plan graphic. They stepped back from a digital visual control
  room. They redefined their scope and put processes in place to reduce being hindered by modifications going forward.
- Historically we (Southern Nuclear) just try to get to the next version of a piece of technology. Now we try to take a larger view of how the technology is used before making decisions.
- As designs are coming forth they make sure they align with the design strategy and having a common design process.
- They are strategic about aligning common products to maximize resources.
  - Example of how WiFi has evolved from just being for internet but now used for unlocking doors, playing music, connecting to phones. • Digital is about how do we work from within to make changes so that it's easier to implement

# Digital Modernization Part 2: Closing the Deal

- Pareez Golub (EXCEL Services)
  - First session was about debunking long held myths about NRC support, economics about feasibility, and myths about obsolesce and cyber security issues.

# SLR/Digital I&C

Robert Atkinson (Dominion)

- Everything is conceptual and is just a plan going forward. There is strong executive backing so the information in the slides could change some.
- Project drivers include the slide bullets as well as driving to 80 years before decommissioning.
- The equipment in the control room is 70-year-old technology. Interns that came into the simulator and were shocked they controlled the plant with all the equipment needed to control the plant. Operators of the future have no clue how to operate with the current technology. We need to make upgrades for the operators of the future.
- We can't say it's economical every time. But we still need to go out and modernize the equipment.
- There is a difference between operating the plant and monitoring the plant. And it's better to monitor the plant.
- The goal is to modernize the equipment across their Virginia plants.
- Enhancements and modifications will help the operators monitor the plant.
- They aren't just replacing cabinets, but also replacing transmitters.
- Dominion is looking at 10 years to complete so they are planning for people moving on and knowledge transfer.
- There is a focus to make sure the existing infrastructure can support the changes they need to make. 11 non safety systems and 6 safety systems.

# Plant Modernization

John Connelly (Exelon Corporation)

- There are standard solutions for everything. That's their (Exelon Corporation) mantra because standardization allows them to pull in experts from around their fleet to solve issues.
  - Any deviation needs to go up to senior level of management because it needs a compelling reason to change from standardization. Modernization eventually reduces risk after you have a known platform that you continue to implement.
- Although some things they are first for, they make sure that they use standard processes so that it can be used across the industry. The intent is that anyone in the industry can use it and it will help with vendor selection.

# Nuclear Plant Modernization

Rob Austin (EPRI)

- Modernization is about relieving intense O&M cost pressure.
- Technology needs to improve to get cost reduction regardless of how policy changes.
- Technology must come with process improvements.
  - It's good to have experience in the existing fleet to help the new plants come online.
- If it's feasible then the methods need to enable success before it can be deployed.
- Feasibility Is there value in modernizing the nuclear fleet? Yes, the cost reductions can justify it.
- (he didn't answer all questions presented on the slides, they were open ended)
- They are starting the look at what a modernization "handbook" would look like.
- It's important to validate the savings.
- In order for modernization to succeed, it needs to be continuous, not just once every 20 years.

## Key Learnings, Recommendations, and/or Best Practices

Emphasis on changing culture to meet new digital needs. replace functionality 1 for 1, but also enhance it and automate it to be successful with the digital upgrades. (same as the session takeaway)

## Q&A

Q1. EPRI is doing great work in the area, if people want to get more information where do they look?

A1. Rob Austin – (there is a handout he brought with him) Utilities can get an EPRI ID, send him an email and he will add you do the distribution list. Most things are publicly available on epri.com. (raustin@epri.com)

Q2. Public/Private partnership, how will that be communicated?

A2. John – I have no good answer to that. INL is effectively the contact point for what he's doing. And we are brining into the effort multiple stakeholders. This will be issued as an INL report open to the public, but exact mechanics not available yet.

Q3. So if you aren't still working for Dominion, how do you strategies sustaining the momentum if stakeholders leave.

A3. Robert Atkinson – it's a 10 year project, it's still developmental right now. They are working with management and as part of that they will identify key functions at the station and corporate level and identify the stakeholders and workers who would be next in line to take over parts of the project. If the project manager leaves he's read there is a 57% chance of failure. They know they need to be serious about putting "new blood" young engineers into the system.

Q4. Cultural enablers How are you going to communicate the framework to people outside of

A4. Chris Whitfield – They utilize doing road shows. They want to identify the strategy then listen to what they see the impact as and then myth bust and start the conversations much earlier.

Q5. What is the schedule for the portable package?

A5. John Connelly – The intent is to get the specification done by the end of the year. In parallel they are doing a cost benefit analysis done by the end of the year as well. Then go forward with funding process by the middle of next year

Q6: You are going to bid out services? How will you determine which part and who?

A6: Robert Atkinson – Whoever wins will provide the services, they will support things independent of the final product like a second simulator at each site.

Q7. Describe your cost benefit cost benefit analysis

A7. Robert Atkinson - Dominion decided to do a subsequent license renewal, digital is only one major project that's part of that.

Chris - They are working within their existing budget and are focused on looking at in flight mods. After Vogtle 3 and 4 will look at it a bigger way.

Q8. Looking at the 25% for O&M reduction, is there benchmarking that shows the 25%?

A8. Rob Austin – there was no basis for the 25% he presented, but they did benchmark some combined cycle generations facilities and a commodities metal facility. One thing you're struck with is that you don't see people at those plants, so he thinks 25% as a personal opinion is conservative for what could be done. Staffing is what drives most of the savings.

Q9. Is the hazard guide done? A9. Rob Austin- Yes that's out.

Q10. LTM is maintained by the sites. But was it a collaborative effort between the site and corporate is that proceduralized? A10. John- yes on an executive level very early.

Q11. What will the second simulator for Dominion look like.

A11. End state simulator will be very different Some soft and some hard controls. They envision large overview displays, and eliminate the enunciator systems. It'll be mostly glass and will be an end state simulator.

Q12. Modernization handbook when is it coming out? A12. Late next year

# Session Takeaway

Emphasis on changing culture to meet new digital needs. Also, replace functionality 1 for 1, but also enhance it and automate it to be successful with the digital upgrades.

# Session 4: See Business/Economic Performance

# Session 5: See Business/Economic Performance

# Session 6: Declining Trend in Fuel Performance Due to Debris Failures

Session Organizers: Bryant Hearne (INPO), Craig Faulkner (INPO)

U.S. Industry fuel performance has slowly declined since the beginning of 2013 as described in IER L4-16-5 rev 1 Adverse Trend in Debris-Related Nuclear Fuel Failures. As of January 2019, twelve cores were operating with failed fuel rods; eight boiling water reactors (BWRs) and four pressurized water reactors (PWRs). These failures are breaches of the first fission product barrier and have an adverse impact on plant personnel and operations, including increased worker dose, lost generation to support power suppression testing, mid-cycle outages to remove failed fuel, and slower ramp rates for power level changes. Prior "Zero by 10" initiative improvements did not result in sustained performance as, it did not sufficiently address most forms of debris-related challenges, and needed improvements in foreign material control. A cultural shift towards improved ownership and focus on fuel reliability, cross-functional engagement, and failure prevention strategies is required to address debris-related challenges. In some cases, there are shortfalls in compliance with existing industry standards for fuel performance.

# Industry Fuel Performance – INPO Perspective

Clint Alday (Nuclear Fuels Manager, Entergy)

## (INPO presentations available through INPO member website)

#### **Presentation Notes**

- (Presentation Slides contains most information)
- Trend graph shows that we've been stagnant in fuel failures for about 10 years. The only good trend is that the "good plants" are staying good and that more plants are getting better.
- Most of the debris failures in the recent past have not been from FME. The debris is a piece/part that's not where it's supposed to be, but it is
  internal to the system. A lot of people are still focusing on FME to prevent debris failures, but this will not solve the adverse trend we're seeing.
- Major oversights in BWR analysis that didn't consider fuel downstream. Lots of OE indicate that we don't have a line-of-sight to the reactor core.
- This IAR isn't just a maintenance IER. It's an "everybody" IER. This needs to be a cross-functional effort to attack the issue.

## Q&A

Q1: Do you assume that the debris is not caught by the upper tie plate?

A1 (Clint): Yes, that's the assumption. But we know that more from OE.

Q2: A few of these slides show that engineering didn't understand what was OK/not OK to leave in the reactor. Why aren't we going back and reevaluating our past evaluations in this new light?

A2 (Clint): I would recommend you do that. The IER doesn't require that. The plant that found the thimble didn't really know what that was a possibility in their fuel. 100% go back and look at your lost part evals and consider if they could impact your fuel. It can hang out in the system for years before it creates a problem, so go back. I can't emphasize enough the role of the system engineer.

# Braidwood Station A2R20 FME Event

Bill Spahr (Maintenance Director, Braidwood - Exelon)

- (Presentation Slides contains most information)
- Rolls Royce, Eng developed the "Safe C", which was essentially a specialty clamp on the end of a "hot stick" pole. Rad worker got in there and held the CRDM until the refuel machine could get to him and hold it instead.

- Westinghouse brought a mock-up of the guide tube so maintenance could practice their evolution before execution.
- When you get comfortable with your processes and procedures, your plant will come tap you on the shoulder. We need to ask ourselves
  constantly "Does this make sense for us?" Trust your procedures, but always ask "why".
- Performance Indicators are reactive instead of proactive. Exelon has created proactive performance indicators based on behaviors instead of
  consequences. Pilot program being implemented at 2 sites, will be evaluated and possibly rolled out across fleet.

## Q&A

Q1: What is the purpose of that pin?

A1: The pins prevent the inside shaft from rotating without the outside shaft. But we need to ask: are we putting things in the reactor that don't need to be there? Do we need 3 pins when 2 will do the trick? The OPEX is considering those questions now with a broader scope.

Q2: Are you going to use this (proactive performance indicators) on other skills besides FME? A2: Yes. The next area will be rework, since that's an easy one to quantify.

# Session Takeaway

- If you can control behaviors proactively, you avoid events in the first place.
- Never assume your procedures and processes are strong enough. Always question "why", especially when things are too convenient.
- Understand the vulnerabilities that we may have created over time. We need to go back and re-examine some of the ways that we've
  dispositioned issues in the past.

# Session 7: Light Water Reactor Sustainability: An Update on R&D Efforts to Extend Plant Life Session Organizers: Bruce Hallbert (INL), Ted Quinn (Technology Resources)

This session will focus on public-private partnerships through DOE-sponsored research and development activities within the Light Water Reactor Sustainability program to extend existing plant life and optimize safety and economic performance. Speakers will emphasize recent efforts and provide updates on progress and plans that are ongoing with industry through this program.

# LWR Hybrid Plants

Daniel Wendt (Research Engineer, Idaho National Laboratory)

## **Presentation Notes**

- (Presentation Slides contain most information)
- Presenting on behalf of Richard Borgen who could not attend the conference. Slides were developed by him.
- Studies have shown that LWRs may be the cheapest source of Hydrogen that currently exist.

## Q&A

Q1: What kind of safety systems will you need to install for the hydrogen?

A1: We're trying to maximize the space between the hydrogen processing and plant. Intend to move storage offsite.

Q2: Did you look at the difference between regulated and deregulated models for this? A2: No, Davis Besse hasn't looked at the viability of this in the regulated market.

Q3: What percent power are you moving to the hydrogen production stage?

A3: A nominal amount. Part of the point of this project is to generate hydrogen and sell power in the most economical way.

# Plant Modernization Pathway

Craig Primer (Plant Modernization Pathway Lead, LWRS)

## **Presentation Notes**

- (Presentation Slides contains most information)
- The "top down" concept of operations drives to reduce the number of people onsite who do things that could be automated. The real money savings in innovation comes from innovating processes, not in buying equipment.

## Q&A

Q1: What about wearable technology?

A2: What we want to do is develop wired workers. We've got some projects in that space, but only where things can't be automated. Again, I think forcefitting a tablet to meet everyone's need is probably not the best idea.

Q2: Are you also looking outside the nuclear industry for this stuff? A lot of it already exists in oil and gas. A2: We've brought in some vendors who have done work in oil and gas, and they know well what is going on in those industries. But oil and gas hasn't figured out everything that would be good for us since we have unique needs.

Q3: Are you integrated in your strategy with other developers? A3: Yes, we work closely with Oak Ridge, Argon, PNNL. We recognize that strengths lie with other labs.

# LWRS Physical Security Initiative

Mitch McCrory (Physical Security Initiative Lead, Sandia National Labs)

- (Presentation Slides contains most information)
- À pretty significant change happened in the 80s where security got a lot more professional and beefed up. Then 9/11 happened and things got even more serious. But physical security hasn't modernized in the same way that other elements of the plant have.
- Risk management is the biggest deal when you talk about security because of the human performance nature of it.
- \$4.8 million average cost to decommission, and \$560,000 of that is security costs alone.

• We don't have to invent everything for ourselves in this space. Government agencies have done a lot of this already, especially in the development of advanced nuclear weapons.

# Q&A

Q1: What do you to disarm these fanciful imaginations of what threats can look like at a nuclear plant?

A1: I just explained what I can about what we do. I also describe that we handle potential threats that do account for those beyond 3 sigma threats (like force on force).

Q2: What is the NRC's receptivity to these changes?

A2: The NRC is currently very favorable to doing these things, which is why we're in such a hurry to do it (because things might change there). It's a very receptive opportunity right now.

# LWRS Materials Research Pathway (MRP) Research for NPP Sustainability

Thomas Rosseel (MRP Team)

# **Presentation Notes**

- (Presentation Slides contains most information)
- The most common and complex failure mechanisms are stress corrosion cracking (SCC) and radiation embrittlement
- Ran out of time in session to cover concrete performance, but that is one of the most exciting areas of study. Data from Russian literature and
  current modeling, combined with very innovative and new study techniques, are giving us very "fun" results. We will be able to accurately
  predict concrete degradation specific to the concrete's use and location.
- Also didn't have time to cover Cable Aging in session.

# Q&A

Q1: Are you working with the NRC on this?

A2: Yes, we have biweekly calls with EPRI and NRC. There was a DOE/LWRS/NRC joint group that discussed this knowledge gap.

## Session Takeaway

- There's money "on the table" for LWR who can find other ways to leverage
- Best innovations are process innovations, not in buying new equipment.
- There is a lot of ongoing research at all the major national labs to study degradation effects and innovate new ways to address them intelligently.

# Executive/Leadership

# Session 1: The Intergenerational Transition Challenge - Passing the Torch

Session Organizers: Jim Little, Sean Clark (AMMI Risk Solutions)

Perhaps the most immediate and impacting challenge facing the nuclear industry is the loss of its Baby Boomer generation of knowledge workers due to retirements, and the transition to reliance to a new generation of workers who do not have the benefit of past knowledge and experience. The nuclear power industry is at a critical point in its evolution in a cost competitive environment, as it strives to maintain the standard of EXCELlence in operation for the existing fleet of reactors while developing new, better, and more cost-effective technologies for the future. Key to the continued success and future development of the industry will be innovative approaches to attract and energize a new generation of workers who can bring new thinking and technologies while accessing the knowledge base of the previous generation.

New approaches, which will require fundamental changes in business and management cultures as well as the aggressive implementation of intelligent technologies, will be required to access and make available the knowledge and experience of the past generation in a framework that is accessible and that allows the next generations to focus on innovations that improve operations and cost effectiveness - needs critical to the future viability of the industry.

This unique panel of nuclear industry speakers from the commercial nuclear industry, the U.S. Department of Energy, and the U.S. Nuclear Regulatory Commission discussed the challenges they are facing along with the results of their efforts to address this significant industry issue.

## Nuclear NextGen

Jim Little, Nuclear Energy Programs

### **Presentation Notes**

- Prefer to call millennials "NextGen" because "millennials" has a bad connotation.
- "Wicked Problems" are those that face the industry with problems that haven't been answered before. They will require an innovative solution.
- Nuclear is unique and special. It requires a higher-than-normal amount of knowledge and talent to keep them running.
- NextGens aren't like Baby Boomers. They're actually different. They're technology workers, not knowledge workers. Much different values
  around personal development and loyalty.
- When Nuclear was "Hot", there were new opportunities. How do we make nuclear "hot" again? Excite NextGens about the things that are advancing in the industry.
- Why can't we use GPS technology (iterative, real time problem solving, data gathering) to manage outage scheduling?
- Create the environment to encourage millennials to be in/stay in our industry.

#### Key Learnings, Recommendations, and/or Best Practices

- Modern problems require modern solutions
- "Just (Let Them) Do It." We need to allow millennials to do their thing. We want them and their technology.

#### Intergenerational Transition Latonya Mahlahla, US NRC

# Presentation Notes

- (Most information presented on slides)
- Our workforce is aging. >50% above the age of 50.
- Millennials learn differently. We need to make changes to our learning and development programs so that they can have knowledge at the right time.
- What's important to millennials? Are we offering them what they want?

#### Key Learnings, Recommendations, and/or Best Practices

- Knowledge Management and Training needs to develop to better accommodate new workers.
- Information needs to be available guickly and easily.

# The Intergenerational Transition Challenge – Passing the Torch Dan Vega, US DOE

#### **Presentation Notes**

- (Most information presented on slides)
- To have a healthy future, we need a healthy present. We're not going to move from an anemic status to suddenly being vibrant and booming.
   There are several sub-sectors of the nuclear industry that aren't getting any attention from young talent. How do we get high-energy talented
- There are several sub-sectors of the nuclear industry that aren't getting any attention from young talent. How do we get high-energy people together and working on things that aren't getting enough attention? How do we leverage tools that already exist?
- We need to teach old dogs new tricks, but more importantly we need to teach new dogs old tricks.

#### Key Learnings, Recommendations, and/or Best Practices

We need to teach new dogs old tricks. Lots of information, research, and resources are already out there that millennials don't have access to.
 We need to make them aware of those resources and get them into their hands.

# Passing the Torch

Greg Sanborn, SRNS

- Everybody forgets about the Gen Xers, but there are a lot of them in the nuclear industry as well. Being mid-career, they're trying to bridge the gap between the large groups of Boomers leaving and the large group of millennials needed.
- Presentation is "outward focused." How do we reach the public? How do we get them engaged with the industry going forward.
- Maintain a frequent, constant contact with the community. Always let them know about all the positive milestones we achieve.
- Community service needs to be a huge part of our strategy. We need to get in front of local community kids. We need to think about the longlong term future of the industry as well.
- Inward solutions as well. Need to refresh training materials and methodologies.

### Key Learnings, Recommendations, and/or Best Practices

- We need to have a concerted management involvement to get this to happen. It will not happen by accident.
- Positive community involvement will pay out in terms of engagement and talent acquisition.

# Group Q&A

Q1 (Greg): Do you do anything to nurture/inspire upcoming leaders?

A1 (Greg): We have focused mentoring circles. Individuals get nominated to meet with directors etc... in a 1-on-1 mentoring relationship

A1 (Jim): Young people 15 years ago wanted soft skill development. People still want that. Business is focused on results, so we avoid failure and we avoid risks that might pay out. We need to let people experiment and let them fail.

Q2 (Latonya, Dan): Are there conversations at DOE/NRC about bridging the value gap between the generations?

A1 (Latonya): We are developing some programs including rotational assignments in order to appeal to millennials who don't want to stay in 1 position. A2 (Dan): You have to compromise between the two. We need to get people to change their brains a little. Old/Young people aren't as different as we talk about them being. But you have to make them adjacent.

A2 (Jim): We need to create social events for young people because they don't like to do the same stuff. In Aiken, we had to create an entire social network to make young people happy. Had to pay for young people to attend USC Aiken to get them to stay in the town.

# Session Takeaway

Unique potential combinations exist between old/young people that could take the industry in a new, healthy, and exciting direction, but we need to make a concerted effort to engage millennials to leverage their strengths.

# Session 2: Care to Lead

Session Organizer: Alec McGalliard (McGalliard Consulting)

CARE To Lead: How to Master and Implement Four Keys to Leadership – Communication, Accountability, Relationships and Example of EXCELlence was written by Alec McGalliard, Owner and CEO of McGalliard Consulting, with one primary goal- to help people be better leaders. As someone who started at the bottom, worked his way up and goes to work every day trying to be a better leader, Alec developed the CARE Leadership Tools through being self-critical and through a lessons learned approach with a desire to create a simple, cost effective set of leadership tools based on treating people like we want to be treated. The CARE Leadership Tools are meant to compliment and work in conjunction with other leadership models as we do not believe any one set of leadership tools addresses the many issues leaders face or the many different personalities at our places of employment. However, we do believe that the CARE Leadership Tools provide a solid foundation for working with people of all ages, genders, nationalities, races, and in many professions.

# Care to Lead

Alec McGalliard (McGalliard Consulting, LLC)

#### **Presentation Notes**

- Alec has a navy submarine experience, and currently works in utility industry.
- Learnings include: leaders having a positive impact of being self-critical.
- Review the CARE Leadership Tools as practical cost-effective approach to day-to-day leadership.
- He started the session by challenging the audience to think about a leadership situation and to apply the tool presented in the session.
- Safety Culture Assessment: things commonly found to be address because of the assessment, knowing the people, team, trust.
- Improve Accountability, by telling people what you're supposed to do and ask them to hold you accountable.
- One of the challenges as a supervisor is dealing with people and different personalities.

CARE: Communication Accountability Relationships Example of Excellence

Leadership impacts the overall cultures. Poor leadership impacts productivity. As a leader, always consider other sides of the story. Alec discussed the CARE model being unique tool that's simple to understand in detail. Being a leader is personal. Always go back and look where you could have improved. If you are honestly self-critical you will be able to improve. Become a better listener, keep ego in check. The beginning of your decline is when you start to think that you don't have any areas for improvement.

Clear communication of standards and accountability is important. Leaders communicate often and in both formal and informal settings. The problem with nuclear utilities is that employees never see their managers out in the field. Transparency ties back to relationships. People may not like your message, but as long as your honest with them you are doing your job. Willingness to listen ties back to relationships. It's important to identify your own weaknesses and to work on them. Diversity plays a role in organizations, and we need more diversity in businesses. Set the standards early and apply consistently. It's much harder to have to go back to reset the standards and establish accountability. Also, positive reinforcement is important. Leaders should communicate standards and set the standards by being an example.

#### Workforce:

- Only 23% employees in the organization work at full potential
- And 44% employees will do only what's required at work.

The best way to go beyond these numbers, is to talk to people. Build a relationship. Getting to know your people and making them feel like you care.

Discussions with employees on what they like and what they plan to do in their career. This will help with the retention in the organization. Leaders make people feel like they are valued to stay in the organization, self-empower. 44% of the survey said they are interested in leaving in 2 years, it's important to get to know people, form relationships and make them feel valued.

Examples of Excellence: When Leaders are out in the plant, it's important to set an example. Leaders behaviors, influence people. People will always be on the watch of what leaders are doing, and they will model their behavior.

### Key Learnings, Recommendations, and/or Best Practices

Praise in public, coach in private. Leaders are servers. If you demonstrate poor leadership and it doesn't bother you then you should worry. Caring about all aspects of your work. The CARE Leadership Tools are: Communication, Accountability Relationships, Example of Excellence. The Book serves as a good foundation for new leaders, also, a good way to recalibrate discipline.

## Q&A

Q1. Business models are not currently built for retention, such that pensions are not offered anymore.

A1. That is a valid question, it's important to be candid; build trust with employees.

# Session 3: Knowledge Transfer and Retention, Young Professionals' Perspective

Session Organizers: Sarah Lynn (Luminant), Tim Crook (EPM, Inc)

With the cancelation of the VC Summer plant and cost overruns of new builds, we have witnessed firsthand the problems that arise from losing experience, knowledge, and expertise in the sector of nuclear plant design and construction. Counter to that, we know the gains across the industry from shared knowledge and lessons learned; that's why outages can be less than a month and capacity factors exceed 90%! Yet the potential impacts of lost expertise now loom large across the whole industry. A generational employment dip, along with the retirement of experienced leadership, makes knowledge transfer and retention (KT&R) between senior and junior staff more important than ever. But just as the US nuclear industry must evolve to survive, so must the methods by which knowledge is transferred. This session will explore various approaches to KT&R that are being utilized to bridge the age divide, primarily from the perspective of the younger generations. Additionally, we will explore the key factors that contribute to educating, inspiring, and retaining top young talent. This will include a discussion of organizational adaptations that may be necessary for nuclear to compete for top tech talent when the motivations, loyalties, and career paths to leadership can be quite different from the generation that came before.

# Presentation Notes (no slides)

The session was inspired by the 2018 Utility Working Conference. Purpose of communicating young professional priorities, foster an understanding between generations.

## Latonya Mahlahla

US NRC, Technical Training Center.

Latonya is Gen-X and shared her career experience. She has a background in health physics; an internship at a utility was appealing due to the handson experience. While worked at a utility, she always had a mentor or a colleague (with a generational gap) that left a positive impact on her career. Advice for young generation is to make recommendation on what could be improved in the workplace.

## Sarah Lynn

Got into Nuclear after realizing her interests in math and science, based on research and building a career plan. After finishing an internship, she went back to the utility and has built her career there. At the utility, a practice has been taken to hire retirees back as mentors rather than contractors to help support employees in newly identified specific roles during the outage. This is identified early for the retiree prior to leaving regarding their willingness to support coming back as mentors. At the site, they are developing a filing cabinet system to capture valuable knowledge that has been left by retired employees.

## Trey Lewis

Has multiple experiences at Duke Energy Harris Nuclear Plant. Fleet president for NAYGN at Duke Energy. Has a background in mathematics, from the University of South Carolina. After several years of working as a high school teacher, he went back to school for a civil engineering degree. His experience has helped him with retention, understanding that the grass might not be greener on the other side.

Seasoned Employee Non-Seasoned Employee Interaction (SENSEI) award at Duke Energy is where young employees nominating mentors for their mentoring efforts. The key to the success of the program is getting support from senior management. Additionally, matrix developed to identify unique skills of seasoned employees. The matrix was effective in its development by being built by young employees from the bottom up of the organization rather than by the management team.

# Q&A

Q1. Have you considered leaving the nuclear industry, why? Have you been influenced by your peers?

A1. Latonya: Yes, twice. While working during the outage at night shift, after doing the research for a different career she realized that the grass might not be greener on the other side. Pursued opportunities within nuclear to find a role that fits a work life balance for her. Always having a good mentor to discuss the opportunities.

A1.2 Sarah: Considered leaving due to other engineering jobs having more opportunities for flex schedules. Peers have left due to uncertainty surrounding license renewal and career outliving the life of the plant.

A1.3 Trey: is not considering leaving, due to the stability for civil engineering. Nuclear pays well, and good management exists. Perception with nuclear as "cool" and leaning into it.

Q2. What are changes you've noticed needed to help facilitate Knowledge Transfer and Retention?

A2. Having flexible work schedule, valuable to all professionals. Trusting that employees are doing what they're supposed to at home. A2.1. Involving young professionals with the big initiatives, this provides young employees with a sense of ownership and fresh eyes that would challenge the traditional approaches.

Q3. What skills (information) do you need from the retirees before they leave?

A. Knowing what's there. Knowing what to look for.

Q4. How do you balance, trust but verify but also not be perceived as a micromanager?

A. This is a cross wide issue, not just in STEM fields.

A.1 We work in an industry where the cost of being wrong on a technical product to high. Once this is properly understood it shouldn't be an issue. Encourage informal reviews with more experienced employees before submitting for management review.

Q5. What are the tools that Millennials need/want to be successful?

A. Technology, innovative techniques. The end goal being personal fulfillment, and having personal accomplishment.

A.1 Access to modeling and simulation software, sometimes sites have few licenses so tools may not be accessible for all, and not the newer employees.

A.2 Making documents accessible in digital forms.

For young employees there are so many barriers in order to enter the nuclear industry in comparison to how the process used to be previously implemented. The ability to fail is something that used to be acceptable, however, it is not built in the nuclear industry anymore. Everything is procedure driven and built to be conservative.

# Session Takeaway

Leveraging of mentoring, employee empowerment, filing systems for KTR, matrix identification of skills, are among the ways that can be used to address the generational gap. It's important for senior executives to recognize the needed attention to build the bridge for the generational gap.

- People are not very different. It's important to identify with what we have in common than what we have differences in. Millennials need to learn from boomers to toughen up a little.
- Mentorship is vital: Identify projects to be involved in and pairing young employees with seasoned employees within cross groups or departments.
- Safety compliance culture, great ideas and having innovation to do things differently. Having a way to capture innovation ideas.
- Millennials are looking for ways to be able to search and find information
- Buy-in from management is essential, but a top-down approach is often perceived negatively by the experienced employees. Bottom up approaches typically work best, driven by the mentees.

# Session 4: Innovative Leadership Techniques

Session Organizer: Bruce O'Brien (Marathon Consulting Group Inc.)

This panel will be discussing Management 2.0. - Innovative ways being used, latest research\*, creating a thinking organization, integrating knowledge, proven learning techniques, social and generational styles and collaboration that maximizes the strengths of the entire team, while recognizing the areas needing bolstering. We will explore the best uses of technology to amplify and achieve stellar, and cost-effective performance, in addition to leadership techniques that are working and providing profitable results. Successful management systems provide the vehicle to facilitate predictability, sustainability and leverages technology to build a culture of leadership for current and future generations.

# Management 2.0

Bruce O'Brien (Marathon Consulting Group Inc.)

## **Presentation Notes**

The presentation covered Generational impacts in the aspects of managing people. Management has to take into account the generational transitions with technology impacts. Although there are generational differences and aspects to different generation's behaviors and influence with style, it is important to recognize that we are all people. There are factors of life and differences in backgrounds that influence who we are as individuals, it's important to look beyond the surface and not categorize our employees within generation groups. Every organization has a culture, you can allow it to happen or you could design it to be how you want it to be. Every stage of the nuclear power plant evolution requires a different type of culture. Instituting high levels of collaboration is not only needed for millennials, it's a need for the organization. Quality work requires focus on behavior, to do that, we must set goals and define behaviors expectations. Technology is a tool that we should leverage in our environment, rather than using it as a method to pass time.

## Q&A

Q1. Do you see a need for training incorporation of innovative technology approaches? A1. Acceptance of the technology is universally good.

# Innovative Leadership Techniques

# Karen Fili (URENCO)

## **Presentation Notes**

The presentation discussed business challenges that are faced in the nuclear industry. Financial challenges of nuclear plants are non-nuclear supporters, this has an impact on the good employees leaving when the company is facing financial issues that lead to shutting down the plant. Efficiency, looking for innovative ways to improve efficiency. Regulatory, the regulatory issue is a much bigger realm than just the NRC, improvement is needed to support nuclear. Resource challenges, labor markets are tight. Talent pool, loosing talents to overseas jobs, as well as retirement. There is a need for small module reactors. Challenge with getting good talent from all traits within the nuclear industry. Knowledge transfer issues, we should be looking at different ways to transfer the knowledge that exists to younger workforce. Having succession planning requires a very specific plan, who's the emergency fill in, 2-5 years candidates. Strong training programs help people succeed.

Fili foresees a strong Job market for the next few years, advice for hiring managers is to have an offer in hand when interviewing candidates due to competition of other offers. Include internship programs and provide interns job offers a year prior to graduation.

Next level leaders at INPO

- Building a team: look for people who are different than you. The team gets aligned after bringing differences, and conflict to the table. Leaders lets people address issues. Leaders allow people to tell them the bad news.
- Three things that people need that would cause them to leave work environment if they didn't have. 1. Acknowledgement is through feedback, positive and negative. Let people know when they are doing their job and that they're doing it well. 2. Inclusion, make sure that everyone is heard, and has a chance to express themselves. 3. Control, this is what everyone needs, think about your vision as a leader and create boundaries for it, then let people control how work is done.
- Communication, requires a strategy. Communicating to upper manager with three B's, Brief, Brilliant, Be-gone. Communicating down to direct reports, the what and the why, take more time and spend time as an investment. Communicating across to colleagues, consider cultural differences, try to understand differences through communication.
- Relationships, "if you don't build strong rungs on your ladder... you will eventually fail". It is not a competition, it's about being a leader who can creates a long-range relationship with someone.
- What's the secret for success: technical knowledge is the foundation, dependent on what you do. Do not skip steps.
- Having a work life balance is very important. It's important for leaders to know their people.

## Key Learnings, Recommendations, and/or Best Practices

Leaders create an environment where others can be successful

Q1. Karen, Nuclear plant side to URENC, how was the transition to current company in terms of retention? Did it change? A1. Transitioned and implemented the same processes. Got to know the people and determined what's needed, worked with HR.

Q2. Karen, slide on communication, up/across/down, how do you manage up and influence boss? A2. A good boss always asks for feedback. If a boss doesn't, then it's important to protect our bosses and provide feedbacks.

# The Digital Nuclear Workforce

Nathan Ives (DataGlance)

### **Presentation Notes**

Resources are extremely limited; the solution is moving toward a digital nuclear workforce. Smaller workforce is required, with the workforce ability to accomplish more. Leverage technology to do work more accurately and efficiently.

The future of nuclear is moving towards a risk based predictive maintenance regime, and moving away from PMs.

The retirement of baby boomers and transfer the knowledge to Gen-X and Millennials. Knowledge focus is needed to be captures across the organization not just retirement. There are leadership challenges that go with digital nuclear workforce achievement. People in the workforce need to be connected to other people and assets of the plant, conductivity. Remote, virtual work will be more applicable. Will need additional workforce, data scientist and analysts. It will take a special degree of experience and talent to be able to properly extract the data. Use of drones will require a different level of management, such that machines are not making decisions for us. It's not only important to have the information but also the ability to understand it. Interaction and interpretation working remotely and virtually. Asset vs. Process data, need to have different skillsets, will require new workers and training of existing works.

Sourcing, requires a deliberate strategy. Standardizing includes retention of information from the workers. Developing a relationship with technology company such that the machine learning has the company values incorporated in it. Adoption requires executions. We are an industry focused on safety, additionally, we are an industry focused on numbers within our culture, metrics. We drive change via matrices. Defining the value proposition of our workforce, developing matrices within the adoption of the digital nuclear workforce.

### Q&A

Q3. Nathan, do you see a live version of Work Orders and package, do you see workers working remotely. And a risk with having information remotely? A3. Working remotely will be cost saving opportunities. It is the responsibility of the company to ensure cyber security, example is Google company.

# Session 5: Cost-Effective Responses to the Upcoming Flooding Issues NUREG.

Session Organizer: John Antignano (Fisher Engineering)

In light of the Fukushima plant damage from the extreme earthquake and tsunami, the NRC requested U.S. nuclear power plants operators to perform detailed "walkdown" inspections of their installed seismic and flooding protection features. The operators ensured the features met current requirements, and identified, corrected, and reported any degraded conditions. NRC inspectors performed follow-up reviews and found flooding seals, assemblies and components installed in NPPs credited for flooding may not meet the criteria or actually provide flooding resistance.

Based on advances in the knowledge and understanding of seismic and flooding hazards and given the severity of the event at Fukushima Daichi, the NRC requested the licensees of operating reactors to reanalyze potential flooding and seismic effects. These reevaluations used updated information and methodologies to inform plant operators of potential impacts to their sites. As a result, several nuclear power plant owners modified the protection of certain plant structures, systems, and components, or they identified alternative strategies to maintain the safety of the reactors in the event of a flooding, (external and internal) which is why the flooding test methodology was developed for basis of testing flood seals, components and assemblies for the application use. It provides a path to provide documentation to installed configurations and manufactures materials, to prove flood installations will perform their design functions. This session will discuss the new flooding test methodology, and how licensees can ensure compliance in the most cost-effective manner.

# Review of the NRC Flooding Test Methodology and Application

John Antignano (Fisher Engineering Inc)

## **Presentation Notes**

Purpose is to share the experiences working on the project for the NRC. Testing methodology based on the history of the flooding events that have happened. There are two types of flooding, external and internal. The internal flooding is worst, due to the ability to predict the external flooding types. Flood doors are designed to help keep flooding contained within the different regulations. Fukushima-Daiichi discussion included discussion about the flooding that accommodated the tsunami. The design bases evaluations and regulations are not developed and tested in Japan similarly to how the US plants approach design evaluations. Additional events that involve flooding were discussed: Blayais Nuclear Power Plant France, and Fort Calhoun Nebraska. Events lead to expanding of other events leading to flooding and fire. Weather causes dam failures leading to flooding. During hurricane Michael a storm flooded access road to Brunswick Nuclear Power Plant. Flooding due to internal causes has significant risk. Dual purpose for protection plugs, against fire and flooding. Development of flooding guidelines with EPRI, NEI and Industry. Three different categories that the NRC required for Flooding hazard reevaluation sites. Once a test was failed, they had to stop it and block it in the test environment. For testing, identify the room, pressure, direction, and height of the flooding. Compliance is going to require a testing that's conducted in a lab, the biggest challenge is for the plants to complete the testing. Looking for partnerships to join with the project.

## Key Learnings, Recommendations, and/or Best Practices

There are two types of flooding, external and internal. The internal flooding is worst, due to the ability to predict the external flooding types. Testing of the test provided insights of expected and unexpected results. The new document of the NUREG will be issues soon. Plants will have to implement a methodology of testing to prove compliance.

## Q&A

Q1. What is the standard testing?

A1. There's no testing that currently exist on flood seals. It's tested by the manufacturer. Fire seals have standard testing.

# Q2. Did you age the equipment that was tested?

A2. Only up to 7 days, aging management is defiantly an area for future opportunities.

# Session 6: Closing the Gap in Organizational Effectiveness: A Process Improvement for Selection and Development of Managers and Leaders

#### Session Organizer: Nila Jennings (Fusion Coaching and Consulting Group, Inc.)

"INPO has identified that weak leadership teams and weak organizations have continued to challenge industry performance and have been key drivers of plant declines."

This was the opening statement for INPO 15-005, released in 2015, as the comprehensive guide to Leadership and Team Effectiveness, providing guidelines for improving leaders and leadership teams in the nuclear industry.

Though many large utilities and their vendors have leadership training and development programs in place, organizations still struggle with human performance which adversely impacts station performance. Where is the magic wand that can be waived to help your organizations to:

Gain Organizational Maturity Increase Rigor to Your Management Model Prevent Normalization of Average or Even Poor Performance Maintain Intrusive and External Oversight Increase Ownership at All Levels Prepare Early and Mid-Career Talent to Become Future Leaders

While it may not be a magic wand, advances in technology in both neuroscience and behavioral sciences provide new insights and tools to better inform when selecting and developing leaders and managers. Although human behavior is not an exact science, use of these tools and insights help to foster a culture of stronger leadership teams centered around greater accountability, creativity and innovation.

# Closing the Gap in Organizational Effectiveness: A process Improvement for Selection and Development of Managers and Leader

Nila Jennings (President, Fusion Coaching and Consulting) Lisa Chamely-Aqui (Principal, LCA Partnerships LLC) Robert F. LoCurto (Project Manager, AECOM Nuclear Services)

## **Presentation Notes**

Select leaders and managers in a better way that gives results. Discussed INPO 15-005 ties to the important of hiring and managers selection of leaders for promotion. There is a problem with application of the leadership training after attending the training. Typical, traditional reasons for promoting individuals into management positions, cognitive bias due to similarities, employees that are good at what they do, expertise in their technical job, and have good drive and demand.

Technology development for thought patterns, learn about your people through the assessment process.

DISC profile:

- D: Dominance, how you respond to challenges and problems.
- I: Influence, how you influence others to your point of view.
- S: Steadiness, how you work with others.
- C: Compliance, following roles and procedures.

From the wheel slide of the presentation: D&I attributes are extroverted personalities. S&C attributes are introverted personalities.

D&C are very task oriented. S&I are people oriented.

Process Improvement 1: Understanding your team.

Process Improvement 2: Job Benchmarking. Matching jobs to personality traits is important. There is a 30% decrease in performance from one bad jobmismatch.

Process Improvement 3: Looking for a growth mindset individual, someone who are looking to improve themselves and are curious for improvement. Process Improvement 4: Self-Directed Neuroplasticity. Ability to see and measure thought processes in the brain. Interesting study was done through FMRI machining. Habits cannot be broken however, they can be extinguished.

The only way to get rid of the bad behavior is by replacing it:

- Have to make a choice that leadership and management is important. Self-Directed Neuroplasticity, directing the brain to make physical changes in the brain to change behavior through thought process.
- Key is valuing leadership and management as much as technical tasks are valued.
- Make space and time for spending focused attention every day, several times a day.

#### Key Learnings, Recommendations, and/or Best Practices

It's important to have diversity when hiring and looking at differences for the team. There are layers that go into hiring. With Self-Directed Neuroplasticity the key is valuing leadership and management as much as technical tasks are valued.

#### Q&A

- Q1. How do you determine the job matching?
- A1. It's measured against the Subject Matter Experts.
- Q2. Does learning leadership skills/management skills replace engineering skills?

A2. No, the need for technical skills and knowledge is still there, soft skills need to be intertwined.

# Session 7: The Carrot, The Stick - or Something Else? Understanding the Keys to Engaging Employees

Session Organizer: Nila Jennings (Fusion Coaching and Consulting Group, Inc)

Let's face it. Managing people is challenging. Today's workplaces are diverse, made up of different demographics, and now, the millennials and the Gen -Ys bring expectations and demands to their jobs that are quite different from those of the baby-boomers. If the Nuclear Power industry is going to attract – and keep - these generations, then the typical carrot and stick style of management must change.

Change can be challenging, too. For instance, Harvard research indicates that poor managerial habits can, and often does, hobble managers for their entire career, as they rely on tactics learned from their parents, teachers, or other managers or leaders they've worked under in spite of numerous training and development opportunities. Not only can poor management habits hobble the leader, but they often lead to disengaged and disillusioned workers. Is there a formula, a solution, or (yes, please!) a magic wand that can help managers improve performance and up employee engagement? The answer is yes!

In this session you will learn about what really motivates people, and how as a manager or leader, you can acquire and teach your employees the skill of optimal motivation, regardless of the task or assignment they've been given.

Learning how to activate optimal motivation for yourself and others is a significant skill to acquire, as research suggests that optimally motivated employees:

- Deliver 31% higher productivity
- Demonstrate three times higher creativity on the job
   Are 10 times more engaged by their jobs
- Are three times more satisfied with their jobs

### The Carrot, The Stick, or Something Else? Understanding the Keys to Engaging Employees

Nila Jennings (Fusion Coaching and Consulting) Lisa Chamely-Aqui (LCA Partnership) Tom Petz (AECOM Nuclear Services) George Piccard (AECOM Nuclear Services)

#### **Presentation Notes**

Helping people be motivated is a challenge for managers and leaders. Benefits of Optimal Motivation, is having a flourishing environment that leads to good station performance in alignment with INPO 15-005. Motivation, is a psychological state that is driven through brain and physical activities to put effort towards actions. Two types of motivation, intrinsic and extrinsic. Typical types of motivation include rewards: promotions, status, bonuses. Other types of motivation include fear of loss: firing, safety. By listening and paying attention to what people say and how they say it, leaders can tailor their language to use appropriately in motivating their employees. Leaders understand their personal motivation style and the motivational styles of their direct reports. Leaders are able to adjust their leadership style towards becoming the type of leaders the team needs. Employees have two types of motivation: 1. Psychological needs, ability to manage their work, being a part of a team, and ability to perform well on tasks. 2. Self-regulation need, how individuals feel about work, feelings are drivers of behavior, having a bigger purpose and vision of the end goal. Activating optimal motivation is a skill that incorporate multiple steps that leaders can use.

### Key Learnings, Recommendations, and/or Best Practices

In order to motivate employee's, leaders should develop leadership motivational skills that are beyond the typical carrots and stick approaches. That includes active listening, defining a purpose, explaining the value of the work and aligning the team to a higher integrated vision.

#### Q&A

Q1. How do you motivate millennials to come into the industry?

A1. Millennials look at how nuclear is a part of a green energy future and find that as great motivating factor.

# Innovation in Technology and Supply

# Session 1: Craft Labor: Market, Technology, and Utility Impacts and Methodologies

Session Organizer: Dale Holden (Duke Energy) Participants: Dale Holden (Duke Energy)

Within the past decade US nuclear operators have placed considerable attention improving efficiency and cost management at operating nuclear plants. One of the areas of significant spend is support relative to contract resources for on-line and outage staffing. Refueling activities now take less days to complete and fewer workers. Maintaining focus on critical path activities for predictable and timely completion has also improved. Although these measures have proven successful to reduce spend on contract labor, unintended consequences of shortening outage duration and ultimately contractor engagement has negatively impacted resource availability of needed labor. Additionally, a growing national construction boom is enticing many previously employed nuclear seasonal workers to choose other market opportunities. Some nuclear utilities that previously experienced year over year returnee rates of 70% to 90% are now struggling to capture 50%. Although the rate of returnees can vary throughout the country, what is consistent is the demand for skilled craft labor. This discussion will review the challenge of obtaining skilled resources under current and project market conditions and what strategies can be considered to mitigate potential labor shortages for staffing nuclear refueling outages and various nuclear projects.

# Contingent Worker Staffing for Nuclear Craft Labor Demand

- The costs for nuclear contingent labor are high (online and outage)
  - Catch the process on the front end
    - Create a standard set of training for on-boarding
    - Deployed Radio-frequency identification (RFID) Technology in associated with on-boarding work flow
      - Create a new method to control outage spend and resource utilization
        - Focused on-demand curve based on the general outage scope that Duke has
        - What's generating these is based on what Supervisors use for their outage scope
    - Created new roles for oversight and management of workforce based on demand
    - Was able to do a much better job with the resources
    - Not about lowering the headcount, but focus on skill based on what was needed
  - Average 50% reduction in previous O&M headcount
- Since 2015, average outage days and employee labor significantly improved
- To be able to see gains, you can't count your successes too early
- Unintended consequences:

0

- Training for workers was cut
- Worker durations cut, which means worker pay is cut on-site. Workers are hard to engage due to a better economy which means less and less workers are wanting to come to a nuclear site with the gaps in work.
- o They can go elsewhere and do construction work (or similar work) and not be dependent on nuclear.
- Returnee rate is lower due to competition.
- Considerations for future staffing issues:
  - Creating Standard Task Evaluations (STE) for all training at nuclear sites to deliver standard qualifications instead of having to retrain workers for each specific site. Lack of 'right' qualifications prevents nuclear site from using the same workers. STE's are working to change that and have better alignment.
- Having better relationship with Supply Chain and suppliers to get the best skill labor with the right qualifications.
- Safe, reliable, and cost-efficient nuclear operations are needed for this industry to continue.

# Q&A

Q1. People are getting older and people are being tied to Vogtle. Don't see much cooperation with the suppliers. Workforce and suppliers need to come together on issues with providing appropriate skilled labor.

A1. Workers are going to follow the money; suppliers can't do much about that issue. Vogtle 3&4 played a big part of that. An option is to roll some of the outage time period into the summer months in areas where it isn't that hot. We found that it was difficult to move workers around in the south and we tried reaching out to community colleges and we couldn't use them because we were cutting back on numbers of personnel. The answer to this issue is hard and difficult to answer.

Q2. To what extend did you look at evaluating and looking at privacy concerns about personal information?

A2. Duke was given the right to understand productivity of the worker and work flow. The system is predicated on measuring workflow and not personal issues. Personal information about certain workers was not prohibited to be shared.

Q3: To what extent did Duke look at timecards to make sure timesheets reflected time on site along with supply chain terms and conditions compliance? A3: Supply chain terms and conditions were mainly focused on rigor and not so much specifics pertaining to work. Execution of the workflow was the main driver in lessons learned.

Q4: Are you able to get the craft number that you need and request?

A4: It comes back to understanding the work needed to be done to complete each request for work and understanding the correct margin.

# Session Takeaway

The skilled labor workforce costs are high across nuclear industry. In order to curve these issues, it will take collaboration from all facets of each site to implement a cost-efficient labor/staffing process that ensures accuracy along with work productivity.

# Session 2: Panel on Utility/Supplier Negotiations

# Session Organizer: Brandon Zimmerman (Southern Nuclear)

Participants: Bill Fry (Duke Energy), Joseph McAvoy (Day & Zimmermann), Ryan Fitzpatrick (Exelon), Robert Cole (Framatome Inc.)

This session will feature a panel of utility and supplier participants discussing how to achieve a win-win during negotiations. Discussions will also include instances where negotiations went sour and the best practices that got negotiations back on-track. The panel will also discuss how recent technological changes have impacted negotiations. This will be valuable information for the first-time contract writers and seasoned CPOs alike.

# Panel on Utility/Supplier Negotiations

What is a win/win negotiation?

- When both come together, find a mutual agreement on the objective. You must build relationship, trust and that both parties opinions are being heard.
- Negotiations are usually heavily weighted in the utilities favor and should be cognizant of the supply base (diverse, mom and pop, etc.). There is a difference to what win-wins look like to a 'big' supplier vs. a 'small' supplier. Tailoring win-wins to what each supplier will benefit from. Understanding how suppliers make money and communicate how we the utility make money.
- Should be prepared for negotiation. Understand your goals and figure out what is important to the supplier that you are working with (cash flow, business status, etc.). People usually only look at price, and that hurts both parties.
- Be engaged with the customers and executives to see what it is they truly want.
- Technology and its impacts on negotiations

# Key Learnings, Recommendations, and/or Best Practices

- Preparation is key. Understand what needs to be achieved with the finished product.
- Be respectful of 'time'. Focus on most important meet with the issues.
- Remember the 'Golden Rule'
  - He/she who has the gold rules. What are the potential leverage in every situation. Don't think just because you are the supplier, don't assume the customer has all of the leverage. Understanding what is driving the customer to make certain decisions.
  - Get Supply Chain to the table early to work on the negotiations for these major deals.
    - Business units may not be communicating key information about the work and it affects terms and conditions.
  - Especially in situations where commercial issues are being discussed.
  - You have to be prepared to pull the plug on negotiations if it comes to it.
- Think 'broadly'
  - Remember that it is not just THIS negotiation right now. There may be situations down the line that could impact you.
- Be creative
  - Meet with the team beforehand to see what other possible issues could be at play.
- Have the right stakeholders at the table who can speak to the right issues.
- Do your homework. What is the need? How important is supplier X? What if we don't meet our date?, etc.
- Listen before you speak. Hear the other side's story
  - Be an ACTIVE Listener
  - Scope of Work and Services agreement
    - Make sure the supplier understands the scope of work which can impact scope of work. Make sure the utility is fully on board with the Scope. Be prepared to take advantage.
- Be strategic with what you take exception to in the T&C's. Don't markup for the sake of marking up.
- Identify Roles and Responsibilities and stick with them
- Be physically present

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- Reading body language is important
- Verbal and written communication can throw off negotiations
- Have appropriate representation
- Technology improvements
  - Adobe Acrobat Pro
    - Allows you to merge documents with signatures and make PDF edits
    - Terra Change Pro
      - Can compare two PDF files and what if anything has been changed.
      - Can do word search on the software
      - Anything that can increase the speed of communications with supplier
  - WebEx/Skype
    - Screen sharing
    - Cells phones
  - RFP Portals (Power Advocate, Passport, Emptoris, etc.)
- Areas of Technology Risk
  - Most information is at risk of breach with Cloud and storage.
  - Data Privacy and Cyber Security
  - o A risk of sharing information that shouldn't be shared such as supplier negotiations
  - Foreign communication can be risky

# Q&A

Q1. Is it a good practice to only select one supplier for certain jobs and projects? Why stay with one?

A1. It depends on the scope of work and what the suppliers can do for you. A big component depends on the scope of work. Some categories may result in one main supplier, but you have sub-sets of scopes that benefit developing other suppliers. Helps competition. Other scopes/projects may result in few options due to specialized work or low supplier base. Also depends on oversight and management of workload by the utility. It depends ultimately on the category.

Q2. How often do you look at sending something out for bid?

A2. SNC and Exelon looked at the value of sending out RFP's and what the cost is to your internal customers to build up scope and Contract Agent to work on contract or Sourcing to build up procurement scope. Usually with SNC it's based on 3-years or based on stagnant pricing that isn't changing much. Depends on the category, commodity, and market situation. Extensions can sometimes not be cost effective.

Q3. How much of an impact does being a diverse supplier have on a negotiation?

A3. SNC is obligated have a diverse supplier on every RFP is applicable. SNC values diverse suppliers. Make sure the utilities are aware of you.

Q4. Does each scope of work have to be bid or can you be grandfathered into sub scopes of work?

A4. Generally utility would reach out to the supplier to bid on broader packages as a 'expertise' supplier. Duke usually adds a 'newcomer' to each major bid.

## Session Takeaway

In negotiations it's key to be prepared and understand the key objectives in order to reach the best outcome for both sides.

# Session 3: IT Advancement and Resulting Cyber Security Risks to the Business Unit and Supply Chain

# Chain

## Session Organizer: Anthony Souza (Duke Energy)

Participants: Anthony Souza (Duke Energy), Robert Ammon (Curtiss-Wright)

As the modes of generation and delivery of energy rapidly evolve to include much more distributed resources (wind, solar, etc.), utilities are seeking innovative ways to improve efficiency. Rapidly evolving technologies such as Al/Machine Learning, Cloud Computing, and Advanced Analytics provide the potential to drive efficiencies horizontally across business units such as Nuclear, Transmission, and Distribution, as well as vertically down the energy value chain. These IT advancements present new cyber security challenges in the form of new, external connections that have typically not existed and integration across the IT/OT boundary which has traditionally been separated. Taking full advantage of the IT advancements will require new cyber security architectures/designs, innovative thinking and close coordination with vendors in the supply chain.

The NRC has recently released the Safety Evaluation Report for the first FPGA based diverse hardware and software Digital Safety System. This fully deterministic design can be licensed under the current regulatory standards with no licensing uncertainty or risk. Further the comprehensive real-time diagnostics can reduce or eliminate all surveillance and rounds during operation of the plant. This presentation will discuss the innovative application of both hardware and software technology to achieve the ultimate goals of enhancing plant efficiency, ensuring safety margins, reducing manpower requirements and managing obsolescence through the end of plant life.

# IT/Operational Technology (OT) Cybersecurity Program

# Anthony Souza (Duke Energy)

- Cyber security is becoming more of a threat than it was 10 years ago. Proliferation of the dark net is a major factor in these threats.
- There are multiple points of entry for a possible attack such as office network, plant network, monitoring network, and control network.
- 3<sup>rd</sup> party supply chain issues are becoming an issue in Cyber Security
- Securing the OT (Operational Technology) environment opens up opportunity for expansion in to new areas such as IT integration
  - Optimization, Data Analytics, and Predictive Conditional Maintenance are ways to manage risk and lead to ROI opportunities These 3 lead to revenue generation. Takes away from traditional power grids with newer opportunities outside of transmission and distribution
- Study was launched to develop a program to first secure the OT networks and then do it to where it could enable IT/OT integration
- Duke invested in \$150-\$200M program to implement.
- Duke settled on one vendor for the pilot program
- From end to end, business engagement is key

# IT Advancement and Resulting Cyber Security Risks to the Business Unit and Supply Chain

James Gracely (Curtiss Wright)

Content all contained on slide

# Key Learnings, Recommendations, and/or Best Practices

- Risk Control target profiles
  - Understand what utility programs truly look like to address any issues and come up with a solution
- The faster technology grows, the faster the attacks on it will also grow

# Q&A

Q1. Who is determining whether or not the risk is acceptable for the program?

A1. Each business unit was asked to provide a sponsor to help determine these types of outcomes.

Q2. For organizations that are thinking about going to digital control systems, that's an area of concern correct?

A2. Yes, because that's not how things have been done in the past so there is a new transaction risks associated.

## Session Takeaway

Reducing Cyber risks are very difficult to solve. Business engagement and knowledge of risks are key. As technology advances and grows, the sophistication of the Cyber attacks will also grow.

# Session 4: Effective Use of Technology and Supply Chain in Disaster Response

## Session Organizer: Charles Poliseno (Duke Energy)

A Review of the Duke Energy Response to Hurricanes Florence and Michael in 2018: Hurricane Florence impacted a significant part of Duke Energy's North Carolina and South Carolina Service Territory with high winds and record rainfall. The rainfall caused historic flooding along the Carolinas' coastal communities and more than 1.8 million of Duke Energy ustomers lost power. Duke Energy was able to restore power to nearly 1.2 million customers in the first three days after the storm made landfall. Duke Energy has received the Edison Electric Institute's (EEI) "Emergency Recovery Award" for the company's power restoration efforts after Hurricane Florence hit North Carolina and South Carolina in September 2018. Duke Energy's Brunswick Nuclear Plant (BNP), the major baseload generation for the region, was an island surrounded by flood waters for days. This informative session will cover the significant logistical challenges during abnormal disaster response scenarios, from supporting isolated personnel to safely restoring power to these flooded communities, and Duke Energy's effective utilization of technology and supply chain mitigating the effects of a devastating hurricane. Specific challenges included: physically getting restoration crews to and through the flooded areas, supporting generating plants' repair/restoration efforts as wells wells usupplying resources (people and supplies) to a nuclear power plant for round-the-clock operations. Do your current emergency response plans include provisions for supplying/resupplying staff that can't receive relief under "normal" response conditions? Have you integrated your Supply Chain organization into your response plans, ahead of time?

## Effective Use of Technology and Supply Chain in Disaster Response Charles Poliseno (*Duke Energy*)

- Integrated Incident management team
  - The hardest part of the structure is the Operational Focus: Incident Management Team
  - Duke focused most of their attention on the Enterprise Focus area

## Key Learnings, Recommendations, and/or Best Practices

Storm Ride-Out teams were a big success

- There were problems getting people in and out of the plant. Duke had to bring supplies in via Helicopter to feed people. Cafeteria was pre-stocked with supplies for the workers who were riding out the storms.
- Emergency response plans were well planned.
- Supply Chain was important in the preparation.
  - Pre-established accounting codes were set up for tracking spend and funding
- Pre-designated suppliers were huge
  - Pre set terms and conditions and prices alleviated issues with planning
  - FEMA has the right of first resistance and can override the use of certain suppliers if FEMA believes they can serve the greater good to a larger group of people
- Supply Chain needs to look at contracts and include language about 'right of first response', to ensure that we get adequate responses from our vendors.
- Keep responses to storms as local as possible. Corporate should not be trying to reach down to areas where they are not involved and take command and control of situations.
- FEMA may need space at a facility which is something that Duke will have to look at with Hurricane planning
- Supply Chain's fleetwide contracts can sometimes miss local suppliers that provide valuable relationships during storm responses. Don't let fleetwide contracts cause you to lose sight of the local relationships.
  - Putting money back in the local communities can help those economies.

# Q&A

Q1. How do you determine who you pull from around the country for support?

A1. By region there is a working group that get together, look at intensity and predict the number of outages. They gather up the information based on the data and project how many people they need for each plant. They get all the info, look at gaps and fill as they can.

Q2. When personnel for Storm ride out crews are selected, are they from the same plant or is there cross training? A2. The workers understand the storm response role to make their own families safe as they can. Plant worker selection is geared towards the personnel who already work at certain plants. HR folks check on employees to verify that they need anything and if their families need to be checked on.

Q3. Does Duke have to interface or be imposed on by FEMA or any agencies with regards to infrastructure? A3. No, but Duke proactively reaches out to them and have good relationships with them already.

Q4. Where does Duke fall in with regards to ESF3 (Emergency Support Function)?

A4. Duke falls into ESF12.

Q5. Were you able to take advantage of your Fukishima response planning to help alleviate any issues?

A5. Water levels were not to the level that would invoke a Fukishima response type response. It was more of an 'access' situation.

Q6. What would you do differently with what you know now?

A6. Speaker didn't know exactly and would have to go back to his emergency team to get those details.

# Session Takeaway

Hurricane/storm response at a Nuclear Plant can be effective with the right preparation/planning, relationship building with response organizations/FEMA, and local support teams.

# Session 5: The Unintended Consequences of Buying Less

Session Organizer: Greg Keller (Curtiss-Wright)

Participants: Dan Pasquale (Nuclear Regulatory Commission), Marc Tannenbaum (EPRI), Greg Keller (Curtiss-Wright)

The DNP has pressured plants to purchase only what is needed and do so at the latest possible date. Buying fewer items with shorter-lead times both increase the unit costs of items purchased and this is having unintended consequences. One impact has been several vendors dropping their Appendix B QA programs. And whenever the costs of items increase, the incentive for counterfeit and fraud increases. This session explores some of the market impacts to the supply chain, the NRC's heightened concern on the potential impacts to quality, and an innovative approach to save costs without adversely impacting parts quality.

The Unintended Consequences of Buying Less - A New Approach to CGD

Gregg Keller (Curtiss-Wright), Daniel Pasquale (Nuclear Regulatory Commission), Marc Tannenbaum (EPRI)

Slides covered content thoroughly.

# Session 6: Advancements in Technology That Enable Business Unit O&M Reduction

Session Organizer: Greg Keller (Curtiss-Wright)

RFID – first giant step to Virtual Warehousing: RFID technology has been around for many, many years but we have now reached a point where the costs of the tags and the capability of the software and implementing hardware are such that the traditional model of warehouse operations is rapidly becoming outdated. This presentation will explore the potential for manpower reductions and gains in efficiency by changing our 1950's model of how to run a warehouse into the current day, and beyond.

# Supply Chain Warehouse and Automation Initiative

Jim Ripple (Southern Nuclear)

- SNC started the initiative about 5 years ago and it was built primarily on cost savings for capital, along with efficiencies for Maintenance.
- By mid-2020, SNC will have paid back the cost of the project due to normal attrition.
- SNC reduced warehouseman count per site from 20 to 14.
- Shift and weekend work was eliminated for warehouseman.
- Pricing of the RFID material has dropped, which has made it more beneficial
- Supply Chain will cease the use of the Issue Counter for material. Will allow for Satellite warehouse to pick up material for the workers and eliminate walking to and from warehouse.
  - Supply Chain will be able to stock the Satellite warehouse with the help of Work Management properly planning work packages on time and having the Bill of Material finalized prior to work start.

- When work orders aren't correct, the right material won't be available.
- SNC uses a machine called an Accuport where the user enters in their work order number, and pick item to retrieve access to their needed material
- Hatch Nuclear Plant went live in July of '19.

## Key Learnings, Recommendations, and/or Best Practices

- CFO will try to cut Maintenance's budget due to the benefits of RFID
- Software that was used by SNC had issues with data dump that the vendor software couldn't handle. That was a hurdle that had to be overcome.
- Huge culture change for SNC
- When you're the first to do and there is nobody to benchmark, people in the org will resist and come up with reasons why we shouldn't
  embrace the change
- Project was seen as low priority for SNC. Due to that, other high dollar projects will try and take away your funding.
- SNC would like for Maintenance to be able to provide their input on how to improve and make the system work better.

### Q&A

Q1. For items that are consumed or installed, what is the process of eliminating the RFID?

A1. Just remove the tag from the item. Nothing fancy.

Q2. What is your strategy for tagging the material as it comes in the warehouse? Are we allowing vendors to tag for us? A2. Typically during receipt is where the tools/materials are being tagged. Some vendors will be allowed to tag, depending on the material being provided.

Q3. How do you keep Satellite inventories from growing?

A3. SNC controls the growth of the inventory and what is being stored. Not the plant.

Q4. How was the culture change with executives accomplished?

A4. Not hard to due to the payoffs with attrition. Have to have good relationship with the CNO, get other executives on the side and do homework on the effort.

Q5. What about communication to the organization about job impacts and changes?

A5. SNC has voice of employee surveys where issues are allowed to be discussed and addressed. You have to prove to people that jobs won't be lost, especially with warehouse and union workers.

Q6. How do you handle storm response with RFID technology?

A6. Southern Nuclear doesn't perform storm response. Storm response is left up to Southern Company (parent).

Q7. Is this transformation helped in terms of innovation with adopting other projects for digital transformation? A7. Not yet.

# Virtual Reality Tools & Impact

Julio Adame (Curtiss Wright)

## **Presentation Notes**

- Virtual reality is a way to be immersed in a fake environment that is perceived as real.
- Can be used from a variety of different access points such as smart phones, laptops, headsets, etc.

## Key Recommendations, Learnings, and/or Best Practices

- Virtual Reality Promotes Efficiency and Enthusiasm
  - Virtual Reality allows for users to see the negative consequences of actions in 'fake environments' as practice.
  - Reduces trial and error events
- Augmented Reality Smart Glasses allows you to see the inside and outside of Plant equipment.
- Face time technologies allow for direct IT support.

## Q&A

Q1. Why was the choice to make the presentation AR? A1. Portability is the main reason.

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# Session Takeaway

RFID and other technological advancements offer cost savings to Nuclear Industry via staff reduction, increasing man hours, and lowering standby time to be more efficient with work performance.

# Session 7: Joint Supply Chain Gap Closure Working Session for ANS Organizational Member Group and the United Nuclear Industry Alliance

Session Organizer: Greg Gibson (Executive Director of UNI)

On June 12, 2019 The ANS Organizational Members Grroup (OMG) and the United Nuclear Industry Alliance (UNI) met at the ANS Annual Meeting to discuss the need for improved supplier coordination and collaboration to identify and close significant gaps related to fleet sustainment services, decommissining projects, advanced reactor development and new build construction efforts. In particular the success rate in winning international build contracts requires improvement. The purpose of the session is to continue these discussions and to explore ways OMG and UNI can work effectively together.

Supply Chain Gap Closure Workshop: Developing the "Supply Chain Strategic and Tactical Working Plan" Donald R. Hoffman, Chairman of the Board, United Nuclear Industry Alliance (UNI)

- This is going to be a truly interactive session
  - Going to talk about the things we're working to do to enhance the global supply chain
- Looking for input to ensure UNIA is meeting the needs of the nuclear industry worldwide
- Want to give a sense of who we (UNIA) are
  - Attempted to find a way to find an approach to fully represent the supply chain industry 0
  - Some don't have the bandwidth to support while others don't honestly have the competency 0
  - While NEI does a great job representing the commercial power operators, they can't really represent the suppliers 0
    - They're not really interested in doing so as it would likely be seen as a conflict of interest
  - When UNIA was formally kicked off last year at UWC 2018, no one from the industry immediately joined 0
  - This was likely because they didn't fully grasp what the benefits would be
  - UNIA believes that no matter where a supplier is along the supply chain, they deserve to have representation 0
  - Want to integrate, coordinate, and share best practices across the supply chain 0
  - The main goal of UNIA is to create innovative business relationships among the alliance's members
- UNIA is attempting to make a real difference
  - Since the first meeting in October 2018, four member-directed working groups have been developed 0 0
    - A report was created to document the strategic plan for every single country on the planet
      - Whether each country has nuclear
        - Whether they want nuclear
      - How they could potentially approach nuclear and where American content could fit into that country's plan going forward
- Not all of the supply chain companies that UNIA works with wish to work internationally or know how to work internationally
- Met with the Ex/Im Bank to talk about how the industry can more easily work with them
- Developed an easier process for suppliers to work with the bank such that international facilitation is much simpler and easier 0
- Want to be able to give a sense of what each working group is doing to establish a sense of value and convince more people to join
- Over the last day, Don went around to every single exhibitor in the expo to talk to them about what UNI could do for them
- The Win in Nuclear (WIN) Plan is the report/plan that detailed the nuclear plans in every country
- The US Nuclear Deal Czar is a person who would be the key target in the Executive Branch that would be the go-to for nuclear in the administration
- UNI believes that if the current fleet doesn't exist, then the infrastructure and backbone of the industry is lost
  - We lose experience and expertise in the supply chain and in operations
- One of the things UNI talked to the Idaho National Lab and other labs about is standardizing contract language for work at a lab UNI wants simplified and standard language such that things are easier to follow and have a flow that all suppliers can follow
  - 0 Also asked the utilities what they think about this concept 0
    - How can we work with you, to work with us to make it easier for us all to collaborate together?
- Finding out that the vast majority of international customers want local content
- Simply currently attempting to sort out the who, what, and when
  - Believe that this should be done sooner rather than later 0
    - A tremendous amount of work has already been done, but want to ensure that everything is just right and perfectly combed over 0 before moving forward
- We're having a hell of a time in this country because we have a capitalist society and don't have any state-owned nuclear power like most of the rest of the world, which makes things difficult
  - We thought about setting up a consortium to have the state buy out all the nuclear plants from the utilities to allow the state to 0 continue to run them- something like TVA
  - Perhaps this could be just the struggling plants if not all the plants 0
  - This may seem like it would be more trouble than it's worth, but UNI wants to leave no stone unturned to try to keep plants in this 0 country from early closure
- One of the things UNI started doing was maintaining a list of Lessons Learned and Operational Experience from new nuclear builds Olkiluoto, Flamanville, Vogtle, VC Summer 0
  - 0 MIT has a report that documents a lot of these lessons learned that have been reviewed by experts at the university
  - UNI wants comments on the Complete Action Item List UNI Vision of Priority
    - There will be a leader for each action item to lead each charge 0
    - Don would like to have the WIN plan complete in the next few weeks to have it reviewed by the end of August and published to the 0 industry in September for discussion
- We started with 105 plants in 2013, now in 2019 we're down to 97 plants
  - That's more than one closure per year 0
  - We can't keep closing plants at this rate
- If we can get past politics and market, nuclear can and should provide 25% of the grid
- Don is on the board of the United States Energy Association (USEA)
  - Twice a year this association meets 0
  - \$196M annual budget with \$0 going to nuclear 0
  - Don asked why nuclear gets no budget or work 0
    - Was told there hadn't been a lot of questions
  - The vast majority of NEI's market base comes from the utilities 0
  - Asked USEA to fund \$10M for this year to create an ad for nuclear 0
    - Why nuclear is fresh and clean and environmentally safe
    - What nuclear does for the economy
    - 30-45 seconds about what nuclear can do for the common person
- Trying to explain what role we're playing in things like why VC Summer failed, and why Vogtle is having issues
  - The focus of this is more like what can we do to ensure Vogtle is completed and what we can do going forward 0
    - What else can we build and connect to the grid
  - The UNI stands by to be your advocate and to make this industry a successful venture

# Q&A

Q1. The Executive Branch and Energy Department prevents us from working with China to learn more about nuclear. Is there anything that can be done to move the gov't in a direction that supports us learning from China with regards to Nuclear?

A1. Discussions have been had with the Department of Energy & Defense with UNI. This administration has a unique relationship with China and are wanting to change how we've done business with them. China has been inconsistent with its quality. One of the drawbacks of the current

administration's decisions is how it has affected Nuclear innovations. UNI is trying to lessen the impact of China's dominance in the nuclear field. Number of things that being done in the world that preclude US to be successful in this effort. UNI seeking to build relationships with suppliers internationally as an effort to get the get the kind of support we need. We have to build relationships individually and be our own advocate in this realm.

Q2. Do we make contacts with neutral banking organizations so that we can assure that we get proper funding for our new build projects? A2. We need to have more firm relationships with banks internationally so that they can be paid. UNI is not exactly sure how they will enforce it, but they are trying to get other banks to work more collaboratively since the new build loans are so complex.

## Session Takeaway

UNI is going forward with a strategic plan to implement their Integrated Concept Plan. This plan and the membership going forward are moving with a goal to strengthen this industry worldwide and very especially domestically.

# Maintenance/Work Management

# Session 1: INPO Analysis of Trends for 2018 and 2019, Including Issues with Maintenance Fundamentals

# Session Organizer: Jon Anderson (ACA Proactive)

This session starts with a presentation by INPO on the current trends in performance, including Maintenance Fundamentals. The session then opens to a discussion of what is working and not working by plant personnel. Participants will take away from this session a deep understanding of industry performance and contact personnel they can talk to about what is working and what is not working. Maintenance fundamentals will be highlighted because it is a top issue at INPO.

# INPO Analysis of Trends for 2018 and 2019, Including Issues with Maintenance Fundamentals Pete Arthur (INPO), Bryant Hearne (INPO)

#### (INPO presentations available through INPO member website)

#### Maintenance

#### Maintenance Fundamentals:

INPO ratings for maintenance have high levels for exemplary and stable. That represents good performance from last year to get to exemplary, but since the departments already had an exemplary rating then it's more difficult to improve. So exemplary and stable is a good result since departments have maintained good performance.

Consequential events attributed to maintenance personnel performance have continued to go down. Value is 0.79 vs 2.0 in 2016. (Valve is # events / month on a 6 month rolling average) Goal by 2023 is 0.33. Maintenance consequential errors follow the same trend.

2019 Consequential events by work group. I&E and mechanical about 25%, supplemental is 46%. 2017-2019 data for types of events involve Mech Comp Assembly and Electrical IC errors. Injuries by disciple, supplemental workers show poorest performance. Consequential events affect operation of the plant, in other words it challenges operations.

Top areas of concern:

Mechanical Component Assembly (24 events)

Electrical / IC Inspection and assembly (13 events). Control of wiring and test leads (<10). Mechanical Joint/tubing assembly.

Without injuries, errors by work group. 42% supplemental, ~25% mechanical ~25% I&E. These are events that affect operation of the plant.

How were plants affected by consequential events?

- 20% scram
- 33% downpower
- 13% <72 hour LCO
- 13% outage delays

6 SCRAMs caused by errors

- 4 by supplemental,
- 2 by station.

Downpower events

- 4 station
- 1 supplemental

AFIs given: Low number of mechanical component assembly AFIs, but that has a high number of consequential events. WHY? Because when INPO evaluates, plants reduce amount of work being done which does not allow for a through evaluation.

Issued INPO 18-002, ACAD 92-008 (revision), using a graded approach to evaluating maintenance departs. Each department may not be graded.

IER 17-9 visits identified some stations did not fully address:

- Supervisor and instructor performance
- Non-maintenance work groups performing maintenance (does chemistry change out pumps, operators perform lubrications) sustainability

IER 17-09 Effectiveness Review: Team determined that implementation of IER 17-09 to be effective. Goal 1 associated with consequential events was met. Improvement has been made, but there is still more improvement needed. Continued focus on supervisory development and supplemental worker performance.

Mechanical Assembly was the primary cause of unit scrams from maintenance consequential events.

WO detail and procedure detail was attributed to the primary cause of events. Industry is over-reliant on process changes to change results. Industry needs to be more driven towards leadership and behaviors to prevent events instead of relying on process. Supervisors need to engage to develop behaviors and coach gaps. Accountability is important for driving good results in performance with supplemental and vendor quality issues.

#### Work Management

Large number of exemplary and stable ratings in 2018. End of 2018, there were almost the same exemplary and improving as exemplary and stable. In 2019 there are a large number of exemplary performers which makes sense since it's difficult to maintain improving performance when performance has been good.

Focus areas for work management for 2019. Fully recover lower performers, promote industry self-awareness and self-correction, sustainably improve operations and maintenance performance, strengthen INPO talent development, Adapt INPO through innovation\*, model WANO program execution. \*Using software to enhance performance.

2019 Department Initiatives:

- Align/revise current performance indicators to support upcoming efficiency bulleting
- · Revise current "WM simplified index" to better align with what was intended to accomplish
- Continue to focus on station performance through monitoring and DSPOC duties
- Monitor progress on revision 5
- Provide assistance when declines are noted.

Communicating with departments INPO Department Single Point of Contact (DSPOC) and getting them to fully understand events leads to a more accurate rating with the department.

2019 Work Management Focus Areas:

- Operational risk -identifying, communicating, and managing operational risk (do the technicians understand how their work fits into plant risk)
- Safety system Work windows –preparation and execution of safety system work windows (measures based % of schedule duration, has to be scheduled 12 hours or more to count on indicator, if preplanned contingency plan exist it can avoid hits to this indicator)
- Resource management –effective allocation of maintenance resources. Are you using your supply-demand model. Are you properly accounting for man-hours?
- FIN team: FIN teams are getting more robust. Do not short staff your FIN team. Online maintenance should be a PM / Surveillance organization.
- Management of backlogs. -PMs, DMs, CMs.
- Critical Scope Survival --There is less critical scope not than in the past, so site must focus on the remaining critical scope to avoid big hits to the indicator
- Schedule Fidelity / Accuracy: Are durations correct? When activities are scheduled for 5 hours (half shift) and it only takes 2 hours, then its other maintenance that gets lost.
- Identify Inefficiencies -PM optimization, effective use of minor maintenance, graded approach to preparation, effective scheduling.

Monitoring versus Evaluations:

- Things monitoring can't see: behaviors, organizational effectiveness, details. Evaluations show full scope of performance.
- Maintenance and Work Management Simplified Indexes are coming.

"Staying on Top" document coming, it drives continuous improvement through continuous learning, self-awareness /self control, setting long term directions, leadership and talent development, excellence standards.

# Key Learnings, Recommendations, and/or Best Practices

- Focus on improving supplemental personnel performance.
- Focus on improving behaviors not processes
- Focus on safety performance for supplemental workers.
- Work Management is a lagging indicator for station performance in that poor equipment reliability will result in poor work management
  performance from the equipment failure. Then when equipment reliability initiatives are instituted, it becomes challenging for work
  management.
- Auto generation of PM WOs or clearances is a boost for efficiency and the industry needs to work together to help implement them.

# Q&A

Q1. Issues of behaviors versus procedural controls: Might get a lot of results on process related since it's easier to write a corrective action? A1. Process is the easy thing to go fix. INPO has observed where the behavior was not meeting the standard and the station responds with adding words to a specific procedure to the task observed. This results in solving the problem at minute levels instead of changing the behavior to prevent future events on different types of work.

Q2. Circumstances where supplemental workers do not understand the standard can be an issue.

A2. Stations are not investing in training the supplemental and giving them the same skill set as station workers. Likely due to cost. Stations should implement more DLAs to supplemental to ensure they can perform at the required level. Are stations increasing oversight during these times?

Q3: How is rework incorporated into maintenance ratings?

A3: If the rework is solely due to a maintenance then it will count. Otherwise it will not.

# Session 2: Using the Demand - Supply Model to Measure and Improve our Productivity and Efficiency Session Organizer: Jon Anderson (ACA Proactive)

In this session we will hear from those that are using a Demand - Supply Model to make significant improvements in their organizational performance. One of the topics we will discuss is getting durations right in our Work Orders, for example, with interns. Durations is one of the issues some organization have with measuring demand. This session will provide insights into how to automate the development of this model and provide sample workbooks others can use to develop their model. In this session we will start our list of actions we can implement to increase our productivity.

## Demand / Supply Model

Tom Morris - Exelon Corporate Work Control Manager

- Demand / Supply Model allows effective fleet management since you can compare models across sites.
- PMs and surveillances are known workloads so they need to be loaded in order to get proper resource allocation.

- Preventive Maintenance Oversite Committee (PMOC) looks at current and future preventative maintenance (PM) tasks and to extend or increase frequency based on performance.
- If a PM task is being done to frequently then you can decrease frequency and allow maintenance to focus on corrective work.
- PMOC is comprised of maintenance, operations, work management, engineering, and supply chain. PMOC oversees PMs on non-critical components only.
- Engineering maintains control of PMs on critical components.
- Demand supply model allows for long-term strategic planning and allows you to compare PM workload among different sites.
- Demand / supply modeling is only as good as the inputs. Accurate durations are essential.
- Supply inputs need to model non-productive time. (shared resource commitments, vacation, holiday, average sick time, training, techs filling in for supervisors, performing walkdowns, performing procedure reviews, etc.)
- Non-productive time can be tracked based on maintenance input and timesheets.
- By reducing non-productive time, the savings can be reallocated to FIN (Fix It Now) Team to allow for more corrective maintenance.
- This model can also steer future hiring strategies and allow for comparison between sites.

## Q&A

Q1. If work management key performance indicators are good, then why do I have more work than people?

- A1. The station must be diligent in extending PMs to reduce demand.
- Q2. How far in advance do you perform this evaluation?
- A2. It is performed annually.

# Using the Demand - Supply Model to Measure and Improve our Productivity and Efficiency JD Miller (*Duke Energy*)

## **Presentation Notes**

- Across the Duke Fleet, the supply demand model is standardized.
- The supply demand model changes each year.
- Changes come from station outages and the length of those outages.
- If demand is greater than supply then the site is changed with a recovery plan to get supply to match demand.
- If supply is greater than demand, then more corrective work should be completed.
- Work Order data visualization tools can allow you to see what you are deploying resources on.
- Gives you good candidates for PM changes.
- Supply is tracked with a resource availability tool to allow tracking of all hours of maintenance full-time employees (FTEs).
  - This tool can send data to the scheduling software. (P6 for Duke)
  - o This allows building histograms.
  - These can allow you to visualize whether the resources available can complete the schedule.
  - It also allows you to track how many resources where available at T-10 vs T-0.
- Worker badges can be used to track employee time.
  - Executive reports how summaries of maintenance productivity.
    - One of the reports tracked tasks per worker hour.
    - This was misleading as tasks can be divided up into multiple tasks which would show an increase in productivity when there was none.
    - Also, some sites do minor work requests, whereas others would use a WO task for the same actual work. Consistency here is essential.
- Power BI (software program) is used to analyze data from work performed using schedule tasks, work requests, and work orders.
- One goal of the demand supply model is to look at sites and see if sites can send resources to another site to assist during on-line safety system outages.
- For example, Plant 'A" needs four resources to complete a diesel outage. Plant 'B' has the resources and schedule to support that work on that week.
- Data can support or refute if maintenance is overloaded.

## Q&A

Q3. How are maintenance hours tracked?

A3. They are manually entered into a computer. We are looking at ways to utilize electronic work packages to help track status in a more real-time fashion.

# Demand/Supply Modeling for the Nuclear Enterprise

Tim Schlimpert (MCR Performance Solutions)

- Using a business plan can drive budget planning.
- Identifying performance gaps and closing them requires room in the budget.
- This planning can all be informed by the demand supply model.
- Modeling has to be specific enough to cover all resource demands and resource supply.
- Knowing the capacity of your organization can allow you to plan for base operations, performance improvement initiatives, and enhancing performance.
- Developing models requires a lot of input from various groups.
- Start at the end of plant life and work backwards.
- What major components are going to need to be replaced prior to end of plant life? When do those need to be performed?
- This information is vital for business planning.
- This ensures sufficient budgets for each year.
- This information happens when all organizations communicate to have alignment.
- This drives us to a common goal of understanding the demand and having the supply.
- Understanding maintenance supply requires modeling all non-productive time.
- Usual productive time is between 70-75% of all total full-time employee hours.

- A graded approach is used to grade the types of work that are performed.
- Grading when the work has to be done does the work have to be performed at a certain time?
- Allow optimizing when you perform work.
- Also, looking for buckets of work that can be optimized.
- Optimization comes from looking at low-risk activities that you can apply less barriers to that lead to non-productive time.

## Key Learnings, Recommendations, and/or Best Practices

- Take the time to track employee time to allow better understanding
- Measuring productivity drives alignment in organization to optimize PMs and enhance plant reliability
- PM oversight committee having the ownership to change PM frequencies
- Worker tracking based on location (worker badge) can lead to worker issues
- Standardize across sites before you implement
- Sites must act on the results of the demand supply model
- Demand Supply model must be continually updated to be useful
- Software tools analyze data (power BI or click view) are powerful tools, but caution must be used to prevent inaccurate representation

## Session Takeaway

Demand Supply modeling helps you plan and optimize maintenance. A high-level of effort must go into building the model for accurate results.

# Session 3: Are We OK With Our Current Productivity and if not, what can we do about it? Session Organizer: Jon Anderson (ACA Proactive)

Productivity is not just a Maintenance problem, it is an organizational problem. In the last session we learned about using a demand - supply model to identify gaps in our performance. In this session we will discuss gaps that many organizations have and how to fix them to improve our productivity. We will hear about tools, such as Syntempo to help automate processes. In this session we will add to our list of actions we can implement to increase our productivity.

# WM Presentation Using Power BI

John McDonald (Fleet Work Control Manager, Southern Nuclear)

#### **Presentation Notes**

Power BI can be used to look at work through the lens of resource needs, work in the work week, material costs and availability, WO bundling or functional equipment grouping.

Looking at data analytics (Power BI) we can look at work through a work week. You can determine total parts or materials costs for work in that week. In other words, you can find out what the costs are with an associated work week. For large costs a station can look a possibly capitalizing the cost if it meets the requirements. You can also look at parts holds or constraints for a particular time period. This can allow a station to better track their constraints and costs. This allows better management of work.

#### Q&A

Q1. Can the tool account for contingency costs?

- A1. The software has this ability if it is properly coded. You can also look in hindsight to see what you spent following a work week.
- Q2. Do you have a review committee or team that looks at the data gained by these analytics?
- A2. Not yet, the fleet is still developing this role. This will probably not be procedurally driven, it's more a tool for management discretion.
- Q1. How do you gain access to these tools?
- A1. Most utilities have a license to Power BI through Microsoft. This software can pull data from various databases. Asset suite, Maximo, eSOMs, etc.
- Q3. Can planners designate parts as contingency?
- A3. Most planning software has this ability, although its use may not be happening.
- Q4. How is this data being used?

A4. This tool is being presented to Chief Nuclear Officers so they understand what is available. Also presenting to plant management (managers, supervisors) so they can see the value and power of these tools.

Q5. Is FIN included in the data. How long does it take to compile data / reports

A5. No. 3 weeks, sometimes reports can be created the same day. The presenters site uses a dedicated person with the skill set to make these reports.

Efficiencies Gained thru Syntempo Implementation

Jarrett Heitzman (Project Manager – Technology Initiatives, Talen Energy)

- Syntempo is a software program that allows better tracking and turnover of scheduled activities. Initially software was created for outage schedules, but that has now been transitioned to on-line. Using this software eliminated schedule review meetings in the outage command center (OCC). This has greatly reduced stress for OCC and maintenance outage command center.
- Turnover process was improved because it prevents having to re-status the schedule every shift. In other words, once you update the status
  of an activity it stays with the activity through turnover.
- No reports have to be generated since Syntempo is the viewer of the schedule and is always live data. On-line schedule exception meetings have been eliminated. Software can also track critical scope survival. Software allows execution users to update outside the scheduling software (P6) which avoids confusion.
- Changes in behaviors are a result of being able to status work in real time. Management can be more strategic instead of reactive since they
  don't have to obtain so many status updates.

Q1. How long did it take you to deploy?

A1. Four months. Had to give 15 minutes of training to learn how to use.

Maintenance Productivity and Innovation in Action Brent Jungmann (Maintenance Director, Ameren Missouri)

## **Presentation Notes**

Reducing the amount of time spent on pre-job briefs for low risk tasks by using a self-brief process. Use a brief card for the self brief. Each brief not used saves 15-20 minutes per job. No significant impact on worker human performance as a result.

Obtained a TECHNI Water jet cutting table. Like a CNC machine that can cut gaskets very quickly. Cuts parts 50-75% quicker than previous machining tools.

### Q&A

Q1. Can it scan a part?

A1. No, you can draw the part in the machine or upload a CAD model.

- Q2. How did you handle training?
- A2. Vendor came in and qualified the technicians.

3-D printers. Used to make parts or tools much cheaper and quicker than vendor solutions. Can use it to make tools to execute work more efficiently. For example blank plugs to satisfy cyber security requirements.

Installation of LED lights. Cheaper to run and cheaper since you don't spend time replacing light bulbs.

Battery powered welding machine. Saves time since you don't have to run cables. Good for small welds.

### Key Learnings, Recommendations, and/or Best Practices

- Data is great, but you have to do something with it.
- If you wait until data is perfect, you'll never use it.
- Power BI has a lot of capability.
- Solutions for Maintenance Productivity and Innovation in Action presentation are craft driven and easy to implement.
- The best solutions start with craft and the manager gets what is asked for by the craft.
- Utilities have more software than they realize, look within

## Session Takeaway

Data analytics can reveal important trends and paint a good picture, but you have to act on the data. Look to your individual contributors for innovation, and have the courage to implement new ideas.

# Session 4: See Business/Economic Performance

# Session 5A: Actions to Improve Plant Status Control And Electrical Safety - Actions to Prevent Arc Flash Events

# Session Organizer: Bryant Hearne (INPO)

This session combines two extremely important current industry issues. INPO will lead this conversation and recent issues associated with loss plant control incidents and arch flash incidents that resulted in injuries to personnel.

# Actions to Improve Plant Status Control

Bryant Hearne (INPO)

#### (INPO presentations available through INPO member website)

Plant Status control events from 2013 through 2017 lead to the issuance of a level 3 INPO IER 19-01 on plant status control. There was a rise of plant status control (PSC) events in 2014-2018, since then the number of events has gone down. Plant status control events are grouped at four levels with the level 1 being status control events that result in significant plant events (i.e. reactor trips, etc.) with level 4 events having no consequence. Component mispositions are the weakest area for plant reporting due to stations not being required to report for minor events. Therefore, the accuracy of data with regards to plant status control could be improved. Maintenance / work management have increasing trends in causal events for plant status control related reactor trips. So far data shows that there will be more human performance related trends in 29 than in 2017 and 2018. Therefore, there is an increasing trend in reactor trips due to human performance. Data shows that PSC events usually result from being on the wrong component. Level 3 PSC events makeup 86% of PSC events in 2017-2018. Valves comprise about 60% of the components that were mispositioned. About 35% of PSC events happened while work is in progress, 21% during restoration, 12% for clearances, 12% for surveillance testing, and 12% for bumping. Personal Accountability gaps are contributing to PSC events.

Q1. What are we doing with IER?

A1. Briefing and focusing on PSC during TAM or 2 minute timeout. Need to do more with supplemental.

#### Q2. What can we do to prevent PSC events?

A2. Most stations have locked 90 deg ball valves in accessible areas. Have operations personally brief supplemental workers prior to station outages on importance of PSC and identifying bump hazards. Specifically, with scaffold builders since they have a lot of bump potential when building scaffolding.

Q3. How can we use technology to improve performance?

A3. Harris Nuclear Plant has a program that monitors all valves monitored by the plant computer and detects any valves that are out of position.

## Electrical Safety - Actions to Prevent Arc Flash Events Bryant Hearne (INPO)

### (INPO presentations available through INPO member website)

In winter 2018 the industry had two arc flash events that resulted in three serious injuries. INPO looked at these events and was considering issuing an additional IER. They determined that previous IERs if effectively implanted would have prevented the events. Therefore, no new IER was issued. INPO issued a letter for stations to ensure the previous IERs had been effectively implemented. WANO had a similar trend in arc flash events. The causes were complacency, inadequate work practices, unacceptable behaviors, and neglecting or violating procedures. Events occurred during planned or preventative maintenance so they are not construction related. In 2016, there were 154 electrical fatalities across all industries, a 15% increase since 2015. The utility industry has the highest rate of fatal electrical injury, followed closely by the construction industry. Statistically a fatality occurs for every 14 arc flash events. A recommendation from WANO is to put hard barriers in place not just administrative ones. This is because a humans are fallible. Arc flash events don't always happen to electricians or I&C techs, scaffold builders for example can contact live voltage. Electrical safety AFIs given in 2019 are one fourth of what they were in 2017 and 2018, indicating improved performance. Electrical Safety events & near miss failure types are mostly related to clearances (either improperly prepared or improperly hung) from data in 2016-2.019. Clearance related events are on the decline in 2018-2019. Barriers put in place to find energy before it finds the worker are failing in some of these cases. Causes are worker behaviors such as complacency, not identifying hazard potentials, not understanding requirements for working on components with danger tags, and a mindset that things will not change as work proceeds.

In 2018, at Sequoyah, they were pulling 6.9kV cables that were grounded. A technician started to remove the ground cart in order to perform a visual foreign material exclusion (FME) inspection. They were dressed out in PPE. They left the area after removing the ground cart. The tech noted some irregularities when removing the ground cart. After they removed the grounds, they went to take a break. His colleagues entered the area after he left and had taken down the barriers to perform the FME inspection. They were involved in an arc flash event. They should not have crossed the plane of the 6.9kV panel, but did. There work instructions did not support anything more than a visual inspection. What is suspected is that an issue with the shutters that block the energized components was opened due to an issue noted during the visual inspection. It is suspected the individuals rationalized the work they performed as acceptable. They had performed work on the back side of this bus for a long time. (weeks/months) They opened the arc flash event. These two individuals that were involved were experienced and had demonstrated good work practices. One thing that became clear is that workers were working differently when being watched versus not being watched. Another thing is that electrical safety events are unforgiving. The energy involved is extremely hazardous. The station though their electrical safety reverence was healthy, but it was not. Take the chance to thoroughly evaluate the culture at your station. Peer to peer coaching is necessary to sustain high levels of performance.

Q1. In the case where maintenance verifies no energy prior to OPS releasing the clearance for sign on, should these count toward near misses. A1. Not per the current rule structure.

# Key Learnings, Recommendations, and/or Best Practices

Stations have taken steps to reduce bump hazards that cause plant status control events, but personal accountability is need to prevent other types of plant status control events.

Electrical safety events are unforgiving. The energy involved is extremely hazardous. The station thought their electrical safety reverence was healthy, but it was not. Take the chance to thoroughly evaluate the culture at your station.

Observation is needed to watch entire jobs to ensure standards are met. Since supervisors can't watch all jobs, peer to peer coaching is needed.

# Session 5B: Soup to Nuts, Automating the Work Management Value Chain

# Session Organizer: Jon Anderson (ACA Proactive)

INPO AP-928 provides guidance in the automation of work management functions. However, the real value is in automating the entire value chain. Many organizations are working on that challenge now. This session will bring together nuclear, non-nuclear and vendor personnel that are well down this path. Takeaway's will include concrete actions participants can take, with their existing resources to start this automation. Participants will leave this session with an understanding of the status of this change and the challenges involved. This session will allow us to add to our list of actions we can take to improve productivity and efficiency.

# Our Goal is to Get Our Work Done More Efficiently with Fewer People. This is How We Are Planning to Get There.

Jon Anderson (ACA Proactive), Rich Weisband (Exelon), Jeff Grieder (Exelon), JD Miller (Duke Energy), Joe Marsala (Endevor), Ronnie Williams (NextAxiom Technology)

- Moving from a "Work Management Team" mindset into a "work management process" mindset. We want to make each person's job as simple as possible; by improving the Work Management Process we make everyone's job more efficient.
- Using Functional Equipment Groups (FEGs) effectively is a key to resource savings. FEGs allow for similar equipment to be worked in a single window, which makes maintenance more efficient and targeted to more specific functions.
- Example: In the WM program, we had FEGs assigned differently for PMs vs component identification. Ended up having people reassigning
  PMs etc... and it wasn't communicated to the component FEG. ARs/CRs weren't communicating with PMs. Had to do a lot of work to
  reconcile equipment FEGs. The key here is that there needs to be a way to automate this process.
- The EPRI Tool that already exists is Data Visualization Software Power BI. Very powerful tool with high functionality that helps you see where you're spending your money. Most sites already own this software but are seriously underutilizing it.
- A key element to monitoring individual components and trains is some sort of data center and performance based modeling software like PRISM. But where does that information go? It needs to be integrated into your other tools.
- Example: System Health Process. In the past, we'd generate a backwards-looking system health report. The new process is simpler: automated processes provide an instantaneous look at the system health. System activity logs show open work orders, action items, trending data, condition reports etc... against machine learning algorithms that pull out a health rating for a system. "System" could be swapped out for component type, FEG, anything you want to filter against.
- What we need are results. Results are based on peoples actions, which are based on information, which is based on interpreted data. In the absence of data, we start making decisions based on assumptions and feelings.
- Once you define the issue, you might be surprised to find that you probably already own the software that can automate your process.
- The right "middleware" can integrate your existing software into a more user-friendly process. There's no need to have multiple screens or apps open to do one task- get something that can combine all/only the relevant information into a format that's easier to digest.

## Group Q&A

Q1 (Rich): Didn't Exelon move to the FEG model like 10 years ago?

A1 (Rich): Yes, though it was slightly different looking and has evolved dramatically since then.

Q2 (Rich): How do you prioritize sensor data? What's the consequence for bad failure data, how do you parse that out?

A2 (Rich): Data all comes into the M&D Center. When an alarm comes in, it could mean 1) the equipment is degraded, 2) sensor failure, or 3) the model is bad. When that happens, they'll have a system engineer review the data and make a prioritization evaluation.

Q2 Follow-up (Rich): Does maintenance always own upkeep for the sensors?

A2 (Rich): No, we try to identify the right person for that job, particularly since there are so many sensors. Sometimes we have operators check batteries on rounds, sometimes they're on a PM, etc... It doesn't have to be real sophisticated. Sensor failures and maintenance are considered in part of the cost-benefit analysis.

Q3 (Rich): Is there a way to highlight extra information in the cycle manager, and does it have any ties to Paragon? A3 (Rich): This is more of a global thing, it's not tied to P6 so it's not tied to Paragon. But that is something we're planning on looking at.

Q4 (Ronnie): How close is the technology to getting the real micro-scheduling of tasks? A maintenance worker takes 10 min to do a task, so the program is making small scheduling adjustments based on real time judgement.

A4 (Ronnie and Jeff): Every new platform (ours included) has a real-time schedule adjuster built in. We're not used to it because of how we have traditionally thought about scheduling. It's just a matter of reporting. You can choose to break out any part you want and look at whatever you want. You can feed that information (meta data) back into the program. I would say, from a maintenance perspective, that actual time should be taken with a grain of salt. But after more data is collected, that information absolutely can be taken to inform future scheduling. The software can be as precise as you want it to be; but if you want it to be super precise it might end up being less accurate.

Q5 (Jon): I've never encountered a site that's opposed to the use of FEGs. Wouldn't NRC/INPO get onto somebody for poor packaging/work processes? A5 (audience member, NRC employee): Yeah, regulators do that. We do recommend that when we see it, and we do see it frequently. It's discouraging.

# Session Takeaway

- FEGs are an absolutely key building block for process improvement. They really work. Most sites are underutilizing FEGs for their long-term scheduling and monitoring. Likewise, most people have software already that they're not using to its full potential.
- Make sure all FEGs are in the cycle plan. Get out of Excel and get that info in a better, more streamlined, automated tool.
- Streamline processes first before trying to automate them. Efficient manual processes can only take us so far; if it's consistent and predictable, start looking for a way to get software to do it for you.

# Session 6: See Engineering/Equipment Reliability

# Session 7: See Business/Economic Performance

# **Operations/Ops Training**

# Session 1: Building an Operations Department from the Ground Up

Session Organizer: Scotty Scott (Harris Nuclear Plant)

If you could start with a clean slate, how would you start a new Operations Department in 2019? In this session, presenters will build a department from its foundation that understands and mitigates the current issues with the industry and how it relates to Operations and Operations Training.

## Building an Operations Department from the Ground-Up Scotty Scott (Operations Manager-Duke Energy)

Discussion participants also included: Ron Gibbs (South Texas Project), Matthew Norris (Southern Nuclear - Vogtle 1&2), Brian Reed (Southern Nuclear)

# **Presentation Notes:**

- Different players and managers, turnover is different for nuclear from one person being hired over a ten-year period to now classes of
  personnel being hired.
- Operating consistency is key, performing at a high-level all the time is the difficult in an operations department.
- Operations supervisors and trainers are the key contributors, they will be the ones that ensure high level performance through turnovers and changes.
- Challenges to ensure the supervisors are being trained to being great leaders, look at ways to train your personal before they reach that leadership role.
- Supervisors are good with technical knowledge but need training on how to be a good coaches and communicators.
- Finding time to train supervisors to be a leader is a challenge and something that needs to be addressed across the industry.
- · Putting an emphasis on Senior Reactor Operator as not just CRS but as an Operations Supervisors.
- Teaching supervisors how to be leaders early is key.
- Industry should focus on treating your operations personnel as a nuclear professional to minimize turnover with current demographic changes.
- Approach job with a high-level of pride.
- High performers need to be recognized because this will help with employee engagement to help high-level of performance.
- You also have to be willing to coach those superstars so the whole team doesn't slip into complacency, something that commonly is done.
- Trainers have the closest relationship with the operations personnel which is why it's so important for managers to ensure trainers understand the impact of their job on overall plant operation and efficiency.
- Developing an academy for leadership for not only supervisors but trainers as well.
- The manager's job is to make the lives of their personnel better, work on managing down and not so focused on managing up.
- Look at the administrative distractions to plant operations, develop ways to eliminate distractions.
- New hires are talking about career paths now and how it will flow. Career development is now a focus for new hires something not seen in the past.
- Industry needs to look at other areas to place operation personnel for short-term job assignments to help maintain employee engagement.
- Think about ways to make personnel want to take your job (managers).

## Q&A

Q1. What are you doing to look at the issues with attrition and why the high turnover?

A1. Demographics, Older folks are leaving and to help with loss we need transition people into mentor roles to off shift designated personnel for knowledge retention. Strategically pushing Ops personnel to cross functional areas to strengthen your base.

Q2. What amplitude test is used for operators when hiring to limit attrition?

A2. Kauffman testing (STP)

Q2. How are trainers utilized by operations?

A2. They are used as liaisons on crew, lead crew notebook, and instructor MRMs lead by the ops crew. (Duke)

Q2. As a point of reference, what percentage of hires from the nuclear navy, engineers, technical grads, etc. A2. 50% are engineers, 50% non-engineers. There has been a decline in the # of nuclear Navy applicants.

- Q1. Are Vogtle 3&4 operations staffing coming from Vogtle units 1&2?
- A1. No, many or most are degreed engineers, nuclear Navy or other utilities (SNC)

# Session 2: Risk Informed Completion Time Implementation and Change Management

Session Organizer: Jesse Key (Southern Nuclear)

The Risk Informed Completion Time (RICT) program is now being licensed and is available for use. TSTF-505 has been the subject of considerable interaction between NRC and industry, to refine the scope and execution of the program. The needed infrastructure - procedures, training, and configuration risk management tools - have been developed and PRA models are being streamlined as so-called "one-top" models to allow faster computation time. The program will work under the umbrella of the mature online Maintenance Rule work control process to successfully manage configuration risk by calculating a configuration-specific allowed outage time and employing risk management actions. This innovative program allows operators sufficient time to address equipment problems and removes undue stress and time pressure on the organization. It also eliminates the need to develop contingency NOED's and regulatory relief, but few plants have been licensed or are implementing to date, as the process is new. This session will explore the tools and methods developed to effectively implement risk-informed Technical Specifications, and provide early lessons learned.

# **Risk Managed Tech Specs**

Speakers shared one presentation but spoke individually. There were two sets of Knowledge Manager notes for this session.

Introduction: Risk Managed Technical Specifications Jesse Key (Southern Nuclear)

### Presentation Notes Risk KM

- Real time calculations impact completion times in TS
- Software is updated by SROs in control room to update risk profile
- · Reduces risk by limiting inherent risk for shutting plant down and allows more time to complete TS actions

### **Presentation Notes Ops KM**

- Allows more time for planned maintenance so more can be completed online and save time during outage.
- Limits burden, prevents cycling organization.

## Q&A

Q1. Do you change surveillance frequencies under TSTF 505 or under another LAR? And how long did LAR process take at Exelon? A1. RITS changes envelopes a number of programs. Surveillance changes were under a separate program. Over a year for Exelon and used F&O closure process to eliminate number of questions in LAR. Use Appendix X closure process so changes are not needed to be documented in LAR. Built into work management process

Q2. How long did it take to implement? Did you have to have all the FNO (findings) complete? A2. 1 year. Most FNOs were complete

# South Texas Project - PRA

Ron Gibbs (South Texas Project)

### **Presentation Notes Risk**

- WCC plans the week, turns schedule over to ops in a work management state until schedule is completed
- Highlighted red items are violations of front stop
- Lessons learned
  - Not everything fits into CDF
    - Limitation of not being able to calculate dose rate and how it affects operators for CDF calculations for control room HVAC Able to do more maintenance online because RICTs extends TS action times
    - Able to do more maintenance online because RICTs extends TS action times
       Can extend surveillance frequencies to save time in outages STP is looking at LOOP-ESF testing frequency extension
    - Accurate communication on RITS is vital for all parties to understand implications
    - RITS are only applicable in certain modes limitations need to be understood and the effects of those changes
    - Need regularly updated model to have the most updated RICT
    - KPI hits are a concern, so more data from other plants implementing RICT could help with changing how KPIs are approached

#### **Presentation Notes Ops**

- Key to understand the color scheme associated with risk profile
- Planned maintenance should be performed before RMAT
- Emergent done before Back Stop
- Made backbone models ahead of implementation with Fire and Internal already incorporated to make implementation and use easier. Will shorten run time of RICT

#### Q&A

Q1.Are you using in planned maintenance or emergent work?

A1.Using it more for emergent but have used for planned maintenance, South Texas Project (STP) uses a lot for planned maintenance.

Q2.Any regulatory challenges when used for planned maintenance?

A2 At first there were push back, but after NRC became more familiar with it they have bought into the program

# Vogtle Risk Managed Technical Specifications

Adam Coker (Southern Nuclear)

# **Presentation Notes Risk**

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- Only 2 entries since implementation
- Operations leads the program
  - Operators use Phoenix and have to ensure programmatic requirements are in place'
  - Required intense initial training and then PRA engineers supported the program live to ensure operators understood program Vogtle uses cumulative approach similar to RICT
    - o Have to shift thinking if plant is willing to go to end of time in a RICT because color changes will be encountered
      - Need to be prepared to manage orange risk when utilizing full RICT
    - Risk Management Action Times
    - o Conceptually simple, but details are complicated and can be confusing when new RICTs don't match with previous RICTs
    - Feedback is important for improvement of the tool
    - Planned vs emergent have different programmatic requirements
    - More requirements for emergent and less time to deal with it to potentially go past front stop time and utilize RICT
  - Potential flexibility and ability to avoid LER using RICT

#### Presentation Notes Ops

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Q2.Any regulatory challenges when used for planned maintenance?

A2.At first there were push back, but after NRC became more familiar with it they have bought into the program

Q2. Difference between emergent and planned use

A2. Planned finishes within RMA, emergent finishes at front stop. Existence of RICT helps with plans for SSC outage

Q3. Regulatory challenges for using it for planned work?

A3. Yes based on misunderstanding of purpose of program, but once discussions were had and everything was understood, it was fine. Using RICT to go past RMAT. Have to measure cumulative risk beyond front stop potentially. Program is new to inspectors and there are a lot of questions to be expected. Invite residents to training sessions to help them understand.

#### Exelon Implementation Schedule James Landale (Exelon Corporation)

# Presentation Notes Risk

- Seems like a PRA program but is actually an Ops program
- Exelon is doing a staggered implementation across fleet of RICT
- Want to leverage existing processes instead creating something brand new
  - Use same program for a(4) as for RICT
  - RICT has to incorporate fire model as well as internal events
    - Continue to take actions as part of existing programs
- Still an expectation that action is taken prior to front stop times while implementing RICT
- Capture items not in PRA models with RMAs in a central location so actions are not dependent on tribal knowledge
- Resource intensive to generate and maintain
  - Work through options to streamline process as much as possible
- Some configuration specific RMAs may not be intuitive
- Already have RICT experience
- Lessons Learned

0

- o Short term LCOs pose challenges to ops team for implementing RICT and operators need continued training
  - Incorporating fire model has complicated and lengthened calculation times
    - Looking at grouping initiators or looking for inefficiencies in model that can be fixed

#### **Presentation Notes Ops**

- Lot of PRA in the RICT but it's an operations program. Operations should have ownership in the program
- Maintenance Rule a.4 functionality being leveraged to reduce risk
- Short term LCOs ie 2-hour LCOs will need clear guidance to not impact time to perform the RICT, streamline the process (lots to do in a short period of time)
- RMA risk management Actions tend to be the most difficult to incorporate in the RICT, incorporate in the guidelines (predetermine)
- Operations should utilize PRA when performing RICT (Programs: Phoenix at SNC, Paragon at Calvert Cliffs, STP has own program)
- Models can take a lengthy amount of time to run depending on the fault trees so take this into consideration when choosing to perform RICT over LCO times
- Invite regulators to training sessions to help with understanding of RICT. The program is new to the NRC as well

#### Q&A

Q1.Is the cumulative risk reset over time?

A1.It re-zeros after a year

Q2. Are there lesson learned at other sites that people can access?

A2. Sharing of lesson learned across industry is coming but not yet available. Contact already established plants to access these learnings.

Q4. Does cumulative risk reset?

A4. Regulation is vague but after 1 year can be used if annual CDF increase does not increases > 1E-5 threshold. Annual threshold for awareness but not limited by exceeding it – not a hard stop. Can still use RICT even if cumulative threshold will be exceeded.

## Q5. Are there other lessons learned for emergent use of RICT?

A5. Tabletop a short LCO and use of emergent RICT and see how response compares. Need shorter calculation times. No provisions for a total loss of safety functions – can use 3.0.3 and enter a RICT – have to know where the line is for a total loss of safety function. Models were consolidated prior to implementation and that shortened calculation times. Optimize PRA models. A lot going on during short LCO times is also considered – not everyone may be comfortable with RICT program, called in for assistance. Get operators thinking on conservative time. Challenge was getting enough information to confirm that plant was entering RICT with small changes that weren't updated in the model – margin was

Q6. Can you implement a RICT once a nominal completion time is exceeded?

A6. Generally no because you've already exceeded the action statement and are now in a different action statement. This may be something to discuss with NRC and licensing especially if you know you're wanting to enter the RICT. May have basis based on a new completion time using model

# Session Takeaway

Risk Informed Completion Times in Tech Specs can provide flexibility for utilities to perform activities to return equipment to acceptable status by analyzing risk insights in real time.

# Session 3: Advancing Operations and Training through Technology

Session Organizer: John Austin (Southern Nuclear - Farley)

While the Operations Departments lead the core of the organizations, we tend to lag in technological advances. What innovations have worked, and what is on the forefront of improving our ability to work effectively and efficiently? Additionally, what do we need to develop for the Operations departments of the future?

# Advancing Operations and Training through Technology

John Austin (Farley Training Director SNC) & Bruce Hennigan (Exelon Corporation)

## **Presentation Notes**

- Non-licensed operator (NLO) came to training department and completed SRO certification in four months. He has revamped NLO training at Farley (Southern Nuclear Company SNC) by utilizing available technology.
- IPAD technology is used for training NLOs. All information the student needs is on the IPAD: training guides, drawings, procedures, and pictures. (SNC)
- Restructured a plant walk down program for NLOs that is lead through a document-based instruction guide.
- Put all training information in a one drive folder for better accessibility for students in real time including from their home and access to the instructors 24-7.
- Looking at making exams electronic (SNC)
- Restructured General Fundamentals Examinations (GFES) training to better align to applicable systems in the plant.
- Vision software available to use which allows all testing to be performed electronically including locking out for exam security.
- Vogtle utilizes IPADs to access IPC (Integrated Plant Computer) to use when placing systems in operation or changing plant system alignments while out in the field
- Exelon is working towards shortening GFES to six weeks. By doing diagnostics testing to ensure operators are ready for class, which helps get rid of a lot of preliminary training.
- Exelon is utilizing distance learning to teach multiple rooms of personnel.
- Distance learning program allows for anyone who wants to refresh on a training topic to access the lecture. (Exelon)
- Simulator training should also focus on routine tasks.
- Exelon and Farley (SNC) have shortened NLO training program to less 12 months. 10.5 months at Farley.
- NRC is looking at no longer requiring GFE by 2021.

## Q&A

- Q1. How long does the operator get the lpad for?
- A1. Until the end of class and including on the job training/training performance evaluation (OJT/TPE).
- Q2. What additional skills do trainers need to learn to perform the distance learning classes?
- A2. They utilize a training program online that allows students to answer questions during lecture to ensure class engagement.
- Q1. Do you have multiple screens for the downloadable content classrooms?

A1. Yes, two per room. One screen is the speaker and the other screen is the subject material. In the speaker's room there are two screens in back that show the students in other classroom and the other is the subject material.

Q2. Do you know who is using the downloadable content besides Exelon?

- A2. Excel is leading the way with this technology.
- Q2. What is the outlook for shortening the initial license class (ILC)?

A2. 67 weeks is the fastest completed, but there is no official change by the NRC to shorten this.

Q2. Can NLO take an Ipad out to perform OJT and utilize drawings and self-study?

A2. Yes, NLO can use them.

# Session 4: See Business/Economic Performance

# Session 5: Managing and Measuring Proficiency

## Session Organizer: Bruce Hennigan (Exelon)

IER 17-5 asserts that leadership proficiency among operators is as important as their abilities to manage within their roles and responsibilities. How do we—as an industry adequately measure the proficiency of our operators and leaders, and what are we doing to adapt training and imbue the importance of proficiency on the next generation?

# Managing and Measuring Proficiency

Bruce Hennigan (Exelon Nuclear), Sara Lange (Ameren), Ron Gibbs (STP)

- Exelon is reducing the number of instructors across fleet by bringing some to corporate office and having them perform non-plant specific training topics to all of their fleet, using technology like distant learning software
- Exelon directed Shift Manager (SM) time be used to help build operator proficiency, which is under the flexible section of ACAD program
- SM time consisted of crew focusing on: what upcoming maintenance will require system realignments? What evolutions do you have coming up? What crew weaknesses do you need to work on?
- Operations performs a roll up of previous cycle common themes or areas for improvement, and spend portion of the SM time working on those
  items
- Focus on those AFIs (areas for improvements) over the cycle to help close gaps
- Training department shouldn't establish what areas to be trained on by crews. This will allow the crews to use their time to do what they feel is needed for improvement
- · Give SM latitude to make decisions to improve crews as they see necessary during this SM time
- SM time used to realign systems in preparation for maintenance activities not frequently seen in the simulator. This opened eyes that the leaders weren't effective coaches and gauging their operators' proficiencies
- Often the industry focuses on SROs not leaving the oversight role but not about being an effective coach.
- Utilization of back tracks/ resets in simulator training are being performed to be an effective coach, so license operators don't leave simulator without knowing how to do it right before the formal critique process takes place.

- Better ways to get training tasks performed and not spending the whole day performing a simulator scenario to get credit for one task. Utilize DLAs
- Most of industry has a minimum time requirement for SM time (4 hours)
- Perform proficiency drills on shift to go over actions while at the plant especially if any systems are currently in a degraded condition
- Proficiency drills on shift can also be used for task preview for clearances or testing activities
- Have workers build an operator 4.0 for a task to help identify gaps and how to do the process to identify gaps
- Multiple sites are having AFIs in task preparation
- Utilizing pre-job briefings to talk about proficiency and utilizing the tool
- · Evaluating if the tools operators are using for proficiencies are effective Ex. The circles on the industry proficiency card
- Place proficient operator with non-proficient operators when performing tasks
- Out of role training newly added to ACAD. Letting operators experience what would happen if they violated a precaution and limitation or caution/ note in procedure and see the effects of that action.
- Perform hands-off demos to allow to operators see what would happen with no action is taken
- Developing the SM, perform a sounding (5-10min) with SM right after a simulator scenario to get a gauge on how he felt the scenario went. See if the SM is off from the expected actions from training then coach SMs when not meeting those expectations
- Ensure the trainers are giving quality feedback from scenarios and stay away from the soft comments
- · Have the SM coach the crews on behaviors and not have the instructors do it.

### Q&A

Q1. Have you polled personnel to see if proficiency tools available are actually useful, user friendly tools?

A1. There is study out there which helps determine their effectiveness

Q2. Could you rank you shift manager from best to worse and then let them be the example of how a SM should try to perform? A2. Video SMs in sim and let the SMs with some gaps watch the video of the higher performers. SM who are best in tune with their crew are the ones who usually have that exemplary performance

Q3. How do you separate the oversight and coaching aspects?

A3. Making the CRS (Control Room Supervisor) and/or middle manager make the decision and not leaning on the more senior managers to make decisions for them.

Q4. Do you preform scenarios that force challenges to a supervisor that might not face normally because they are a part of a strong operating crew? A4. Yes, we run scenarios where something is intentionally wrong to help challenge supervisors

Q5. How are you utilizing your training department to perform a crew 4.0?

A5. Have them do a part of the 4.0 like leadership and teamwork sections

# Session 6: Crew Performance Evaluation Changes

Session Organizer: Bruce Hennigan (Exelon)

Participants: Sara Lange (Ameren - Callaway Energy Center)

Last year, the Crew Performance Evaluation program changed significantly, highlighting the theme of simplification. In this session, presenters will share their experiences with the revamped CPE format to include lessons learned and potential future changes.

# **Crew Performance Evaluation**

Bruce Hennigan (Exelon Nuclear), Sara Lange (Ameren)

## **Presentation Notes**

- Plant submits three scenarios designed to last 90-105 minutes in length: should look like "as found" exam style scenarios
- Use industry and station OPECs to generate scenarios
- Shift to get back to more realistic scenarios
- Write the scenarios for 85 minutes because with extra evaluators the scenarios will run at the 90-105 minutes
- INPO will run same scenario on two crews
- INPO has added additional items to watch the rest of the training week for CPE evaluations.
- INPO is watching OJT and TPE of the non-license operator training during CPE evaluations
- CPE change is part of the DNP initiative.
- They are using previously run As-Found scenarios that happened during the cycle as the CPE scenarios
- Using previously as found scenario gaps
- ODSI implies that the events are "triggered based" for the CPE scenarios
- Hiccup at last CPE- one guide passed through with an event-based trigger in the scenario and this caused the crew to get to a point where they caused a plant transient that was not a part of the exam guide.
- INPO asked generic plant operating questions during CPE which were generated from the sites training department.
- INPO is focusing on the crew being self-critical of their performance.
- Lesson Learned: Corporate implemented a new program through the servers which caused the simulator to not function properly. So it a good
  idea to verify simulator can support and have contingencies already in place before the CPEs are being run
- INPO is looking for results from the SOER 17-5 actions during the CPE evaluations

## Q&A

Q1. What if no OJT/TPE going on at plant at time?

A1. Pulled two JPMs and did JPMs with the non-licenses

Q2. Were you using operating crews to validate the as found scenarios?

A2. Instructor did the initial validation and continued to be validated during the cycle by operating crews with the As Founds can be taken for credit as validating the scenario
Q2 How long is a typical post scenario critique scheduled for? A2. 1 hour is typical for SNC and Exelon

- Q2. Did the sites hear the INPO response to SOER 17-5 action implementation assessment?
- A2. The individual sites should have taken care of the 17-5 implementations not on a corporate level.

# Session 7: OPS Track Rollup / Takeaways / Considerations

Session Organizer: Dan Randolph (Exelon Corporation)

The 2019 Utility Working Conference has been a unique experience, focused on the future. From abstract ideas such as building a department from scratch to the more concrete of present-day innovations, the industry and Operations departments are quickly catching up to the contemporary concepts of leading organizations. This wrap-up session will bring together the learnings of the Conference and provide an open forum for any unanswered questions or unaddressed concerns and serve as a jumping off point for the Operations track at the 2020 ANS UWC.

# Where do we go from here?

Dan Randolph (Exelon)

# **Presentation Notes**

- Large change in demographics from earlier years
- Next year bring in or make videos of operators utilizing technology at the different sites.
- Perform demos of the technology being used.
- Brain storming of ideas to gain efficiency as a session
- Continue to look at ways to reduce Non-Licensed Operator (NLO) training through the DIF process
- · Assign newly hired operators to the shift they will be going to. This will transfer responsibility to the crews on the quality of training
- We need to talk more about lessons learned from plant assessments, INPO evaluations and NRC exams.
- Start setting up monthly phone calls to talk about the session prior to next year's conference
- Talk to the sites to bring more people to the conference
- Send the CNOs specific information about why this conference is great for bench marking and information sharing.
- Design a session on what the sites are doing to train personal on leadership and what changes people are making

# Q&A

Q1. Has NLO training changed over the years?

A1. Reducing the length of NLO classes and moving towards less time in classroom and more time at the plant

# Performance Improvement

# Session 1: Culture; Willful Violations, Best Practices

Session Organizer: Kim Leffew (Consolidated Nuclear Security)

A troubling trend in our industry is an apparent increase in willful violations of important plant safety requirements such as safety checks, inspection records, and falsification of important records. These events are cultural in nature and have the potential to severely undermine regulator and public confidence, and threaten our sustainable nuclear future. In this session we will explore potential drivers for this trend, best practices for responding to these type of events, and insights into how to evaluate and correct the underlying organizational and cultural causes of these events.

# Leaders' Role in Willful Violations

Dr. Dorothy Andreas and Elmo Collins (EXCEL Services Corporation)

#### Handout: Integrity Factors in the Work Environment

#### Presentation Notes Text or bullets:

- Main reference: Dr. Dan Ariely Duke University Behavior the Honest Truth About Lying.
- Humans can rationalize about lying to an extent.
- Willful violations are not a generational problem.
- There is a difference between deliberate and blatant careless disregard.
- There are factors and instances that have been going on in the organization before the willful violation occurs, the person/people didn't wake up one day and decide to make a willful violation. There are a series of small steps to get there.
- INPO 12-012 Organizational Culture
- Having a teaching culture that teaches ethics to prevent unethical behavior.
- Ethical behavior is the identifying factor principle to run organization
- Leaders your station is under your control that is something that you can control and change.
- Human factors and organization drivers contribute to a person's willful violations.
- People adapt their ethics to your work environment.
- Work Environment Integrity Factors
- Cognitive Flexibility
- When people read the 10 commandments before a test, they are less likely to cheat, no matter their religion or race.
- Technical consciousness reminder and ethical reminders are important, especially when it comes to outages, before meetings and all work.
- Biased incentives for leader behaviors can push away from a safety ethics.
- This is not an either-or question, it's a question of do you have more pushing toward or pushing away from safety ethics. it is a leader's responsibility to analyze for the company and determine how to do this.

#### Key Learnings, Recommendations, and/or Best Practices

• Leaders must know where they are at in terms of the organization culture.

# Entergy ADR/ Confirmatory Order Lessons Learned

Ron Gaston (Entergy)

# **Presentation Notes**

- Alternative Dispute Resolution may not always be the best for everyone but was for Gulf.
- Causal Analysis Determine why the corrective actions in the past were not successful and how can you use that analysis to improve the future.
- What are the organizational factors that are leading to Willful Violations?
- There is a need to teach employees about priority when they are tasked with multiple duties or getting interrupted during a task.
- Integrity audits for when similar events may occur.
- When an incident occurs the fleet should be made aware of the event and the disciplinary actions should be the same across the fleet.
- · Communications what you do or don't say has an impact on what is believed to be important or not.
- Random Audits can be a deterrent just as a fitness for duty test can be a deterrent.
- Use the causal analysis during the investigation to determine the underlying factors that are contributing to the willful misconduct.

# Human Factors Best Practices

Lauren Clements and Trent Sewell - Human Factors Specialists from Pantex Plant (Consolidated Nuclear Security, LLC.)

# **Presentation Notes**

- DOE 452.2E lifecycle of the program.
- Human Error the Book Field Manual of Understanding Human Error by Sidney Decker looking into the why and not all Human Error is
  equal.
- Human Performance Improvement (HPI) Evaluations start with Formal control procedure that is written down and followed by the employees (Hands on Workers)
  - Task Demands
  - Work Environment
  - Individual Capabilities
    - Human Nature
- Introduce Open Forum communication the workers are introduced to work environment; procedure and the workers can explain and work on the effectiveness/ clear communication or the procedure. The 4 groups are to work together and work out misunderstandings.
- Creating a way that narrows out even more outliers (bad apple employees).
- Communication is key in order to understand the why of the willful decision.

• Over 400 NSR (New Source Review) controls – finding a meaningful way to work with hand on employees to ensure that they understand the procedures and giving them the right tools.

# Key Learnings, Recommendations, and/or Best Practices

Open communication between working groups is the best way for all groups to learn what is and isn't working.

# Q&A

Q1. Internal Audits how do you populate that audit?

A1. Gate logs, for each department, look at activities and set up what types of items would you include. Have a comparison for the activity. Procedure per group.

# Q2. Have the DOE seen willful violations?

A2. When we come across the willful violations they will be honest and upfront that they didn't like or something didn't work. Making changes on the human resources end on what is looked at. Why did the worker think that was okay? Answering the how and why.

Q.3. (Comment) – The person committing the willful violations may not know it. Have to go back to the procedure and then look at how the person was trained and make adjustments accordingly. Test operator signing as the control room operator
 A.3 (Thoughts) – determining deliberate violation or careless disregard and the NRC puts a high hat on deliberate violation.

Q.4 Is there a way of applying HU tools to the screening process?

A.4 Screeners need awareness that these events occur. When identifying anomalies, they need follow up and get those questions resolved. When the CR doesn't look right, ask another question.

Q.5 Did you have many have causal factors between 1 and 2 level employees? A.5 Operations put in place that managers go out with supervisors and look at the potential causal factors

Q.6. What research is happening for applying safety culture to the supply chain (NRC policy safety culture)? A.6. Adjust policy and procedures within the supply chain. NRC may have supporting research for a study.

# Session Takeaway

Create a benchmark system that takes a look at the cause of the willful violations and how to move forward and cut down on further violations.

# Session 2: Conducting Cause Analysis for Personnel Injuries and Fatalities

Session Organizer: Kimbel Leffew (Pantex)

Learn how recent investigations into fatalities at non-nuclear facilities, such as T&D, Hydro Plants, Fossil Plants, Helicopter Line Operations, and vegetation management activities, can provide insights in examining these types of events at our facilities. This session explores 1) strategies for examining these events to get past the human error cause (i.e., situational awareness, did not follow procedures, etc.), 2) tools found to be useful in these types of analyses, 3) examining programmatic and organizational issues, 4) appropriate depth of analysis for these types of events, and 5) how to deal with the unique nature of injury RCA's (i.e., dealing with lawyers & legal perspective, OSHA perspective, public perspective, etc.).

# Cause Analysis for Personnel Injuries and Fatalities

Fred Lake (WD and Associates)

- Analyzing personal injuries and fatalities.
- Utilities can analyze equipment very easily but when it comes to Human Performance it's not simple.
- Between 2003 and 2017 the US labor statistic the fatal work injuries by employee status hasn't changed.
- TISAR Total Industrial Safety Accident Report
  - Restricted duty cases
    - Nuclear over the past 15 years TISAR has slowly decreased but became stagnate around 2012-2013.
      - It appears that the industry took measures to get the incidents down but there is still room for improvement, but you won't get to 0.
        - Take a different approach to safety at the plants.
  - Cause evaluations over several industries from line men to cutting trees.
- Basic principle: • Re + M

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- Re + Md  $\rightarrow$  reducing error and solid defense to get to 0 consequential events
  - Work error free and defenses against potential error.
- As evaluators the job is to pick apart the event and investigate the worker and the system of the event.
  - Why did it make sense at that moment? (understanding the thought process of the person)
    - how you ask the question will help get the answer from the person.
    - Did the worker see the risk with the task? How did the worker manage that?
  - Human Performance Analysis? why would you questions human performance analysis?
    - Task analysis is different than causal analysis.
      - There are multiple things that lead to the primary cause.
        - Human Performance Analysis you have to be careful when using it and disregard hindsight bias.
  - Simplify the system so that people can learn from the event and identify all the barriers in play.
- Figure out the challenges that the worker had to deal with.
- MD- Resilient = the capacity to recover quickly when something bad happens.
  - Do you have the ability to learn from those errors?
  - o If you saw the precursors, why didn't you do anything once its identified.
  - When the consequential event hits 1 you are too late, but you can still learn from the event.
- Cultural issue is in the resilient system.
- Pyramid more processes and procedures does not make us safer, we need processes and procedures to help with matters, but people tend to stop thinking when there are too many procedures.
- Management either enforces right behaviors, tolerates bad behavior, or do they not know what is going on?
- Need to be better at seeing the risk.

- Example: employee on the scissor lift in the ceiling standing on the rail.
  - As the supervisor what do you do?
    - What processes, procedures did you follow?
    - What work order are you following, what was your pre-job brief
    - As the supervisor why didn't I get you a lift to fit in the ceiling?
    - Just culture doesn't mean there is no accountability.
    - Why did this make sense to you?
    - Do you feel safe doing this?
- What does the organization need to do with the precursor incident?
  - Organization needs to change the behavior.
  - Sub-contracting need to be evaluated more frequently, equipped with the company policies and procedures.
  - What can you learn from this so the person/people don't do this again?
- Snake video (https://www.youtube.com/watch?v=wxWOz7SgNVU) the perception of risk (accident precursor) between a worker and supervisor is different.
  - Need to determine the delta between the worker and the supervisor's perception and how to limit the delta.

# Key Learnings, Recommendations, and/or Best Practices

Understanding the employee thought process will lead to being able to have a better-quality Human Analysis.

# Q&A

Q1. Humanistic side – how do you bring that into the equation?

A1. Not bringing that in is oversite. Have to handle in a caring manor.

# Session 3: See Decommissioning

# Session 4: Causal Analysis for HU Events or Investigation

Session Organizer: Fred Lake (WD and Associates)

Organizations search for quick fixes to Human error because they may lack understanding or time to perform a deep dive into a true HU problem. A human performance analysis should be integrated into the Causal Analysis process and not be a segregated piece. This methodology is from a system thinking perspective to help design smart, enduring solutions to HU problems. This briefing will help give you a more accurate view of the reality of Work-as-Done at the job performer level and how it is impacted by how work is planned and imagined to be done at the organizational level.

# Safety Event Analysis and Learning Study (SEALS)

Stacie Fontenot - Entergy Nuclear

#### **Presentation Notes**

- Cause analysis tend to make us forget the person in the work that is being done.
- Understanding the individual doing the work and what is impacting the individual doing the work.
- Focus on significant industrial safety incidents.
- Lesson learned from Condenser replacement incident-
  - (Contractors mindset: we have always done it this way and we do get hurt but why are you making us change?). Incident on site that brought to light what was going on.
    - The contractor was blowing air within the condenser and when one person went for lunch, the contractor just kept going to get the work done even though it wasn't safe alone.
      - Realized they had a large group of people (contractors) on the plant site that didn't think the same way that the plant really thought.
  - People don't always think the same way; we need to continue to understand how everyone is doing work.
- Making sure to identify the underlying causes.
- · Finding facts: interviews, site visits, pictures, review documentation and drawings, allows for a deeper understanding for the interviewer.
- Analyze: People, Activity and Environment. → causal factors worksheet. (SEALS worksheet)
- Risk Tolerance → what has happened in the past and what is the tolerance of risk.
  - o Using the worksheet with Yes and no questions for the assessment:
    - Pre-job brief?
    - Could the job be set up differently?
    - Should the hazards have been removed or mitigated?
    - Has the job scope changes?
- Equipment, Physical Environment and Physical and Mental demands → identify the levels of issues for each category to determine what were some factors.
  - Equipment out of service?
  - Were there things in the environment that created issues?
  - How was the person mental attention, potential physical issues?
- Communication verbal and written are both equally important when it comes to understanding the individual and the work that is being done.
   There are multiple causal factors (Equipment, Physical Environment and Physical and Mental demands etc.) that can influence the way that
- the individuals think and act.
- Ask the why questions in order to get the real answers.
- SEALS Team Makeup may vary based on the significance of event.

# Key Learnings, Recommendations, and/or Best Practices

Understanding safety crucially depends on understanding activities, environment and people, especially people.

# Q&A

Q1. What is the benefit of using the checklist?

A1. Checklist forces the evaluator to go through the entire process.

Q2 When going through the factors how do you decide that it does or does not effect? A2. Even if it doesn't affect the event it is still documented.

Q3. Is this documented in the CAP space? A3. Yes, it goes in the CAP space.

HPI/ Causal Analysis Investigations Kimbel Leffew – Pantex

• Mindset: How can we be successful as an organization?

- Fundamental knowledge is not the same over the last 5-10 years in the DOE and Nuclear Industry.
   Transfer of knowledge has taken a dip over the last 5-10 years.
- Re (reduce error) + Md (Managing defense)  $\rightarrow$  0 Significant events
- What is skill of the craft?

0

- Baseline knowledge that the individual should have.
- Where do we right the procedures? To the new or the older skilled workers? There is no such thing as a perfect procedure.
- We know human error is going to occur, but we want to put the right barriers in place to help prevent the events.
- Reducing error in the past we believe that it relies heavily on procedures and pre-job briefs.
- It also relies on preparation from management and information from the past.
- Understanding mindsets of employees is key. For example, maintenance employees have a mindset that is made for troubleshooting- (you must understand where your workers mindsets are). Maintenance employees are hired to fix things.
- Cell phones distractions, classified information, transmission
  - o Cultural issue is hard to fix, especially when management doesn't want to spend the money until something may happen.
  - Signs aren't always going to work, they tend to be wall-paper to those that work there every day.
- Reactive events: airbag event employee under semi-truck where the airbag deployed.
  - Before lunch they started to install the airbag (two bolts to secure the airbag)
    - The top bolt was assumed to be in.
    - Every 2-3 years that this work is done. Skill of the craft.
    - Employee was worried about the arm and worried about getting fired. The employee was not immediately made aware that him being fired was not even on the table, later he was re-assured that he would not be fired. Pantex wanted to be able to discover how to help this employee and others in the future.
  - Pantex thought process to learn from this incident:
    - How did we set the worker up to think this was okay?
    - Call other companies to understand the process of installing the airbag.
    - Pantex had never watched the process until this event procedure says follow manufacture instructions, Manufacture
      said no air inserted. Caterpillar (CAT) installed the airbags very well so Pantex got training from them and transformed the
      procedure
    - Got all the feedback from employees on how to do the job safely and ensured that the skill set was there.
  - From this event it showed the workers in the organization that they could ask for other eyes to look at procedures. This allowed the organization to be proactive and not reactive to fix procedures for their employees.
- Causal Analysis and Human Performance needs to be integrated not segregated.

# Session Takeaway

- Human error is seldom the root cause.
- Causal Analysis and Human Performance needs to be integrated

# Session 5: Engage and Innovations for HU/IS

Session Organizer: Kim Leffew (Consolidated Nuclear Security)

Nuclear industry has undertaken human performance improvement initiatives in recent years with various degrees of effectiveness when measured by results achieved and sustainability. Effective improvement initiatives at one site/company were not effective when duplicated at another site/company. Analysis determined that engagement was significantly lower during the duplicated efforts leading to suboptimal results. Conclusion was high levels of front line worker engagement was a key factor determining success or failure of these initiatives.

# Integrating NP and Hu

John Thompson – OPG Pickering Nuclear

# **Presentation Notes**

- Having operations on your side is beneficial to creating positive lasting change.
- Common Services manager monitor service water.
- Pickering now has a 10-year operating license for end of life to that station.
- "Behind every component there is a core and in front of the component is a nuclear professional."- new way of thinking when thinking of employees as Nuclear professional.
- Planned shut down 2020 but extend to 2024 is this a challenge or an opportunity?
  - Darlington plan to last to 2050, make Pickering the best until the end.
- Redefining what's possible looking for ways to improve and more forward (innovation).
- Trying to get employees talking about the work and how it impacts the core
- HU and NP(Nuclear Professional) bringing them together.
  - o Go back to the basics and what it means to be in the nuclear industry.
  - 3 c's Control, Cool and Contain the core.
- Frontline supervisors tend to be the most influential with employees.
- What standards we need to focus and drive those standards.
- Came up with 7 standards:
  - Went back to the core 4 to protect the core.
- If you don't get into the people's hearts and minds there is no buy in.

- Paired observation facilitate communication and acknowledge the positive.
- Performance indicators help start interventions.
  - le: going after gloves help coach on good gloved.
  - Eventually got to peer coaching and took about a month.
  - Won't leave or start a new intervention until the current intervention is complete.

# Key Learnings, Recommendations, and/or Best Practices

Go back to the basics and finish strong.

# Employee Engagement if the Front-Line Workers

John Shaeffer Sr. (Williams Services)

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- You can take the same process to the entire fleet but if the engagement is different across the fleet the process will be different.
- If you are having a problem that isn't being solved, it may be the way that management is thinking about the problem.
- Dan Pink's book "Drive" Levels of engagement depended on the level of the task (cognitive task).
  - Easy tasks are easy to get engagement with but cognitive is not that much.
    - Give them purpose
      - le: Vogtle 3&4 had to turn the work force around from unproductive workforce to a productive workforce.
      - Explain the potential benefits of completing the task at hand.
  - Human beings are rarely satisfied with jobs and you need to eliminate the dissatisfied.
- It doesn't matter what the management teams thinks is fair it's about what the workers believe is fair.
- Deming's 14 Principles:
  - #8 Drive out fear so that everyone may work effectively for the company.
    - Fear stops engagement and productivity.
      - le: someone has a great idea and askes for engagement, and no one will volunteer for the fear that they may be blamed and/or fired.
    - Reality and what management say must be the same.
    - You must drive out fear in order to cultivate innovation.
  - Security = productivity among employees
  - Establish a Safe Just Environment and drive out fear.
    - Don't discipline around the one-off event.
    - Preventing the worker from tying the event to the discipline
  - Paul Armstrong book "Enabling Joy" –presenting the idea of if you don't enjoy your work place, people or what you do, why do you do it? 3 essential components to create joy: Connect, Create, Contribute
- Allow employees the opportunity to create potential outcomes and work with management to create positive results.

# Session Takeaway

We are Nuclear Professionals.

# Session 6: INPO 18-001 Implementation, Best Practices and Innovations for "Must Know" OE

Session Organizer: Peg Lucky (Entergy Nuclear)

INPO recently issued INPO 18-001 Implementation, which includes Best Practices and Innovations for "Must Know" OE. Speakers will provide innovated ways for using "Currently Relevant" and "Historical Relevant" SOERs/IERs and methods to make "Must Know OE" applicable to the workforce.

# INPO 18-001 Implementation, Best Practices and Innovations for "Must Know" OE

Jason Hennen (Entergy Nuclear)

- 2 big things that have come from INPO 18-001
  - Flexibility for stations to create OE program.
  - INPO 28 OE retired some OE
- OE checklist:
- Assessment with cross functional team and what our weaknesses may be.
- External person in the group is external to the station within the company.
- OE Effectiveness Screening too Perf. Monitoring. To help change behavior.
- Efficiency gained not having to do periodic review of those that have been fully implemented
- 17-5 has a lot to implement
- Need to be able to prove implementation.
- Evaluate the trends of corrective actions that are closed to trend report. Leverage the data that you have.

# Q&A

- Q1. How often do you see revisions happening to the original OE that are picked?
- A1. Screening tool will change with 1 or 2 IER. Once missed opportunities are identified. Changed based on performance challenges.
- Q2. How long have you been doing this?
- A2. Hasn't been initiated yet but its been approved by INPO.
- Q3. Have your determined roll out?
- A3. No effective measures have been determined for the roll out.

Q4 End date rolled out to the station?

- A 4. 7 stations August start November end.
- Q.5. Has AFI database been maintained?

A.5. It is updated quarterly.

Q6. 18-001 from INPO perspective - it should be more forward leaning, driving performance or is it concerns around what the station considers important.

A6 It's meant to be what is important for the station.

Q 7. Completed OE evaluations on all must know OE?

A 7. Evaluation perspective its performance based and if the performance doesn't suggest INPO go look they don't go look.

Q 8. Expectations for number of years for review

A.8 If it says periodically it's up to judgment. If it has a time period it needs to be within the time period.

Q 9 Lessons learned from the journey so far?

A 9 In the beginning started one way and then backed up and went to INPO and they said back up you are doing too much work. Consult INPO before starting instead of after.

Q 10. How are you going to share the 28?

A 10 Share point page potentially but not sure yet.

Session Takeaway

18-001 allows you to perform continuous monitoring, a systematic approach

# Session 7: PI/CAP & HU/IS Proficiency or Best Practices

Session Organizer: Kim Leffew (Consolidated Nuclear Security)

Open Discussion; PI/CAP & HU/IS Proficiency or Best Practices. Participants can discuss or request best practices or challenges currently being faced. This forum is created for sharing what is going well, need to change and seek help from others.

# **Open Forum**

Best practices start of conversation

- PuMP process –8 steps to evaluate your measures. Quality and CAP (Corrective Action Program) take a hard look at your measures to
  identify the trends to understand the results and the why.
  - Be more effective based on measures put the information up quickly when it comes to dashboard.
    - Data tells a story Stephen Few
      - o Looking at charts and getting the quick visuals
      - o Getting the right measures for decision making.
      - o Customers demand that there are some measures
  - Proper frequency of metrics up to the management team on the frequency
    - Low level day to day
    - 3 month rolling average
    - Monthly site review
    - o Real time data
    - What are the metrics and how are you using them?
    - Causal analysis being evaluated and given feedback.
- Be transparent it's the only way to improve the area.

Investigation templates: ERC (Event Review Committee) checklist

- Investigation templates where is everyone else at checklist?
- Being able to allow reviewers to be linear through the entire checklist.
- Using the checklist to go through and understand where the organization is.
- Getting a level of consistency through the checklist
- Having engagement on the front end (oversight) instead on the back end. Creating efficiency throughout the process.
- Looking at procedures and making sure that technical information is included.
- Trajectory information in front of the management team where you can see the direction.
- Be open to feedback when people tell you your baby is ugly.
- Making sure that the detail is included in all the information.
- Understanding the error mode of the worker.
- Do you look at the system that you have and see how much that system is costing you? Idea from the Kimberly Clark company.
- Creating a forum during the year and share learnings throughout the year.
- INPO mid-cycle evaluations can lead to compliancy and waiting to identify issues.

Next year potential topics:

- One session on measures/ metrics?
- Bring in the guy that does the training
- Start finding way to communicate throughout the year.
- What is the new tech?
- How to engage the younger workforce? Learn from the younger work force?

# **Regulatory Relations**

# Session 1: See Engineering/Equipment Reliability

# Session 2: See Engineering/Equipment Reliability

# Session 3: See Business/Economic Performance

# Session 4: SDP/ROP Experience and Lessons Learned

# Session Organizer: Ron Gaston (Entergy)

The NRC Reactor Oversight Process (ROP) has reduced unnecessary regulatory burden in the last 20 years by better focusing on safety significant matters. Utility selfassessment and continuous plant improvement - fundamental aspects of the ROP – have also been notably effective over its course. NRC's current environment of transformation has prompted ideas how the process can be enhanced. This session will explore recommendations from internal and external stakeholders on ways to further improve the process, including changes to the significance determination process (SDP) infrastructure, performance indicators (e.g. MSPI), licensing and inspection. SDP consumes considerable resources to arrive at significance conclusions, and 'regulates' in a low safety significance regime in most cases ... several orders of magnitude below the Public Safety Goals. There exist very few greater than green findings - evidence of continued industry plant performance – so perhaps it's time to rethink the 'color and column' approach. This session will explore innovative approaches and ideas to improve upon the ROP, and useful lessons learned from SDP cases.

# SDP/ROP Experience and Lessons Learned

Chris Miller (NRC)

- The changes came out at the end of June for the ROP.
- They took recommendations from the transformation team and recommendations from NEI and decided that they needed to take a risk informed approach to spend more time on important things and less time on less important things. The goal was not to be one and done, but continue to show progress. They wanted to cover things with less resources.
- There is still no vote out of the commission but there is progress on workable focus areas.
  - They found that white findings were being over played. White findings are low risk so that adequate time is spent on low vs high risk activities.
- Not all the changes will make everyone happy, but they are trying to do what makes the most sense. And they still try to get a good stakeholder population and input from all of the regions with a senior advisory panel. Then they used a sharepoint site and external site for communications and 13 public meetings to date where they invited the industry, unions and concern groups. They didn't want to make changes and then have issues crop up in the last phases.
- Now they want to move to the next phase after using the lessons learned at the end of the June. There is another 60-day comment period that is about to start in the next few days where anyone can comment on ROP.
- A team of experts looked at areas where there was overlap and tried to find efficiencies or gaps. The result was changing sample size and hours.
- The definitions of White findings changed to be more clear that it's of low risk significance. For items of high interest there can still be a press release for white findings. For white findings they wanted to decrease the number of hours of effort required down to 12hrs. They wanted to encourage good performance by labeling findings white until they came out and inspected it, which was a change.
- They tried to make a white finding in EP (Emergency Preparedness) similar to other areas.
- They addressed overlap in the commission paper in June for the PI (Performance Indicator) program.
- The cross cutting issues program is hard to get good input out of, so they are trying to either do away with it, or fix it so that it's meaningful.
- Radiation Protection heard from the industry that ISFSI (Independent Spent Fuel Storage Installation) needs to be treated differently and expectations need to be clear.
- They've gotten positive feedback on where Appendix M has ended up and they feel pretty good about it.
- If Corrective Actions take a long time before the letter goes out, then it's hard to make corrections, so they are working on sending the communications out earlier.
- Looking about in the control room and out of the control room and how FLEX plays a role with Human Reliability Analysis.
- It is usually a couple year effort to get a PI (Performance Indicator) changed.

# ROP Enhancements

Larry Parker (STARS Alliance)

- He hopes to provide industry perspective on what Chris Miller discussed, and these are his opinions.
- Any fans of the SALT days? (show of hands, no one raised their hands except for Gene Kelly)
- When ROP was first put in place, performance indicators (PI) would have fewer green windows, now it's almost all green. This took a lot of work at the stations and there were lots of improvements made to get there. There were many proactive steps taken. The industry has earned some relief on the inspections.
- Contrary to what congress says in their letter, the industry has not gotten through anywhere near all the recommendations, but he feels we are at a good spot.
- The industry shares the same mission as the NRC and we look forward to making the process better and more efficient.

# Reactor Oversight Process: Minor/More than Minor Issue Screening

Leonard Sueper (Xcel Energy)

- The ROP has been very successful over the years and has improved over time as lessons have been learned. The same can be said for SDPs themselves.
- The first question might better be suited at the end of the list as a catch all.
- The second question the word potential can be problematic. Some of the other questions don't have any additional details about the intent of the question. It's possible to have a finding with no violation and vice versa.
- Even minor examples have an impact on a cornerstone objective.
- The questions and examples are intended to be complementary to one another. Now the inspectors answer the questions before reviewing the examples. The Appendix E examples tend to be treated very specifically. The examples are narrow and exact, but there are some common themes. The difference minor and more-than-minor would be there is the concept of consequence.
- Sometimes minor violations that continue to repeat can lead to a green violation.

- There is little guidance for a security advisor to determine significance.
- He does still believe the minor / more-than-minor process is the right way to handle things but there can be minor enhancements.

# SDP Observations...Time for a Change?

Gene Kelly (Exelon)

- ROP and SDP is a good process that continues to evolve
  - o Based on getting robust stakeholder input and we still see that focus today
  - Originally intended as a simple probabilistic framework but has gotten more complicated.
  - A lot of work at the green/white threshold are we really spending our resources smartly?
  - There are pros and cons of colors when dealing with PRA and does the public really understand what they mean?
- We are seeing that ROP has greatly improved but has flatlined.
  - Audience thoughts:
    - We will need to work harder to continue to improve which means that all obvious items have really been captured
  - We spend a lot of time and energy and resources on screening and determining the significance
- · Good idea to get in front of the process and make initial communications
- Have to understand degradation mechanism (FTR, FTS matters with exposure time)
- Good thorough root cause means everything in a case
- What's the message when looking at Green/white finding that is still 1000 times less than NRC safety goal
  - Margin of safety
  - o Look at other indicators to show improvement
  - o One part of the full picture
  - o Have to put it in perspective! Still a couple orders of magnitude from where real impact is to public health and safety
  - Spending a lot of money on things that are still low safety significance
  - Double work for utilities because PRA have to run both models (NRC and utility) and determine differences
  - Creates issues/questions
- Common Cause needs to be recognized as rare with big consequences
  - Important to understand
    - o A lot of dialogue about alternative approaches with regards to policy
    - Employ good common cause defenses in industry but no incentives but do that could really improve safety
- Performance improving doesn't just happen
  - In an unparalleled point of performance
    - o Creation of INPO, safety cultures, CAP, etc., that make the industry robust and safe with lowering number of findings
    - This is what excellence looks like
- Why does the industry fight so hard on white findings?
  - o So few of them that you stick out more if you get one and this is a business and you want a good profile for investors, etc.,
  - More than the finding itself
  - Time to rethink the idea of a white finding
  - The future is now room to improve the process
    - Do we use just the utility model?
    - Cases where fire is 90% of CDF contribution not realistic and something potentially wrong with the model and they need to be made more stable
  - NUREG 2178 is looking to improve
- Models are not meant to do SDP cases
  - o May have to parse out scenarios or manipulate model for a conditional assessment
  - Have to change model
  - A lot of work involved in SDP modeling
  - Shouldn't be risk based, should be risk informed
    - HRA is an area for improvement

# Q&A

Q1. SECY Engineering inspections - replacing one of FEIs; what's the latest info on that?

A1. It was never unanimous in industry. Sounds like a good idea but when you get into the details and look at unintended consequences, there are issues. A lot of work is being done by outside peers and consultants but we realize the pain of implementing it may be worse than the inspection. NRC not working on it unless they get something from the industry creating a model of framework for how it would work and want to pursue it. Pushback from various stakeholders. Industry is working on solution before they bring it to NRC. Not a major topic at NEI meetings – nothing active

#### Q2. Changes to be made be phased in or full change over?

A2. Minor changes to ROP over last 20 years – on hold until approval from commission. Wait for the vote and they may come back with different timeline. Will have to play it by ear. Changing definition of white finding – some have already been done. Other things like engineering inspection issues are commission driven and we are waiting for their decision

#### Q3. 60 day comment period - phase 2 or second paper?

A3. Yes – comments can still be coming in on docs already in the process and will be analyzed. Phase 2 hopefully will have more public interaction. Wide open for comments. Inspection cycles starting up and this needs to be resolved. Contingency plans if not closed up by January. Dependent on what comments are.

# Key Learnings, Recommendations, and/or Best Practices

There is too much focus at the utilities on white findings, and too many man-hours used for low risk items. The NRC has made efforts to reduce the white finding burden and overall the processes in place are good.

# Session Takeaway

There can be minor improvements to SDP/ROP, but overall this is a good process and it's moving in a good direction.

# Session 5: Regulatory Process Innovations and Innovation at NRC

Session Organizer: Everett "Chip" Perkins

The US commercial nuclear industry currently is under pressure to reduce operating costs and maintain strong nuclear safety performance while supporting costs are increasing at the same time. Since there will always be crucial work that needs to be accomplished, how can we solve this problem? The smart solution is to use less people to complete the necessary work more efficiently and effectively. In this session, we will explore examples where the industry and NRC staffs are using innovation to implement required business processes. Today's sophisticated, online technology allows for automated tools that more closely match business processes at individual sites and companies. Such tools enable fewer people to collaborate and cooperate to accomplish the same amount of work with more consistency, with fewer errors, and at lower cost. Customizable, state-of-the-art, existing on-line solutions can be modified without additional coding. They do not require software to be downloaded onto company servers or on individual desktops. Such solutions can be designed and implemented in months instead of a year or more. Some specific case studies, with the projected savings, will be presented.

# Innovation in Regulatory Inspection Management

Stephenie Pyle (Entergy)

- Talking about how Entergy uses CERTREC's IMS (Inspection Management System).
- CERTREC's tool simplifies and streamlines. You can also access the database anywhere and anytime.
- The report generation option is something Entergy utilizes; it has a link that is simple to click on. Sensitive information can be uploaded and at the end of the session it removes NRC access. Information can also be shared with other sites.
- The database allows the user to do searches for past questions and can see old responses.
- It was important to align with the NRC early so that it could be efficient for the team. She recommends that other utilities do this as well.
- Everything is available electronically which saves time and resources.
- (most of the information was on the slides)

# Regulatory Process Innovation at the NRC

Eric Banner (NRC)

- We are trying to modernize how we do our work. He is going to talk mostly about the mechanics and about how we get the job done.
- The old inspection reports were tedious and on paper. They should now save 10-15 hours per inspection report. Which over the course of the year is one full time staff member.
- There can be multiple users on the system at the same time, no more cutting and pasting, and the need to navigate between two systems has been eliminated.
- They engaged all the end users and experts. They tried to use existing tools when practical for specific capabilities.
- In the future they are hoping to link the system to their webpage as a future transition all at the push of a button.
- There is now the operator digital docket (ODD) which processes a large number of documents each year. The approximate savings now is 1000 hours and \$60,000 a year. Savings will eventually be triple that.
- They are continuing development for more operator improvements.
- They are trying to have a good system for a bunch of the work that they do. By having the right tools it enables everyone to take a look at how the processes are working and can make them more efficient. They've started laying the ground work for the system.
- They are looking for easy, simple access to the data and to be able to conduct business transactions with external stakeholders.
- They want to make timely risk informed decisions and a tool can help with that

# Innovative Technology for streamlining process and Navigating Regulatory Hurdles

Michelle Thomas (CERTREC)

- They've been in business for over 30 years now. They needed to be able to both host and protect their data.
- They host their own servers, off the cloud and on servers in Dallas, Texas.
- 4 9's means 99.99% uptimes. equates to 52minutes of down time total in a year
- The computing power on a single smart phone is greater than the power of the system on the Apollo 11.
- TAKTIX is better than purchasing existing software or purchasing customized software.
- TAKTIX is a web based application and there is no IT involvement or downloading software
- TAKTIX is like Legos, you can build it to be whatever you'd like it to be.
- You still have features similar to MS Word has which we love (ie. for spelling checks).
- We can do nothing, but we really need to embrace new technology and bring efficiencies into the work place.
- TAKTIX is meant to mimic our process. CERTREC says to give them your process and let them prove it in TAKTIX at no cost to you.

# NuScale's Implementation of TAKTIX(R) – A Case Study

Elizabeth English (NuScale)

- NuScale is a design company. NuScale should be about 62% the cost of a traditional nuclear power plant.
- NuScale uses TAKTIX for Design Certification Application (DCA). In a span of 3 years they've responded to more than 1900 RAI (requests for additional information) from the NRC all paperless. All managers work remotely and CERTREC supports them 24/7.
- NuScale is ~343 people and it works for all of them. A change to the model in TAKTIX is a simple call in to Michelle and it can be done by the end of the day.
- It helps cut down on operational and staffing costs and reduce errors. They have a living DCA which is unusual.
- TAKTIX can hold much larger documents than their in-house capabilities before.
- TAKTIX saves time, money and the environment and helps them move quickly through the DCA process. And it's very customizable.

# Q&A

Q1. What would you consider to be the radical differences between legacy software and TAKTIX?

A1. Michelle – The involvement of IT. Software has to have a large IT presence which is cumbersome. With a web based application they can upgrade constantly and avoid cumbersome IT processes.

Q2. What barriers to progress have you experienced with upgrading?

A2. Eric - Some of the benefits are intuitively obvious, and they needed to make sure that they had the right people involved in the process. You need to make sure there is discipline in how you use it to avoid barriers.

Q3. Will this speed up your processes?

A3. Eric – There is lot more customizable schedule and a fairly even distribution of items being done very quickly. The vast majority are done in 10 months or less. The tool helps identify the pinch points in the system.

Q4. What can you use it for beyond just NRC inspections?

A4. Stephenie – internal self-assessments, INPO audits.

Q5. Can IMS enable NRC inspections to be done remotely?

A5. Stephenie – Yes they can upload and view information remotely. Eric – for a lot of the inspections that are done out of the region you'll get more of a hybrid where you can really focus your onsite time

Q6. DOE has online event reporting, is the NRC looking at that? A6. Eric – I don't know. Person in the crowd – The NRC doesn't currently have that, but it is a possibility. It's done in other ways but there is a lot more to do with it.

Q7. If I want to create a new system that does Inspection Reports, do you all have to do sprints and the utility needing to send you procedures? A7. No coding involved, so to time to deploy is much smaller. A web specialist can very quickly create something or change something in the system. Some clients make changes themselves.

Q8. What sort of challenges did you face with the deployment?

A8. Elizabeth – change is hard. Before it was word document processing and people were very attached to that. But now it's all PDF. They sold it because it's a huge benefit for configuration management. The biggest challenge is getting people sold on the idea of it.

Q9. Is CERTREC output the final document in PDF format? A9. Elizabeth – Yes it is. And it assembles the reports for them which is why they only need two licensing employees.

Q10. So the permanent record, where does it reside?

A10. Elizabeth – It resides both in the Dallas servers and at NuScale.

# Key Learnings, Recommendations, and/or Best Practices

There are cost savings and organizational savings when you use the customizable web tools CERTREC creates with TAKTIX.

# Session Takeaway

TAKTIX is radically and demonstratively changing how we do our processes. Using advanced web based technology can improve our processes and cut down on operational costs.

# Session 6: Regulatory Innovation for Resolving Tornado Missile Protection Issues

Session Organizer: Ken Lowery (Southern Nuclear)

The nuclear industry has been challenged with legacy design issues where the regulatory requirements, as applied in the post-Fukushima era, have in many cases resulted in significant capital expenditures. The NRC issued Regulatory Issue Summary (RIS) 2015-06, Tornado Missile Protection, on June 10, 2015 stating that there have been several instances of plants that have been identified as not being in conformance with their tornado-generated missile licensing basis. The nuclear industry has been working with the NRC to develop innovative, simple, and cost-effective options to resolve legacy design issues related to tornado missile protection. These options include the following: (1) development of the tornado missile risk evaluator (TMRE) and pilot plant implementation and approval of TMRE via the license amendment process; (2) post-pilot plant implementation of TMPR via the 50.59 process; (3) clarification of the licensing basis; and (4) re-evaluation of the plant configuration for tornado missile protection against the UFSAR, initial safety evaluation report issued by the USNRC, and any other NRC approvals, exemptions, or regulations. This session will explore these options for resolving tornado missile protection issues and provide a forum for discussion with industry and NRC experts.

#### Regulatory Innovation for Resolving Tornado Missile Protection Issues Chris Miller (NRC)

• We got into the requirements to make sure the SSC (Structures Systems and Components) can maintain safe shutdown.

- In the past utilities have used the deterministic approach in their analysis.
- In 2015 now it is more of a risk based approach where we look at probability and initiating event frequency, and core damage frequency.
- In 2015 there were many examples of how the previous analysis wasn't done completely right, and we're spending a lot of time and money on things that are not significant risks. There were also multiple examples where people weren't meeting their tornado missile requirements.
- The NRC decided this was a prime candidate for risk evaluation after doing a study where they found the tornado missile risk was no greater than 4e-04. This was a bounding assessment. FLEX equipment can also be used and that wasn't always accounted for. The NRC said this is really not worth all of the effort we are putting into it. A memo put out some more relaxed timelines for completing modifications.
- There was a lot of work still going on. They are trying to get to the right amount of work that has commensurate requirements to the safety risk, and the risk is very low.
- There are commitments under Appendix A that are not to the standard of the new Appendix A as it's written now.
- Keep as close as you can to the pilot application language and the NRC can do a speedier review. You don't need a lot of bells and whistles.
- Since it's low risk significance they are counting on a quicker review process.

# Harris Pilot Implementation of Tornado Missile Risk Evaluator (TMRE)

Jordan Vaughan (Duke Energy)

- Duke did a scrub of all the documentation and performed walkdowns to make sure we were in compliance or put in compensatory measures.
- There were over 20 nonconforming conditions that were put into the corrective action program and they started looking at options.
- Tornado Missile Risk Evaluator (TMRE) was a joint effort between multiple utilities. TMRE is outlined in NEI 17.02. Step one is to perform walkdowns, step 2 is to come up with SSC failure probabilities, step 3 using the PRA model and calculate the baseline delta for CDF (Core Damage Frequency).
- There were lots of internal reviews and the LAR (License Amendment Request) was submitted in 2017. The reason for the change was that there were so many nonconformance items, and Duke wanted to avoid costly mods.
- Risk based is not the whole story for Duke, it's Risk Informed, so it has deterministic principles as well.

• There were weekly phone calls to see if there was anything that could expedite the review. The SE (Safety Evaluation) was issued this year and now it's in the UFSAR.

# Understanding and Clarifying TMP Requirements of the Current Licensing Basis

Christian Williams (Exelon Corporation)

- Each plant did a specific review of their licensing basis after the RIS 2015-06 letter was issued.
- Originally there were 9 sites with nonconforming conditions but then were able to get it down to 7.
- Anything that was analyzed using the SEP was not licensing basis (Systematic Evaluation Program). This was an evaluation of safety against a new standard.
- Dresden Unit 2 SEP happened between when the license was submitted and when it was approved. This is an ongoing dialog with the NRC.
- TMRE was opened up to have 50.59 applied to it.
- They believe the NRC recognizes that there are two different failure modes for equipment, crimp and crush or complete loss. This difference allowed them to take two units out of the nonconforming state, which is a good cost savings.

# Tornado Missile Protection

Ken Lowery (Southern Nuclear)

- Showed an image of an example of a tornado missile.
- If you have 6 non-conformances you are looking at \$10M in changes.
- We can utilize TMRE under 50.59 without submitting a license amendment for accept-as-is items.
- Guidance should be issued soon after a meeting in September with the NRC.

# Q&A

Q1. Big distinction between crimped vs loss. Is it explicitly lost or just a loss of function?

A1. Christian – it's an explicit loss because the function isn't lost if the pipe is removed for an exhaust pipe because the pathway isn't blocked.

Q2. What is the payback for mitigating the issues rather than mods?

A2. Ken – Can't really quantify. It's got to be millions of dollars. TMRE cost about \$500k. TORMIS model is about \$1M. Jordan – TMRE was chump change, it probably saved millions.

Q3. If there is a nonconformance and we are trying to resolve through 50.59 without NRC approval. How does that get done through an NRC process? A3. Chris – the letter from the NRC, and if it's an actual nonconformance. With 50.59 if you can say that you are still in compliance and you've evaluated the delta then it could be fine. The letter from the NRC gives three different options on how to sort it out.

# Q4. Can you talk about back fit lessons learned?

A4. Chris – We talked about the risk and the enforcement. They were about 2 years apart. In 2015 if we had a good risk evaluator hat on, then the language would look a little different. There is movement at the NRC to not have to look at low risk significance items as closely. There is a new wind blowing and it's important if we are really going to be risk informed. We need to spend money and effort in the right places.

# Key Learnings, Recommendations, and/or Best Practices

Many plants had non-conformances for tornado missiles which is a low risk item. Utilities are using TMRE under 50.59 after guidance in a letter from the NRC.

# Session Takeaway

Using the 50.59 process for TMRE is a new approach some utilities are planning to use for tornado missile non-conformances. The NRC is moving to be more risk informed and not put so much time and money into very low risk items.

# Session 7: No Regulatory Relations Session 7

# **Risk Management**

# Session 1: PRA Models: Extracting Actionable Insights

Session Organizer: Greg Zucal (Jensen Hughes)

PRA models have become increasingly important due to the adoption of risk informed programs at nuclear power plants, however the ability to extract insights is becoming more challenging as the models become more complex by including additional hazards. Additionally, what constitutes "insights" from a PRA model is not necessarily clear. CDF/LERF metrics, basic event importance measures, high risk fire areas, and other immediately available data provide meaningful insights, but how can we leverage the PRA model to obtain other actionable insights? The PRA models represent a uniquely integrated model of the as-built and as-designed plant response to various plant challenges and therefore it is prudent that we look for new or improved ways to extract actionable insights. This session will explore innovative tools and methods developed to help better interrogate PRA models, and provide some examples of the insights obtained.

# PRA Model Insights ... Introduction

Gene Kelly (Exelon Corporation)

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- Direct 1:1 and we never stop learning more about insights and how they can improve our plants
  - How do we find insights and what do we do with them?
    - Vast amounts of information and detail, but not intuitive have to dig in a smart way to get the insights needed to improve
      operations
    - Not just a number interpret cutsets in a "smart" way but it's not obvious
    - Have to have realism for accurate modeling
- Study on Battery load shed
  - Number of plants with same issue to solve
  - o Looked at numerous options to get power back to battery chargers and gave insights on deployment of FLEX generators
  - Able to make recommendations to plant management based on study
- SDP
  - Things that may not be important in internal model are now important for SDP use sensitivity studies to improve reliability
     Looking for relatively simple changes to bring to a PHC as low cost improvements that have a big positive impact on safety
- Lots of specific fire models across fleets
  - Complex models but are so specific that insights can tell a user which individual cable tray/cabinet/circuit is the most important
     Powerful information in the model that we need to determine how to use it to lower risk profile and actually improve safety of the
    - plant
      - Electrical really drives fire risk
      - NUREG 2178 has promise for realistically modeling electrical cabinets

# What Insights Should We Expect from PRAs?

CJ Fong (US NRC)

- Focus on insights that help collectively make smart decisions
- Continuously collect data and challenge models to ensure errors aren't being introduced to improve PRA models and gain further and better insights
- Used PRAs primarily to find plant vulnerabilities
  - Could not make generic insights across industry or fleet because some plants didn't fit in with the others on some aspects and others didn't fit in in other areas
- Apply modern tools shows that risk profiles vary among plants and show different drivers to risk
- NRC needs to use this information to determine what to look one size inspection does NOT fit all
- NEI-18-04 is framework for advanced reactors
  - More likely transients have very strict dose limits and as likelihood of accident goes down, "allowable" dose limit over 30 day period after event goes up
  - o This process starts and ends with risk rather than retrofitting risk insights to deterministic analyses
- Risk Management at fleet level
  - Licensees should look at "most bang for their buck" for improving risk across fleets
- Can use PRA models to determine level of defense in depth by looking at insights from interpretation of cutsets
  - Cutsets with 1-2 basic events may need improvement and DiD can be applied
    - o Cutsets with higher numbers of BEs can be argued to already show DiD
- Common cause can exacerbate failures
  - Can be difficult to communicate
  - Analysis can be complicated
  - Total risk going down over time
    - Some due to modeling changes or actual improvements
    - Trending in right direction but can't oversimplify lots of moving parts and that can complicate communication of risk insights

# Compare Risk Insights from IPE to Current PRAs

Bob Rishel (Duke Energy)

- More analysis in current PRAs vs judgement from IPE/IPEEE
  - Plant vulnerabilities identified were obvious from IPE
  - Continue to reach back to IPE for insights to improve margin and safety
- Need good analysis because you won't get the "right" answer with average or subpar modeling
- Still room for improvement in current models as current analysis is too conservative or not thoroughly explored
  - Reality vs. capability to be modeled may not be equal
    - Lack of knowledge of actual response contributes to conservatism because insights are based on predictions of response based on known response to similar events
  - Near impossible operator actions became plausible with research and improvement of models
- Risk of plants is generally trending down but is not smooth or linear

 Addition of new models (fire, seismic, etc.) can increase risk but new modeling techniques or new data can contribute to overall lower risk

# Application of Internal Flooding PRA Insights to Improve Plant Safety Steve Mongeau (*Entergy*)

- State of knowledge changes can change total CDF contribution
  - Specific analysis of most contributing flood area to CDF
    - Had to develop strategy to address issue and reintegrate into PRA for more insightful results
    - o Larger pipe breaks may auto start second fire pump; 2 fire pumps running in parallel sending more water to break
    - Fire suppression of some kind is needed so elimination of wet pipe was not an option
    - o Looked at actual components for critical submergence depths, etc. rather than assuming any water in area failed component
    - o Can run sensitivity cases in GOTHIC or other thermal hydraulics modeling software with different size breaks to screen out
      - Assumed plugged and not plugged floor drains not extremely effective in either case
      - Looked at drainage under door gaps and dp across doors opening them to relieve and equalize pressure/amount of water
         Can see how much time before critical depth is met
      - Insights used to develop new internal flooding AOP to mitigate things like second pump start on low pressure operator is directed to determine if no actual fire then stop pumps
      - No sensitivity studies conducted on break frequencies
      - Scenarios were parsed out based on consequences
      - Can find importance measures from cutsets
      - Overall improvement in contribution of this flood area to overall CDF
        - Plant safety improved

# Fire PRA Insights Using Tesseract

Greg Zucal (Jensen Hughes)

- Didn't go with a traditional sensitivity study wanted to see the risk contribution for each component analyzed
- Dependencies are hidden and there's too much data
- Need to look at cutsets from different perspectives
- Tesseract allows browsing of cutsets and fault tree
  - Looks at how often logic propagates through tree
  - Recovery of critical participants for importance measures
- · Tesseract analysis required mapping for fire-induced failures and power dependencies
  - Mapped directly to fire induced failures
    - Created dependency events to map to
- Ran sensitivities on high value, minimal cutsets
  - Looked at delta CDF, Participating and Critical altogether for insights
    - Look at plant modifications based on sensitivity results
  - Can apply potential risk benefit for crediting operator actions not currently modeled
- · How do we build models differently if we knew we were going to ask a computer to browse the tree for insights
- Tesseract inserts additional logic to measure PI and CI

# Q&A

Q1. Rationalist view use of PRA - is there something to be done for DiD?

A1. 1.174 rewrite - expanded definition of DiD for more disciplined view of it. Have to be able to explain in licensing space of 7 elements of DiD.

Q2. What has been the biggest challenge when communicating/translating insights for actual change?

A2. Bring to PHC and they are very open to it, but other initiatives are always taking precedence. Quantify savings (what can it help with?) and get a sponsor for it. Reinforce idea of walking through scenario – event trees may be common ground for communication. Acknowledge we don't know everything and that there always are ways to improve the safety of the plant and lowering risk. ALL ABOUT COMMUNICATION. Have to overcome perceived challenge of idea of risk informed being multi-year endeavors. Need to highlight successes we have. Look at other benefits in addition to safety such as using PRA for target sets review.

# Session Takeaway

Risk insights are vital to improving plant reliability and safety – new techniques are being created and refined to gather more in-depth insights to better support modifications and risk informed decision making.

# Session 2: See Operations/Ops Training

# Session 3: Risk Informed Decision Making

# Session Organizer: Fernando Ferrante (EPRI)

Participants: Fernando Ferrante (EPRI), Jeff Stone (Exelon Corporation), Mike Franovich (US NRC), Bob Rishel (Duke)

Risk informed decision making (RIDM) is a philosophy whereby risk insights are considered with other factors to better focus attention on issues. An integrated RIDM process provides an objective means to assess the safety significance of regulatory issues, plant design and operational issues, and effective risk management. Such a process uses insights from PRA models - more valuable than just the numbers - but not intended to supplant deterministic requirements. PRA tools provide the capability to measure the residual risk and implementation of risk informed applications serve as a foundation to enable the broader use of RIDM. This session will explore how we can break down the barriers to effective RIDM and provide innovative examples on how to move forward on areas that have been challenged with deterministic, non-RIDM aspects, which may require different, innovative approaches to RIDM implementation. A panel will focus on how to move forward, in the spirit of current transformation-oriented initiatives, to achieve a modern and flexible integrated approach to decision making.

#### Risk Informed Decision Making (RIDM): Breaking the Barriers Femando Ferrante (EPRI)

• Complexity of the model is adding to the complexity of maintaining them and gaining insight in a straightforward manner

- Low hanging fruit has already been picked, so more work is required to find more risk insights that are impactful
- · Risk informed may not mean the same thing to every person who utilizes risk insights

# Risk Informed Decision Making: The Journey Continues Mike Franovich (US NRC)

- NUREG-1855 deals with key assumptions and uncertainties
- Issues and challenges were addressed directly
- Can use risk insights to grade the level of review of licensing documents
- Some issue resolution requiring too many resources for level of safety significance of issue
- Strong interest for risk informed information
- New Reactor Licensing
  - Redesign licensing basis
    - Core feature: integrated decision making process to look at DiD, safety measures, and PRA for a full picture of risk insights
    - Other approaches such as importance measures to determine/grade level of effort for new LWRs, but need to change for advanced reactors
  - Forward fit: what is the burden and is it justified? Can't just have "good" ideas need to analyze all aspects of plant changes to determine if modifications are truly worth it

# Directions for Risk Informed Decision Making

Doug True (NEI)

- Industry performance has been phenomenal
  - US Nuclear Industry has been described as highest performing industry in the world
- Margin and Transformation
  - NRC Safety Goal Policy: How Safe is Safe Enough?
  - Set the goal for safety not all plants may have met that goal initially
  - Focusing on what's risk significant and that drives down CDF and performance improved
    - Using PRA proactively to improve performance and/or design
    - FLEX not yet addressed as how it will affect safety margin
- Increase in plant trips predicted may not be indicator of declining safety performance or increased threat of harm to public
- Margin is more significant than initially understood
  - Need a process to maintain current margin to NRC safety goal
  - More margin could mean that fewer things should be significant
  - Commission decision took single failure criteria and modified it to allow risk insights to affect what is analyzed

# Risk Informed Decision Making from Duke Energy perspective Bob Rishel (Duke)

- Dan River coal ash issue started a company-wide RIDM process for all decisions at Duke for safety and economic interest
- Plant specific experience draws from industry experience as an input to risk of activity
- Fire is approximately half of risk for Duke plants
- Internal events misses a lot
- Continue to challenge first answer to ensure full picture is seen and risk is adequately understood for activities
- Conservative is easy and cheaper but leaves out important considerations
- PRA can't exist by itself and deterministic can't exist by itself need both to make good decisions
- Case Study
  - Question accuracy of wiring is it correct and if something goes wrong, do drawings reflect what will be affected?
  - Could result in unplanned consequences example given was that Duke found they had two "#1 relay wires" that were not both accounted for in the drawing and caused issues

# Risk Informed Decision Making: The Exelon Perspective

Jeff Stone (Exelon Corporation)

- Thought process and reality has changed over the years for what is important and what areas are being focused on
- Multiple ways Exelon operates in RIDM process at all times
  - Generic risk assessments have prevented need to go to cold shutdown
  - o Missed surveillances can be mitigated by extending surveillance using risk insights
  - RICT reduces stress looking to implement across fleet
  - Focus on the right equipment all of the time
  - Fleet application for Barriers for Initiative 7a application
  - In Service Inspection (ISI) is saving a lot of money and focusing on the right items
  - o Integrated Leak Rate Testing (ILRT) extensions and Tornado Missile Evaluation (TMRE) are being looked at in the right way
- NRC has been open minded with looking at how risk insights can affect RIDM
- Risk initiatives are important and resources are being applied to deal with them
  - Large benefit if done properly

# Q&A

Q1. Why do we not focus on plants from a risk perspective rather than approaching them as a whole, specifically for things like arc flash? A1. Project plan itself is risk informed, but with engineering issues it may get broken down into individual hazards rather than looking at a top down direction and the big picture is lost. Programs like FLEX still have potential to be optimized to accommodate more testing for arc flash and response. A lot of room for more dialogue. Risk has been part of equation, especially with frequency of this type of event, but there's more work to be done. NRR does not want research to become plant-specific, want to be able to apply across industry with RIDM process. Many issues that were initially seen as risk significant were determined to not be anymore, so we were able to move back to RIDM. Understand risk significance at front end of process is the right way to approach it for issue resolution and potentially see cost savings. Need consensus on issues between utility and regulator for scope, level of significance

Q2. Expanding RIDM – is it wishful thinking to expand RIDM to the perceived/hypothetical levels that others in the industry believe that RIDM can be applied to?

A2. Have the right people involved but it's still evolving – still determining what are success paths. Have to spread the knowledge – it won't always be a PRA person doing the work, will be multi-disciplined personnel performing work but is foreign to a lot of engineers and we need to hurdle that gap for this to work in applications that affect other areas. Need to do better at knowledge transfer to break down silos. RIDM is fickle – it comes up and people latch on to it, but may not be exactly what RIDM is meant to do. Cyber and Security are some examples – work can potentially be done to reduce the scope but to risk inform using PRA may not be correct application. Industry may make its own mess by jumping to RIDM

Q3. Any ideas about Risk Informing the research that NRC does? (such as consequence analysis for Spent fuel pools) A3. It's going to take a systematic approach and sitting down line by line to look at prioritization of work. May be in a better position if PRA came in and looked at items to determine what can be gained from risk insights and prioritize that way.

#### Q4. Is PRA just not the right tool for Digital I&C?

A4. PRA may not have a particular role in several programs including Digital I&C. Did studies to find physical margin for need of RIDM. Potential need for policy changes with regards to this stopped many efforts. Big question is "what do we mean by risk-informed"? It may not be just PRA – need a blend of strategies for the full picture. Need to draw the line and utilize PRA for what it's good at. Have to be more careful about we use the term "risk informed"?

# Session Takeaway

Risk Informed Decision Making is developing into a valuable tool at plants for utilizing risk insights from PRA models, among other information including deterministic analyses, to see the full picture of activities are understood and adequately managed.

# Session 4: See Regulatory Relations

# Session 5: See Business/Economic Performance

# Session 6: Flex Human Reliability Assessment Advances

Session Organizer: Bruce Morgen (EPM), Jeff Julius (Jensen Hughes),

FLEX is now fully deployed and available for use, providing important defense in depth capability for a variety of scenarios (not just ELAP). Training has been provided, the equipment is being tested, reliability data are being compiled, and we are incorporating FLEX into our base PRA models (internal events, fire and seismic), to accurately reflect the as-built/as-operated plant. However, assumptions for component reliability and human action remain in debate and have been challenged. There exists considerable skepticism in certain circles about the reliability of portable equipment, the success of the operator actions to deploy FLEX, and the actual declaration of ELAP (decision and timing). Industry has invested considerable resources to develop FLEX capability; we should expect a reasonable return on that investment, including realistic and innovative risk benefit. This session will explore innovative tools and methods developed to help better incorporate FLEX into our PRA models, discuss recent estimates of human error probabilities, and provide examples of the insights obtained.

# Advancing FLEX HRA

Jeff Julius (Jensen Hughes)

- Looking at different options of how FLEX is plugged into the PRA
- Portable equipment prior to FLEX was already being incorporated in the past for use
- Risk has a range of impact depending on the site
- May have more of an impact in internal events or seismic depending on location and design, etc.
- Seeing there are other places that FLEX equipment can be linked to plant procedures
- Used same method as control room HEP determination
- Treat it as any other human action and use HRA calculator to determine HEP
- Success Criteria was nothing short of 100% success (e.g. if 100 bkrs need to be load shed, but only 98 accomplished, normally would be a
  failure)
- Concept of what an HRA is for and how realistic is it
- SPAR-H doesn't have a way to approach recoveries
- Command and control not a big HRA contributor
- Resource management in FLEX may be an issue and is an uncertainty in FLEX HRA
  - HRA may be overestimating challenge of ELAP declaration
    - Need to understand consequences of declaration
    - Make it idiot-proof

# USNRC Activities to Improve HRA for FLEX Strategies

Mike Franovich (US NRC)

- Word cloud looks at focus areas of HRA not scientific
- Need a repeatable, predictable, and realistic approach
- NRC uses SPAR-H
  - Researchers have to come up with a more unified approach to HRA
  - Looking at different literature for cognitive basis of HRA in NUREG-2114
  - No limitation on use unknown if can be used in HRA calculator but should be publicly available
  - Has flexibility opportunity for optimization in non-Fukushima type scenarios
  - EPRI working on integrating new methodology into HRA calculator but only where it will be most beneficial
- SACADA offers sanity check
- Did not complete benchmarking and scenarios were limited for IDEAS-ECA (ECA = Event and Condition Assessment)
- Stations are differing on use of FLEX equipment

- Some use on a more regular basis for shutdown, etc. for familiarity
  - Others do not allow any use except FLEX scenarios
  - Sites were concerned
- o Some use of FLEX equipment has made difference in risk confirmation of value proposition
- Both sides need to be open minded and look into expansion of use of FLEX equipment
- Get the right experts from both PWRs and BWRs to explain views on how and why certain things were implemented
- At least one of the cases needs to include a visit to the plant broader more integrated approach than just a tabletop exercise
- Schedule is demanding for implementation of IDEAS-ECA

# PWROG HRA Efforts – Past, Present, and Future

Roy Linthicum (Exelon)

- Strong technical basis for what and why certain responses and operator actions were analyzed for use
- 16-08 talks about using portable equipment for other uses besides FLEX (use for outage, etc.) and be able to take credit in the PRA
- RG 1.160

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- PWR fleet standard was to put it in EOPs during ELAP
- o Maintenance Rule doesn't tell you how to do maintenance, it monitors effectiveness of maintenance
- Can use FLEX wherever you want as long as it doesn't impede EOPs
- Risk Beneficial Operator Actions (OA) where does it make the most sense to stage FLEX equipment to get most bang for buck
   Given OA, where can we use insights from how we model HRAs to get more credit in EOPs
- Still need to collect more data for Reliability Data for FLEX equipment due to late implementation times from some sites
- Shooting for realistic results
- Want to use more than just FLEX equipment want to leverage benefit of all the money that was spent on FLEX equipment

# HRA for FLEX: An EPRI Perspective of Past, Present, Future

Mary Presley (EPRI)

- FLEX and PRA has evolved to working together more to utilize risk insights
- Report meant to be used as an index to find variation that most resembles your plant to find guidance that will best guide plant for modeling
- In 3 stages that are distinctly different for operation of equipment
- Webcast training offered by EPRI on document
- FLEX was intended to be flexible and not prescriptive
  - Should be able to account for conditions at that time
    - o But we like to idiot-proof things to get credit
- Needs to be a balance in level, frequency and understanding in training to help operators make better go-no go decisions
- Have to look at bigger picture
  - May miss small actions
    - But overall action is successful
- Understanding what factors lead to failures vs time elongation
- Don't know what to do with a gualitative or semi-guantitative approach
  - Need forum to hash out details of issues that utilities are seeing trying to credit
    - How do non-quantitative guidance fit in with the PRA Standard, etc.
  - Once you get far into the scenario, you could hit the "floor" where you model beyond what you should and will limit credit
    - Justification for realistic use of qualitative/semi-quantitative approach

# Q&A

Q1. Qualitative approach is challenged because it might not meet interpretation of ASME Standard.

A1. Standard doesn't say you can't take credit, but looking for a bounding, simpler approach. When it becomes important and is worth refining, then you go after scenario. If you're close to threshold/at threshold/LAR should be able to qualitatively say that utilizing FLEX will drive down overall risk. Reasonableness check from standard doesn't have a structure or guidance for qualitative analysis. Don't credit operators' ability to be creative or take strategies to buy time.

# Session Takeaway

HRA with FLEX equipment is still in flux and there are differing views of how to address, calculate, and treat HRA information, as well as a general lack of data for use in updates.

# Session 7: Data Collection: Methods and Model Impact

Session Organizers: Owen Scott (Southern Nuclear), CJ Fong (US NRC)

Accurate data is critical to PRA models. With over 4000 reactor years of operation in the US fleet, the risk management community has more data (e.g., component failure rates, initiating event frequencies, recovery curves) than ever before. But are the models themselves actually "better"? This session will explore how data collection methods impact the accuracy of PRA models and – more importantly – the ability to make risk-informed decisions. Specific topics include: modeling of FLEX, recent trends in initiating event frequency and component reliability, the impact of Maintenance Rule 2.0, proposed changes to MSPI and 50.69 considerations. The session will explore how this data is used for regulatory decisions, difficulties in compiling reliability data, and progress with failure recovery models. A new repair approach will be discussed, as well as lessons learned from the newly developed Methods Peer Review Process. Finally, the session will address improvements in data monitoring for risk-informed applications (SFCP, RICT and 50.69) and other uses of data that allow us to get more information from our models.

#### Equipment Performance and Monitoring Strategies CJ Fong (US NRC)

- We might have a problem but want to get feedback on where we are and where we're going
- Positive changes are coming in world of risk
  - Utilizing risk insights to drive performance and use programs like RICT, etc.
  - We have to be mindful that NRC is still gathering data and still needs data from the industry

- Changes in programs like MR (Maintenance Rule) MSPI (Mitigating Systems Performance Index), etc., could change the type and amount of data collected
  - o Collecting different or less data is a licensee benefit
  - Not a benefit for NRC with less data points to analyze and input in SPAR models
  - SPAR models are used for generic issues that licensees may not be aware of, not just PRA inputs for SDPs
    - Having standardization of data across industry will really help
  - NRC practices RIDM using SPAR models
     Inputs feeds into database which feeds into SPAR models
    - Data from a lot of different places
    - Key pieces of data may not be available with new programs
- "Data" Rule is not well known
  - o Potential regulation proposed by NRC staff to require data from licensees
  - o Industry agreed to voluntarily send data information
  - No PRA data regulation as a result
- "SECY" papers are written from NRC career staff to commission, "SRM" is commission response
  - SRM response to SECY 97-101: If at any point staff is not getting enough data for PRA models, come back to commission to determine further action
    - Potential that industry is getting to that point unintentionally
  - Some numbers are explicit, some are inferred, but information is reasonably accurate
- New programs could shrink pool of data being received by NRC
  - Need to work together on a solution
- As long as NRC is happy with how INPO 12-009 is laid out, then feel confident that NRC is getting the info it needs
   INPO 12-009 is paid for by NRC

# Update on FLEX Data

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# Roy Linthicum (Exelon Corporation / PWROG)

- RG 1.160 allows us to take credit for FLEX in the EOPs without putting equipment in Maintenance Rule
- If risk is dominated by LOSP, bigger benefit for using FLEX equipment than if other contributors dominate (like SBLOCA)
- Owner's Group took over effort to develop data from EPRI
  - Lesson: if EPRI thinks it's too hard, may be a challenge to develop and complete
- All FLEX equipment at plants is somewhat modified need to investigate to see if it impacts failure rates (next phase of project)
- Estimated values for demand and run hours for equipment or plants with little to no real data
  - Probably will underestimate demands (conservative)
  - o If plant uses equipment for other purposes, can use info and include it
- Typical failure definitions may not work for FLEX equipment
  - Ex: most FLEX equipment not run for an hour (FTR (Failure to Run) criteria)
    - No minimum run time in FLEX data
- Getting close to finalizing first report
  - . Recommendation: Don't have sites do screening, give all CRs and information to Owner's Group
    - Some sites are sending all CRs, others are sending raw data dump
- No numbers in graph

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- Substantially larger failure rates for FLEX equipment compared to NUREG rates
- Expected to reduce based on internal review
- FLEX may not have been implemented at stations for very long, affecting data
  - 1-3 years depending on site
    - Not enough data to determine is lessons learned from initial implementation is correct
- Next update scheduled in 3-5 years
  - Recommend end of 2020 to start collecting new data
- Overall: just need more data
  - Working on prior values
  - What about vendor info on reliability? May be too optimistic and not being used
  - Need consistent data
  - Owner's Group wants raw data
    - o Don't have demands and run hours and it will take a while to develop all of that
      - Not reported through INPO system
        - Cost involved
        - NRC doesn't care how it gets to them, as long as final product is able to be independently verified and is accurate
      - Audit in mid-September with major changes from draft reports
    - You would think FLEX owner would be keeper of info but is not necessarily the case, so sometimes data is difficult to find and collect
- Incorporating FLEX has been compared to Fire PRA
  - o Complicated
  - Not straightforward
- Having more data may not improve numbers
  - Variability introduced with larger set of numbers
  - o Limited data could also be a hinderance to reduction in risk numbers
  - Larger pool of numbers may increase uncertainty
- Looked like failure rate was higher than expected
  - Have we looked at the cause and drivers?
    - Don't have enough data, no owners of equipment, lack of education on equipment operation.
  - More run time may flush out bad initial data be able to discount early failures that may be due to infant mortality, etc.
- Industry looked at military data for similar equipment to indirectly influence prior value, but may not be directly applicable to FLEX equipment due to environment

- Intent that report will be set of generic priors (rather than current NUREG 6928 values) and plants will do Bayesian updates with plant specific
  data
- Owner's Group thinks declaration of Extended Loss of AC Power (ELAP) needs to be adjusted to utilize and take credit for FLEX equipment
- Working with NRC with a goal of more similar information
- Guidance may not be interpreted the same across industry
- Maintenance Rule 2.0 eliminates Performance Indicators
- Failures are all still being reported to INPO, but Low Safety Significance failures will not be reported on same frequency
  - Mitigating Systems Performance Index (MSPI) is plant specific
    - No real comparison between plants
    - Looking at getting rid of program and using CDF trending
  - MSPI reports unavailability
- Need a better way to collect data
  - Want to reduce burden, not shift burden
  - Have to use innovation
  - For some investment upfront, can work to reduce overall burden

# PRA Data for Risk Informed Program Updates and Performance Monitoring

Owen Scott (Southern Nuclear)

- Industry wide initiative to try to standardize Ops log entries to help with tracking equipment unavailability
  - CDF trending could provide insights to determine areas of concern
    - Compares real data to average CDF, zero maintenance CDF, and PSA applications guide (EPRI TR-105396) CDF
    - o Can evaluate what SSCs are contributing to "peaks" and evaluate what to do about that info
    - Could also show that model doesn't reflect recent plant experience does model need to be updated?
    - May need a workshop
    - Keep the discussion going on benefits
- Doesn't take into account advanced reactors

# Q&A

Q1. Are we seeing downward trend in failure data with what we have received (i.e. is data getting better?)

A1. First data dump may not have been representative because FLEX hadn't been implemented for very long. May still be getting a large number of CRs that are being submitted due to unfamiliarity with equipment. Can do initial screening based on title of CR, then evaluate full screening. Cost is shared amongst all utilities.

Q2. Could you expand data pool to include B.5.b (Mitigating Strategies Requirement) equipment?

A2. Possibly, right now just want to get through initial dump. There are similarities but it's not quite the same.

Q3. Did you look back at existing generic priors?

A3. Yes, but didn't work on that personally.

Q4. Do you think ops logs and eSOMS logs are getting better now that you have RICT, etc.?

A4. Interface between current tool and eSOMS logs are not being utilized. Operators using Phoenix directly. Industry wide initiative to try to standardize Ops log entries to help with tracking equipment unavailability

#### Q5. Does anyone audit Maintenance Rule a(3)?

A5. There was a review that NRC wasn't yielding many findings, so they discontinued. What you might see is "soup to nuts" MR inspections at a site. Early on saw a couple issues and industry fixed them and performance improved. With a whole new program, may see some oversight until NRC has confidence that program is being implemented properly. Now that you're using PRA to run plant, will see more attention

Q6. NEI 18-10 – exposure/level of awareness? Is there value of having some type of engagement on what's going on in this area to elevate awareness? A6. That's MR 2.0, but that hasn't been submitted until demonstration, but still pursuing CDF trending for use in applications.

# Session Takeaway

Improvement in risk insights from enhanced PRA models and advances in data have sparked new programs such as Risk Informed Completion Times, 50.69, and improvements in Maintenance Rule and MSPI, which now allow the industry to collect less data. This could lead to issues with the regulator created PRA model and treatment of data updates with regards to FLEX equipment, CDF trending, and collection of data itself.

# Technology and Innovation

# Session 1: Innovation from the US and Canada National Labs and Academic Research of Nuclear Industry Trend

Session Organizer: John Downing (John Downing Consulting LLC)

Since 1946 the seventeen United States Department of Energy National Labs have been the innovation engine for the commercial, peaceful use of nuclear power. These labs, and especially Oak Ridge, Idaho, and Argonne National Labs have positively influenced the operation, reliability, safety and capacity factors of the commercial nuclear generating fleet with research projects of importance. In addition to discovering 22 elements of the periodic table, DOE labs developed nuclear Reactor Excursion and Leak Analysis Program (RELAP) and other tools used by the commercial nuclear generating fleet. This session is intended to highlight some of the new and exciting research underway at the DOE National Labs.

This session will also feature Dr. Corey McDaniel, Chief Commercial Officer of Canadian Nuclear Laboratories (CNL), who will speak about CNL's unique approach to supporting utilities through the Centre for Reactor Sustainability (CRS) and how light and heavy water reactors could benefit from the results of collaboration between CNL and DOE Labs. Dr. McDaniel's presentation is titled - "Challenges and Opportunities in Sustainability – A Canadian Perspective. Dr. McDaniel will present highlights on the research and operations that CNL is performing in support of nuclear utilities and sustainable operations. Topics will include the latest activities of the Centre for Reactor Sustainability (CRS) with a focus on new capabilities in fuel PIE, a case study on providing emergent support for utilities as a national lab, and CNL's innovative research in Instrumentation and Control System (ICS) cyber security for nuclear power plants.

The final speaker in this session is a senior electric engineer from Duke Energy who is also MBA graduate student. She will deliver a synopsis of some of her MBA research into changes and recent technological developments and related influencing factors and their impacts on the commercial nuclear industry.

# Versatile Test Reactor (VTR) Overview

Kemal O. Pasamehmetoglu (Idaho National Lab)

# **Presentation Notes**

- John indicated the Virtual Test Reactor will be constructed at INL
  - Wanted to confirm that this has not been finalized yet.
    - o The reactor will be built at a Department of Energy (DOE) site, but not necessarily INL.
  - Over the last decade or so, the DOE has invested a lot in the current infrastructure.
    - In many cases, the DOE has reconstituted things lost in the 1980's and 1990's.
    - There is one exception there is not access to fast-spectrum testing.
    - o There is a platform needed to test materials and fuel systems.
    - Test capability beyond just reactor design is useful in the fast spectrum.
- Internationally, there has also been quite a push for fast reactor technologies.
  - Currently, the U.S. is not staying in the game, and the future will be detrimental by our leadership, international safety, international security, and non-proliferation purposes.
- The very first thing we did when this first started was look at the end users.
  - This was primarily the industries/vendors developing the advanced reactors.
  - o Universities and other scientific and industrial communities could also develop these.
  - The U.S. Senate language in the bill wants the reactor up and running by 2025.
    - By the time the bill passed it was already a year and a half late.
      - Doesn't believe it will hit the Senate in 2025, but hopefully 2026.
- Wanted to go with a mature technology because DOE did not want to have to do research to build it.
  - This is why a pool-type SFR (sodium fast reactor) was chosen.
- How big should the reactor be?

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- Don't want it to be cumbersome, it's a test reactor, not a power reactor.
- Don't want it to be too small because we want meaningful flux and test locations in the reactor.
- One of the reasons a pool-type reactor was chosen was because it has a lot of inherent safety features.
- Metallic fuel also has quite a few inherent safety features as well (high-temperature reactivity feedback).
- We are looking at innovation cartridge designs for the different reactor types.
  - Lead is an example of this.
  - This way we can insert the experiment and the cartridge into the reactor without having to worry about radiation areas outside the reactor because everything is integral to the reactor.
- In summary, we believe that if the U.S. is going to lead the nuclear industry globally in the coming decades, it is really important to have this
  platform.

# Q&A

Q1. As part of the overall development of the technology, is the analysis of the supply chain and cost effectiveness going to be a part of that?

- A1. There are two things that keep me awake:
  - 1. Yearly appropriations and the way the Congress does things.
  - 2. Do we really have that supply chain?
    - a. You start digging deep into it, we don't have too many qualified suppliers left in the U.S.
    - b. We want to really start kicking the tires on the supply chain ASAP.

# Challenges and Opportunities in Reactor Sustainability: A Canadian Perspective Corey McDaniel (Canadian Nuclear Laboratories)

# **Presentation Notes**

- I have to jump off of Kemal's presentation first, we're going to talk about what the Canadian Labs are doing similar to the U.S. D.O.E. and the current reactor sustainability.
- The stuff that we do as a Canadian National Laboratory is very similar to the things the U.S. D.O.E. is doing and we work very closely with the U.S.
  - Canada would like to sign up to work with the U.S. on VTR.
  - There's something of a resurgence for smaller reactors in Canada and VTR would be useful.
- I'm primarily going to talk about what we're doing at the Canadian Labs in terms of light water reactor sustainability.

- Half of our business is commercial (we do operate as a business).
- The challenges (that Marilyn Kray alluded to this morning in the plenary) are that there's a lot of constant pressure on the (aging) existing U.S. fleet.
- This year for the first time, our commercial work topped \$100M (services such as selling heavy water to the Canadian nuclear industry).
- Greg Hersak heads up the mechanical testing lab at the Canadian Nuclear Lab; he builds all the neat contraptions.
- By 2025, (at the Advanced Nuclear Materials Research Center) we will be the world leader in advanced hot cells and have a brand-new facility operating.
- Because the lab operates as a commercial entity, there are no Cooperative Research and Development Agreements with no strings attached when work is done.
- Unfortunately, there is not a test reactor anymore.
  - o The National Research Universal reactor was shut down after 60 years.
  - There are however, PIE (Post-Irradiation Examination) facilities that can take samples irradiated elsewhere around the world. Skipped over case study three.
  - o In a nutshell, the cyber-security program dealt with unintended consequences of upgraded software on control systems.
  - Denys Elliot is the person who organizes tours of the facility (we want tours!)
    - The best to come is before November (...unless you're an avid cross-country skier).

#### Q&A

Q1. Do you have any restrictions or limitations as far as supporting foreign countries and transfer of technology?

A1. We do not conform to the export controls of other countries. For example, in India- we did not collaborate with them for a long time. Canada took longer to get with these countries. Canada originally had very stringent export controls, but now has come around. We do not have restrictions to support life-extensions, SMRs, or advanced reactors with China like the U.S. does. It's really on a country-by-country basis. We are even working to support getting CADUs in Pakistan.

Comment: It sounds like because your government funding is flat that you need to grow and seek to do more commercial work.

- Q2. Corey, could you explain your background with transporting irradiated/contaminated material and used fuel?
- A2. We transport material from Argentina, Romania, and Korea regularly. Shipping between the U.S. is fairly easy and hasn't proven any difficulties so far. The lab can also dispose of foreign materials and take full ownership after work has concluded on the material.

# Nuclear Industry Technology and Innovation

Ruba Kachlan (Queens University MBA Student / Duke Energy)

#### **Presentation Notes**

- The content of the presentation is based on independent MBA studies and not specifically related to Duke Energy. Any questions and information regarding Duke Energy can be found on the company's public website.
- · The intent of the presentation is to provide a high-level, birds-eye view of technology and advancements in innovation in the nuclear industry.
- Of all of the U.S. electricity sources, 20% is provided by the nuclear industry.
- In the 1950's, nuclear energy started providing energy to the grid.
- The U.S. has 97 reactors in 29 states.
- The industry is impacted by the following four things:
  - Political

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- Energy policies
- Economic
  - The costs
- Socio-culture
  - Aging workforce
  - Knowledge transfer and retention
- Technological
  - Any technological advancement will obviously impact the industry
- Digital transformation is when an organization changes its practices and culture to innovate digitally to drastically increase efficiency
- Finding the balance between traditional and agile practices will help maintain innovation.

# Q&A

Q1. You talked about the four pieces that fit together in our industry, I find it industry that in the opening plenary session they talked about people having an interest in new nuclear (with the expectation of because its new its better). Thinking about it though, we already have these plants that work for 40+ years. Why do you think people have jumped behind these new technologies? Is it hopefulness?

A1. I think it's a different perspective for everybody. I think part of it is definitely hopefulness and part of it is preference. I think also open communication really helps here.

Q2. There was a study done in England about a year or so ago. They tried to walk away from nuclear, but realized it would not be feasible. In the study, people were asked "are you against nuclear energy?" 60% of people said yes. The question was asked again if nuclear could work with renewables. This time 60% of people said no, if they work together it's fine. It seems that most people tend to think we want to replace everything with nuclear, not work side-by-side. When people are informed that nuclear is part of the solution, but not the only solution. What do you think about that? A2. I definitely agree, nuclear is a part of the solution, but not the only solution.

Q3. Often there is fear from the public or workers about nuclear radiation. Have you looked at addressing this with people because radiation is a thing you can't taste, touch, feel, or smell. Have you looked into seeing if there are other things similar to these fears? Also have you noticed if these things have changed in the younger generation?

A3. I haven't looked into this specifically, but in my opinion is that it seems that the younger generation seems to be more curious and more willing to look into facts and doing research to find out about the facts themselves in order to make an informed decision.

# Session Takeaway

Technology and innovation are working to flourish at both in America and Canada at the National Lab level and the US utilities are looking to follow suit. The US DOE is hoping to have VTR operating by 2026 to support global technology and innovation and the Canadian Nuclear Labs are working to bolster their research capabilities as well their commercial work.

# Session 2: Panel Discussion on Fostering a Culture of Technology and Innovation

# Session Organizer: Sally White (EchoWolf Solutions)

Transformative eWork Mobile Solutions, exemplified by Exelon's 2015 TIP Award, revolutionized plant maintenance through availability, usability and portability of work documents. Employing an agile digital platform supports the predictive analytics, high-reliability organizations need to drive improved personnel and equipment safety, reliability and productivity, concurrently reducing risk and costs by an order of magnitude. Augmented reality, remote collaboration, data availability, enhanced training and knowledge consolidation transcends generations; enabling the collaborative, thinking workforce of the future.

Session began by playing the YouTube video "Did you know? Shift Happens" https://www.youtube.com/watch?v=TwtS6Jy3ll8

# Fostering a Culture of Technology and Innovation

Bruce O'Brien (Marathon Consulting Group Inc.)

- Want to set the stage for the presenters
  - This morning's plenary was interesting and thoughtful
    - There are four stages of nuclear plant lifecycle
      - Concept
      - Design and Construction
      - Operation and Maintenance (longest term)
      - Decommission
- Had a moment with Sally at a conference recently where I realized a lot of people don't realize transformation and innovation are different
   Transformation is wholesale change
  - Such as using nuclear rockets
  - Innovation is changing something for the better
  - This panel will include both
- Proceeded with introduction of the presenters

# Innovation & Next Generation Fuels

Jody Blackshear (URENCO USA)

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- · Going to talk about innovation a little bit and what next generation fuels mean for the industry
- SWU is a separative work unit (that's how much we need to spin the uranium before it goes to the fabricator)
- How does the fuel cycle work?
  - Starts with dirt in the ground
    - Becomes uranium hexafluoride
      - Urenco enriches it to what the customer requests
        - Typically in the 4.5% ish range currently
        - This is changing
    - o Leaves our facility and goes to a fuel fabricator such as Westinghouse
    - Off to a nuclear power plant
    - For the next generation of fuels there's going to have to be innovation in the fuel cycle
- You may have heard about HALEU (high assay low enriched uranium)
- LEU (low enriched uranium) is anything up to 5%
  - These are currently in use
  - LEU+ is anything from 5 to 10%
    - These are what will be required for accident tolerant fuels and higher burnup rates
- HALEU is anything from 10-20%
- In the future we will need to enrich higher than 5%
  - Orano in France and Rosatom in Russia currently can enrich up to 5%, and maybe up to 10%
  - From 10-20% will need innovation and new licenses and new facilities
- Gaseous diffusion is slow and inefficient
  - Fuel costed 5-6x what it does now
- Gas centrifuges consume much much less electricity
- There is not currently an approved transport product for uranium enriched over 5%
  - This work is currently in progress
- Right now Urenco is working on this stuff on a regulatory perspective before commercial demand with the prediction that demand will come

# **Digital Work Force**

# Ashok Shetty (DataGlance)

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- Been doing this for 25 years (developing software for the nuclear industry)
  - 5 years outside of nuclear also building software
- Putting a chip in your brain (like in the video at the beginning) would be a fully digital workforce
  - You cannot fundamentally change how the work is done
    - How the people perform the work, the tools, the information
      - What you can change is how information is presented
        - Make procedures and work packages digital instead of 3-ring binder
- How do we automate the work process?
  - We are working to automate this process to make everything more efficiency using eWork process software
- Let's go back to the eWork solution today and what we are doing

- Dataglance went live at Exelon in 2014, and since the launch data has been trended to continuously improve processes as well as the technology itself
- When all of the documents in the 3-ring binder generated by the eWork software are generated they are fully populated
  - Eventually this could transition to fully digital with no-print out
  - The savings from no longer printing all that paper alone could pay for the software
- eMedia as a product was initiated by a customer
  - A customer said that they take a ton of videos on the job, and they wanted to take advantage of it
    - How do you handle this data, how do you present it, how do you store it?
  - Dataglance has solutions to solve these issues
- o Imagine if you're using a mobile technology how much data you are collecting
  - Éverything that you do on a pdf for example (when did you open it, how long was it open, what pages did you use) can be captured and trended for future use
  - What's going on, what was the problem
  - You will have analytics
- Today we have pdf documents, we want everything to appear as a piece of paper
  - We start on paper-like documents
    - Then we started introducing active fields
      - Prepopulated or open form fields that can be evaluated
        - These are small changes, but they add up to become major changes when you put them all together
    - Then we add smart fields for data extraction
  - Finally there are computer based procedures with guided execution
  - Everything was done starting from minimal change to using paper, and small incremental innovative changes were made
- Every customer has an EDMS (electronic document management system), but with newer types of media becoming more prevalent, there is a need for a software that can make efficient use of each different type of media

# Electronic Work Package (eWP)

Randy Prewett (Energy Northwest)

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- The thing in the management and supervisory team is efficiencies, but the other large part is to attract the younger generation
   The implementation of eWP at Columbia Generating Station (CGS) intended to address both of these issues
- Benchmarked NextEra because they had already implemented
- Dataglance was selected as the eWP software for CGS
  - o The opportunity was presented to choose between iPads and Surface Pros
    - 200 iPads were purchased for use
  - Even supplemental contractors were using the electronic work packages during the outage
    - As a management team they did not expect the engagement that was realized
      - They were trying to shoot for 10% adoption by July and by the end of the year 40%
      - After the first week they were already seeing 90% adoption
  - People wanted to use the tablets
  - Also heard a lot about the WiFi in the plant
    - CGS is a BWR
    - EMF from the plant has interrupted WiFi signals in the past, so it was never a priority
    - With the tablets however, the gains from having WiFi and connectivity outside of the plant while in the plant are huge

# Q&A

Q1. We've looked at paperless procedures for a long time. What types of unknowns did you encounter during implementation? I'm thinking of things like P6 scheduling and OPS approvals.

A1. That OPS pre-approval was a big deal. Knowing that OPS needed to approve work packages from 4 in the morning to get work done was huge. The other part is it was surprising how many people didn't know how to operate an iPad. Make it bigger, make it smaller, turn things. We had people skip steps because something was re-sized and didn't realize it was off-screen. What we did to overcome these issues in large part was work with Dataglance and the IT department. They had reps come in every day for the first month, then down to once a week, then down to once a month. They're now on call because of how effective the training was.

- Q2. How many iPads did you break during the first implementation?
- A2. Zero, we put them all in Toughbook cases.
- Q3. What about contamination?
- A3. We've had no problems with contamination. We're a BWR, so we have a ton of experience decontaminating parts.
- Q4. What was the general demographic of workers?

A4. In 2014 we saw a lot of later career people getting ready to retire and we needed to attract the younger generation. We're now looking at people newer in their careers. I also learned that as an OPS manager you were considered a proficient operator after an outage and a cycle. In maintenance that's a five year cycle. We have a number of people that haven't gotten through the first wave of the process yet, but are progressing very quickly because of the iPads.

Q5. So given the name of the panel, what I heard was here's some things we need to change, here is a tool for making change, here we applied the tool and made change. Did making the changes for electronic work packages signal a motivating factor that will change technology or is it the change itself? A5. From the side of Dataglance it was how to Deliver the Nuclear Promise. How to save money, how to reduce paper usage, how to utilize technology. That was the motivating factor. These types of innovations make people thirsty. They want to keep pushing harder to get better and better. This is almost a which came first, the chicken or the egg type question. Management can set goals and ideas, but what's really important is to engage the workforce and see what is exciting for the workers.

Q6. How can we leverage previous HALEU enrichment technology and infrastructure for future use?

A6. Urenco is currently investing in building a HALEU investment facility adjacent to the current facility. The largest question is what is the timing that needs to happen to make this work, and are the economics right?

Q7. For media storage, why can't we use EDMS?

A7. EDMS was meant for documents. EDMS can store picture and documents, but it wasn't meant to store videos or audio. It doesn't have the capability to present these types of large media files. You don't want to download 200MB videos. You want the capability to stream.

Q8. If you want to use this as a model for the industry can the 3.5 year implementation be shortened?

A8. Columbia is a single-unit utility and doesn't have the corporate support that everyone else does. Our IS department is specific to our site. I think that can absolutely be shortened for a larger utility with more support and resources. Dataglance typically takes about 8 months to develop for a site, and then it can be configured and implemented fairly quickly. Most of the time is spent with change management and getting your team ready for the change and how work is going to be done going forward. What you are really doing is a simple paper-based process.

Q9. In your cost-benefit analysis did you reach the full potential that you predicted and what is your next phase?

A9. CGS has not yet reached the full business case. Some of it is union issues. We can't just lay off people that may not be needed. The second part is WiFi and getting it more throughout the plant. The next phase is automating. Working with Dataglance to generate artificial intelligence-based solutions for work packages. Putting remote sensors in the plant that can generate work packages in Dataglance for the craft to complete would be huge.

Q10. What would the difference be between using EDMS and capturing and storing images uploaded later? In civil construction you often have dirt and water all over a worksite. How would you feel about implementation in a field civil environment as opposed to the plant? A10. During the outage civil workforces use a piece of paper generated by the system that is later uploaded.

Q11. What are you doing in terms of place keeping? It looks like the industry still has 15-30 CRs/week related to human performance and procedures. How are you handling that? It's more than putting a system in, it's also revising content. Is there anything going on for validating qualifications using IDs?

A11. Procedure use and adherence (PU&A) was found to be much more effective with the proper stylus. Being able to properly use circle/slash was big. CGS has found that the use of iPads has increased productivity and the use of proper stylus. CGS has found no PU&A issues when the proper stylus is used. Work packages are already assigned using validated qualifications.

Q12. If I'm Joe the electrical craft, whatever work my supervisor has assigned me is the work that will be on my iPad?

A12. Yes, that's exactly how that works.

Q13. Do you have information that you're collecting such as communications or working with engineers?

A13. Do we? We could, but I'm not exactly sure if we do or how engaged the engineers are with the work package software.

Q14. It seems that what Rosatom is doing is rolling out new plants, supplying the fuel, take away the spent fuel, reprocessing, and supplying new fuel. They capture clients. How are you reacting to this?

A14. Yes, they also finance. They capture the clients totally. It's a one-stop shop for nuclear. What it does is it really increases the ability for Rosatom to grab a bigger piece of the market. Obviously state-backed entity will always have an advantage. If you're someone like CNNC you can enrich however you want without having to worry about consequences. We can't be as cheap, but we protect our market-share by being a free-world supplier, having a diversity of supply. We have an office in China and have done some business there. Nobody really wants all their eggs in one basket.

Q15. Does the training software have the ability to track staff being mentored during the work process?

A15. We do it the same way we did it with paper. When someone isn't qualified they initial it, and someone that is qualified will initial right alongside.

# Session Takeaway

The future of the industry will depend on future uranium enrichment technologies that Urenco is hedging their bets will be needed. eWork products have been developed and implemented at plants and have shown positive gains in cost and efficiency.

# Session 3: Wearable Technology and the Future of Creating an Innovation Telepresence

#### Session Organizer: Vincent Williams (Southern Nuclear)

Wearable Technology permeates almost all facets of our lives, including its initial infiltration into the nuclear power production industry. Wearable Technology in combination with the Internet-of-Things (IOT) creates a phenomenon known as a Telepresence.

Telepresence can be defined as a 'a set of technologies' which allow a person not normally in one location to digitally give the appearance of being present in an entirely different location. This could be a system that include a combination of hardware and software components, including: Augmented Reality (AR), Virtual Reality (VR), Merged Reality (MR), Robotics, Drone Technology (aerial, ground, and submersible), Thermography, and 3D-Laser scanning. Why is focusing on creating a reliable Telepresence important? Come enjoy this exciting, innovative, and informative session to find out!

# Wearable Solution for the Industrial Worker

Tyler Reitmeier (Realwear)

#### **Presentation Notes**

- Using the headwear, you can see what the person in the field can see.
- Potential for remote inspections
- Potential hurdles:
  - Enough wifi for connectivity
  - Safety glasses and use with PPE
  - Safety paying too much attention to the device and not on being safe.
- Addressable market for wearables is upwards of 100 million.
- Wearable Technology is making the industrial industry more attractable to the younger generations.
- Realwear is a knowledge transfer platform using Android 8 software, 16 megapixle camera.
- Assisted Reality virtual reality spectrum more along the assisted reality side to just give a small amount of information and can go back to work.
- Allow more competency for workers in the field.
- Document Navigator: bring up documents just by saying the name of the document and not having paper or to take gloves off.
- Remote mentor: SME (Subject Matter Expert) can see over the persons shoulder and help in present time.

- Digital Workflow: shows the work and the amount of time it takes to do a job.
- Data Visualization: showing work that is being done in the field.
- Using the equipment to enhance work safety and use when needed.
- HMT-1Z1(headset equipment) is used to learn by doing in the field and not just in a classroom.
- Savings that are real safety and compliance. 55% when going from paper & tablet/ iPad to HMT.
- Downtime avoidance because of the ability to get more accurate information in real time.
- #Freeyourhands

#### Key Learnings, Recommendations, and/or Best Practices

Using the headset and VR will lead to cost and time savings down the road.

# Q&A

Q1. What is the battery life?

A1. 8-12 hours depending on use.

Q2. Can one eye get fatigued and can you flip it? A2. The farther from the eye causes more fatigue than those that keep it close and you can flip for eyes. EPRI has a report on this device.

# Wireless Remote Monitoring and Virtual Reality Training

Lorne Poindexter (Ameren)

#### **Presentation notes**

- Saved over \$1 million in generation loss (avoided cost).
- Can help with understanding what is wrong with the equipment when monitored.
- Continuous monitoring while troubleshooting.
- Smart Cart "Crash Cart" put together and trouble shoot.
- 3 phase process and worked with EPRI but cannot implement as directed.
- Created quick guide with EPRI for integration.
- Using existing plant data, workorders and KCF (Knowledge Chain Formulations) to create a dashboard for all 14 motors.
- Saved money on PM's.
- Virtual Reality training ran approximately 1/3 staff during outage (Tsunami SX created the training).
- Created more engagement for students, students were in VR together and still instructor lead.
- Can join the VR training material in 2D and augmented reality with the training.
- VR is a way to practice the activity in a room without safety or time issues.
- Training material presentation: VR
  - Learn objectives
  - Created video about certain objects within the presentation.
  - VR takes the student through the entire process from signing and selecting PPE to completing the activity. Exact replica of the room. Interactive learning with learning activities imbedded into the VR training.
- Valuable tool for knowledge retention.
- Enterprise software license to come and employees will have their own log in.

# Q&A

Q1. How easy to program software training routines?

A1. Had to create showcase material in 6 weeks with iPad scanning pictures, instructor held phone calls, personnel has been drafted to start building your own. Trained 6 and 6-12 more employees by next year. Make whatever into a 3D model.

Q2 Is it able to be live or to get radiation dose or recent information?

A2. Yes, they are working on getting data to be able to get live more information. Radiation protection team, guiding you through the plant with the least amount of dose of radiation exposure.

Q3. Are operators using this equipment?

A3. Lowest level HMT is with video peer check. Concurrent verification.

Q4. Will there be a regulatory barrier?

A4. Working to see that there is a barrier with concurrent and independent verification. Wanting to work with the NRC to define those barriers from a regulatory stand point.

# Session Takeaway

Virtual reality is going to help the future generation gain knowledge through transfer. VR is meant to help eliminate wasted time and resources.

# Session 4: Embracing Technology and Its Transformational Impact

Session Organizer: John Mahoney (High Expectations International)

How will the existing nuclear generation plants play in the energy markets of tomorrow? With utility customers wanting safe, reliable, green and efficient energy, what is nuclear's long-term role in delivering on these demands and how can nuclear plants embrace innovative technologies that will have a major long-term transformational impact on plant sustainability. These questions will be discussed and answered with an infusion of lessons learned and example case studies from within and outside the energy industry in leveraging, implementing, and managing technological innovation and culture shift. The coming changes within your operations will redefine the manner with which your staff, contractors, and partners, will work and prosper in the new energy future.

NOTE: All presenters used a single slideshow containing all presentations.

Application of Transformative Technology Doug Kibler (KAP Project Services, LTD)

- Want to look at emerging technology
  - What's coming, what's out there?
  - o Probably missed a few things (this is not comprehensive), but still a good list
- We always (KAP) look at innovations and technologies that are coming down the innovation pipeline, but what's important is what do we do with that?
  - o Is there anything there that we can use to solve industry pains?
  - Look at outage execution debriefs and lessons learned
    - What can we take out of there that repeated that can be improved?
  - o Some plants have innovation groups that do this themselves
  - The New Orleans Flood Protection Authority-East
    - Have a lot of old equipment (pumps from 1920s)
    - o Older employees that will be retiring soon
    - Have to deal with infrastructure going all the way back to the 1920s
    - o Did a benchmark study called iStorms that was documented in the ISO5500 standard
    - Looking into advanced solutions such as a hive of drones
      - People were out on boats looking for servers post Katrina
      - Drones are a piece of technology that solve a business problem with an innovative solution that meets the stakeholders' standards
    - o Didn't just take a piece of technology and jumpstart with it
      - Did a formal analysis first
  - Advanced Outage Control Center (AOCC)
    - Found report on an internet search
    - Focused on design of the complexes
    - What kind of technology would be good to use?
    - Unfortunately technology has such a short half-life that the report was even out of date
    - o Public and private industry both looked at the problem from different viewpoints to later coalesce
    - This was implemented at Palo Verde
- Chemical Industry Plant Turnaround
  - Learned so much from the nuclear industry
  - Had an opportunity to take this technology and process know-how over to the chemical industry
  - o Deployed the technology from the nuclear side to the fossil side
    - They didn't initially believe the readings from the fuel

# Embracing Technology and its Transformational Impact

Al Casas (BCP Engineers and Consultants)

- Technology needs to be embraced
- This presentation will take us through the past to see where tech came from and where we need to go with it
  - Reactor Coolant Pump (RCP) pump motor removal and refurbishment at Waterford 3
- There's a lot of as-engineered data out there, but not a ton of as-built
  - The Waterford 3 pump removal showed how important as-built data is
  - Part of working with Chrysler in the automotive industry was automating and digitizing their assembly line
    - Lessons learned from this were used to automate some parts of a refueling outage
    - In this way, 3D simulation videos of component movements and work can be married to a live schedule to visualize when things are done in related to each other and plan more efficiently

# Is Industry Ready for VR and AR

Frank Botdorf (EON Reality, Inc.)

- Going to share what EON Reality has done in the VR and AR world as well as what the challenges are
  - Very few companies in the nuclear industry are using VR or AR so far
  - Exelon piloted a program a few years ago
- Most of what EON has done over its 20 year life has been in aerospace and oil and gas to start
  - Expanded into other industries, but mostly stay in the energy industry and mostly oil and gas
- Digital Twin

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- Newer term in VR and AR
  - Recreating the environment and having the ability to perform operations and have actual feedback
- It's important to have an understanding of what you're getting in to
- AR Pokémon GO
  - Use your phone to see the real world with overlaid computer-generated content
  - AR is more centered on actual performance of the job
  - VR- More where you're totally immersed
    - People with full headsets
      - VR typically is more on the front end (training side of things)
        - Teaching someone how to do their job
  - Lock out Tag out (LOTO) was something that was tested in VR and AR tech
- You can look at the news statistic or headlines and they'll always tell you how good or bad the economy is
  - The best way to actually check is talk to the trucking guys
    - If there's a lot of deliveries to be made then the economy is doing well
    - Similarly if there's a lot of jobs available then the market is doing well
  - An example of a High Risk Scenario is an oil platform in the Gulf that could catch on fire
- You want people to go through the training to see how they would react and what they would do to see how to train better
   ExxonMobil has been using VR and AR for almost 20 years
- Joe Cheban (former Oil and Gas executive) championed VR and AR for how well it can prepare employees quickly
- With the US Air Force
  - The Air Force was pretty low-tech

- When a plane comes into the hanger it is inspected for dings and dents and such
- What they currently do is use duct tape to mark a scrape or dent or ding
- Someone else follows up on the tape
- AR glasses are now used to look at the plane and create a virtual sticky note on the plane that's tied into a database so someone can look at a database and pictures before ever even going out into the field
- The ability to deploy software directly to cellphones is what Creator AVR is
- Virtual Trainer is things like HTC Vive and Oculus

# Embracing Technology and its Transformational Impact

Gregory Lormand (BCP Engineers & Consultants)

- Going to talk about the culmination of technologies and being truly transformational
   Going over lessons learned
- The real mission is to help current and new nuclear plants survive, thrive, and compete in the market
  - When renewables first starting coming online in the 1980s they weren't really seen as true market disrupters
    - As production tax credits came out they grew
    - They still weren't reacted to by the industry
  - When franking and natural gas came about there were much more significant market and cost pressures that caused reactions
- Regardless of what we decide to do as an industry (we meaning everyone)
  - Things are going to change, it's inevitable
- Right now there's a whole lot of plants just trying to survive
- In nuclear we tend to have a very silo'ed approach to everything
  - We're a slave to compliance
    - We need to start thinking holistically and more like a manufacturing plant
    - How can we run things better and more efficiently and more cost-effective

# Q&A

Q1. How do you engage with a client to get into something like this?

A1. From EON's perspective, many of the things we've heard of here are doing more with less. Cutting down resources and being more efficient. If you don't bring these new technologies in you're not going to do that. If you apply and leverage these technologies there is a lot of potential gain.

From BCP's perspective, we actively reach out to potential clients that we think would see value from the product. We want to show them how the tech can interact with their product line and show them what the benefits could be. We want to improve commodities for the client. It's not a one-size fits all solution for each client, but there are typically similar solutions that can work.

From KAP's perspective we've learned to just spend more time with the client. The more time you spent directly with the client the more integrated the tech solution can become and the more potential gain there is from implementation. We really just need to invest.

Q2. Cost-wise, how do you capture and engage a customer?

A2. From EON's perspective most of the time people are very intrigued with VR and AR, but they don't know where to start. We're experts at VR and AR, but we're not experts in whatever your industry may be. When we team up with someone like BCP it's a perfect marriage because we can handle the VR and AR aspect and they can mentor the technical industrial aspect. Typically something like \$50k-75k for an initial concept for a solution. We also have a three-day workshop we can do to come in and help explain what we can do, where we can do it, and why to help the customer really get started.

BCP has been asked for solutions for force on force drills. We need to get on the site and capture the entire site. Once this is done, this model can be used not just for the red vs. blue force on force, but it can also be utilized for other purposes. We can use the VR to simulate thousands of different scenarios. You can then trend the data to know where to put sentry locations and where to put security forces. This is better than just an analytic simulation because you actually get to visualize and see what's going on.

# Session Takeaway

VR, AR, and other simulation technology can and should be applied to the nuclear industry to leverage these technological innovations for increased efficiencies and cost-savings.

# Session 5: Improve Performance, Safety, and the Bottom Line with Innovative Solutions Engine Technologies

Session Organizer: David Garcia (AMMI Risk Solutions), John Downing (John Downing Consulting)

One of the greatest challenges to the commercial viability of the nuclear industry is finding a way to reduce staff sizes without impacting plant safety and performance. Reductions in force and early retirement programs have been ineffective as they tend to eliminate the staff whose knowledge and expertise is most needed, the Baby Boomers. Without some major development, the loss of this knowledge and expertise and its unavailability to younger staff is inevitable over the next five years as the Baby Boomers retire. However, as developments in the Japanese nuclear fleet show, US developed intelligent solutions engine technologies are already being used to capture expertise, knowledge, regulations, and rules in easy to use applications that provide fast, predictable, and certain responses to activities and events that impact their plants. This same innovative technology can play an immediate and significant role in ensuring proper knowledge transfer and retention (KT&R) between the retiring Baby Boomer generation and the Gen X/Millennial/Gen Z generations to help maintain today's high levels of safety, availability, and performance while dealing with smaller, less experienced staffs. Take the opportunity to interact with executives from AMMI Risk Solutions, Northern Apex and Curtiss-Wright who have developed and implemented this technology for such applications as outage management, fire protection, emergency planning, and other areas; and find out how this innovative technology can truly improve your performance and bottom line immediately and into the future.

# Improve Performance, Safety and the Bottom Line with Innovative Technologies David Garcia (AMMI Risk Solutions)

- AMMI has a proprietary risk management software developed in house
  - Most of the people who worked on the software had 30-40 + years of experience in the industry
- Don't believe that the industry in the US is dying
  - Believe the industry is at a transition point and everyone is working to figure out where we are and where we're going

- In order for nuclear technologies to succeed, the new nuclear tech vendors need to understand what the cost of the long-life plant is
- If you're a utility viability means capacity factor and energy produced and uptime vs downtime
  For a vendor viability means margins and profit as well as desirability to the utility
- The thing to keep in mind if you're here looking for technologies to start a process is the tech companies have already taken care of viability and feasibility aspects
  - All that is required from the customer is desire for implementation
- Part of the message here is in the spirit trying to survive, some companies will grab anything low-hanging that could potentially offer any hope of surviving
  - What needs to actually happen is to be patient and work with a product until it can find viability
  - AMMI's software product is called PRISM
    - Somewhat based on PRA and that technology, but also based on unscripted DNA such that it can be changed and modified for many different industries and information
    - o This means that it is relatively blank and baseline and can be easily molded
  - Last thought is the youngest employee at the company is now the software lead
    - He basically explained that the software has the capability to be extremely powerful, but there were certain restrictions causing a lot
      of inertia
    - The employee had the more senior people go back and think about what the issues were and what the software could be, and ended up leading to a lot of the success they have found

# Innovating with Digital I&C

Robert Ammon (Curtiss-Wright)

- The question that often gets asked is what will a digital I&C system do for a plant outside of solve an obsolescence issue
- Going to mostly focus on Curtiss-Wright's digital control and protection
- Some of the people involved with the Oconee digital I&C replacement commented on how many employees were offered early retirement packages because of how much gain the new system provided
  - Obviously we won't get rid of control room operators by doing these replacements, but a lot of functions can still be replaced or more streamlined
- Analog channel checks are commonly done every 12 hours by plant tech specs
  - Can vary by plant
  - o There's a non-trivial amount of work that goes on outside of just the control room operators checking the channels
- It was amazing the Westinghouse designed a brand new plant (AP1000) and wrote the tech specs for Vogtle 3/4 just like a legacy analog plant
   Westinghouse and Southern are now going through a license amendment to go back and remove these things that they shouldn't
  - Westinghouse and Southern are now going through a license amendment to go back and remove these things that they shouldn't have included in the first place
  - The whole premise here is if you have a digital system instead of an analog system, you can potentially save tens of thousands of hours of work over the lifetime of the system components
- Brad Adams at Southern Company coined the term Management Attention Units
  - Brad loves to say that they should be driving to reduce these
    - o These are when you need management's attention to get work authorization to do tasks
    - o If you minimize the number of management attention units, you save work
- There's lots of examples of OE in the industry of somebody testing a component or system and doing something out of order and accidently tripping the unit
  - With a digital I&C system that can perform an automatic self-diagnostic this risk is entirely eliminated
  - With an analog system, when you're testing components you need to take part of the system out of service
  - With a digital system, this isn't necessary, so there's no loss of protection system function
- FPGA architectures are used in the Curtiss-Wright products are much less complex, and thus are easier to get through licensing than microprocessors
  - FPGA is field programmable gate array
  - A big state machine
  - There's a new product called radICS
    - The safety evaluation from the NRC was just released in July 2019
    - o Currently the only platform that the NRC credits to meet the NRC Diversity and Common Cause Failure (CCF) criteria
    - o Eliminates the need for an external diverse actuation system

# Improve Performance, Safety, and the Bottom Line with Innovative Solutions Engine Technologies Rick Raber (Northern Apex/Alpha Source)

- The common focus at UWC this week is when you have one organization with staff from 4-5 generations you get a lot of tribal knowledge
   There's people 75+ on staff as well as four engineers that are part of GenZ on staff
  - You can't ignore tribal knowledge in an organization
  - We all think that because we have the knowledge we know the best way to communicate this knowledge to other people who know this Bad assumption!
  - If there are humans involved in a process there are human factors, and those cannot be ignored
- When I am coupling to a specific process, I need to make sure that I am best equipped to mate with that process
  - It doesn't matter if its mechanical, digital, human factors, etc.
  - Have a son that is in his third year apprenticeship in plumbing and pipe-fitting
    - o The nuclear industry is dying to get young people like his son into the plumbing and pipe-fitting organizations
    - o Don't raise children anymore that are expecting to get their butts kicked by the journeyman who haze them
    - o It's a present reality that there is a proportion of GenZers that don't want to be told they don't know anything
    - His son came back after the first few weeks in apprenticeship upset that he was treated like he knew nothing and his ideas got zero traction purely because of his age and experience
    - This is a dangerous place to be in it!
- Human factors cannot be ignored
  - Everyone sees things a little differently
- Most nuclear companies have at most 75k SKU's or likely less

#### uwckb.ans.org/2019

#### 2019 ANS Utility Working Conference Knowledge Base

- There's real value to be had when you get the right people working on the right stuff at the right time for the right reasons
  - Previously seven people were cycle counting all month long
  - A good inventory precision number as described by the General Accounting Office (GAO) is 92%
  - With RFID inlay in every component this increased to >99% and one employee in one shift instead of seven all month long
     Annual product ID training will consume time that could be used for knowledge transfer
    - Annual product ID training will consume time that could be used for knowledge transfer If this training is minimized or eliminated you get that much more time for knowledge transfer and productivity
  - Users often hoard tools because they want to know they're going to have it when they need to do a job
- Why do your people need to find stuff?
  - It can be easy to find stuff
    - What is RFID IQ?
      - It's your knowledge about how this stuff works
- If you have people that are spending time counting, identifying, looking for, checking into an FME zone you can save time with RFID tool tagging
  - Duke saved two full outage days
    - This is approximately \$2M

# Q&A

Q1. What is the true value of an RFID tag?

A1. It really comes down to what you're applying it to as well as the cost it could potentially prevent you from paying. It may seem like a waste to tag a \$4 screwdriver, but if you're able to locate that screwdriver before it becomes FME and causes \$20M of damage to the plant, its easily worth it. At this point you can tag a component for \$0.07 per tag.

Q2. Nuclear power stations have a lot of high radiation and high EM fields. How do the RFID tags perform in these environments?

A2. It depends on the dose. Certain tags can be used specifically for high radiation areas.

Q3. Besides the money there's dose. If you're in the contaminated area how much dose are you saving to workers? (a statement, not a question)

#### Session Takeaway

Novel digital solutions such as risk-mitigation software, RFID tags, and digital I&C replacements for analog plant systems can and have produced nontrivial savings to cost and time at plants.

# Session 6: Improvements in Measurement to Enhance Engineering, Planning, and Testing of Steam Generator Tube Generation of Cobalt 58

Session Organizer: Lee Borthwick (Borton-Lawson Engineering)

Advances is measurement precision and accuracy can greatly improve the engineering and confidence for on-schedule construction completion and labor skills and manhours. They allow survey of indoor and exterior space and three-dimensional measurement and complete characterization of equipment modules to a level that ensures precise planning and confidence in transport, lifting and fit ups.

A second presentation will discuss the results of research into how nickel tube materials in a steam generator generate cobalt 58 and how oxide films can reduce the rate of release of this radioactive component. The presentation will discuss the research methods and results and the costs anticipated for development and maintenance of a quality oxide film on the steam generator tubes.

# Utilizing a 3D Approach to Reduce Schedule, Budget and Radiation Exposure

Lee Borthwick (Borton-Lawson Engineering), Kip McCabe (Talen Energy)

#### **Presentation Notes**

- Will talk more about the engineering side of using the simulation scanners
- Digital twin

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- A twin having a visual component
  - o This can also be something from a sensor basis without a visual component
- Use professionally licensed surveyors
- The thing that's nice about the models is that when you model them you get clash detection and things like that, and you can also push to your analytical model to get calculations done
  - This approach is often used for prefab and module development
- Susquehanna had air trapped in the concrete in their ISFSI (independent spent fuel storage installation) pad concrete
  - This pad is supposed to be flat
    - 1/8" or less deviation in 10 feet
  - The pad was scanned to determine how severe the deviations were
  - o The pads are connected, so if a pad isn't flat it puts undue strain on not just the cask placed on it, but also the adjacent pad
  - Feedwater heaters that were being manufactured were scanned in the plant and the as-built scans were compared to the designs
    - One of the three feedwater heaters was out of spec
      - Because this was caught before installation, significant time and money were saved by just fixing the heater
    - Reactor water cleanup pipe reverse engineering
      - The intent of the project was to take the six welds in the pipe and do four of them in the shop to save dose so only two connection points needed to be done in the field
      - The equipment was able to be operated remotely via Bluetooth
      - This enabled the operator to set it up, return to a low-dose waiting area and operate, thus saving quite a bit of dose
      - 3000 mRem and two full days were saved, and the precision ended up being to within 1/16", which was half of the required 1/8"
  - Haul Path Planning is a future task solution to replace an aux transformer
  - Haul path clearances can be identified via the point cloud generated by the scanner
- In summary, the combination of 3D Technology and Engineering Integration offer true benefits to cost and schedule planning

# Q&A

Q1. How do you operate in high-dose areas?

A1. We have drones and the laser scanner is operated by a traditional surveyor. We focus on long-range scanning. Everything is based in a coordinate system, so when different scans are combined they will be added together on the fly.

Q2. Can you give an estimate for how many man-hours one of these projects takes?

A2. The reactor water cleanup job specifically was 80% planning, and 20% execution because it was during an outage, so there was no room for error. The workers were in the plant for a week, but were really only in containment for ~half an hour. The total effort was likely on the order of 600 hours.

Q3. How much effort went into scanning the feedwater heater from scanning to the 3d model?

A3. We spent about a day in the field and an afternoon to create the model. Maybe two days total when you put everything together.

Nickel Release and Oxide Formation on Alloy 690 Steam Generator Tubes in Primary Water Conditions Brian Irving (Sandvik Nuclear Power-America's), Johan Frodigh (Sandvik Materials Technology), Jerry Dougherty (Sandvik Materials Technology)

#### **Presentation Notes**

- Two mills solely dedicated to nuclear products in Sweden
  - Nuclear fuel rod cladding tubes & steam generator tubing
- Research on nickel release has been ongoing for 2-3 years at this point

#### Q&A

Q1. The rate of release is much lower than what we consider for leeching.

A1. The release is much lower than even normal corrosion rates. If you have this release rate it can run for 200 years without significantly affecting the tube wall.

Q2. Do we expect similar phenomena in Alloy 600 and 800?

A2. 600 has the same phenomena, but 800 is higher in iron and less in nickel, so it does not really experience these phenomena.

Q3. Do you also test other tubes?

A3. We can test any tubing, but we have not done that. At this point we have just focused on our own tubing.

Q4. Is there a treatment for the tubes that could even further reduce the rates?

A4. We have not developed one yet, but it seems that it may be possible. It will be tricky because to create the correct oxide layer you must be quite precise, but it may be possible.

Q5. You were testing Sandvik tubes. Is there any difference between velocities of flow in your tubes? These were not tested side by side with other tubes.

A5. The environment is pretty much the same through all tubes other than the flowrate. We use 3 L/hr, while the operating plants are using something like 1000 times higher.

Q6. Is the water boiling?

A6. No, the system is pressurized such that the water remains liquid. We are only looking at the inside surface in this study.

#### Session Takeaway

3D scanning technology and advances in steam generator tube manufacture and testing can both be implemented to save time, money, dose and manhours in operating plants and future plants.

# Session 7: See Innovation in Technology and Supply