Webinar INPO IER L2 21-4 Improving Plant Reliability

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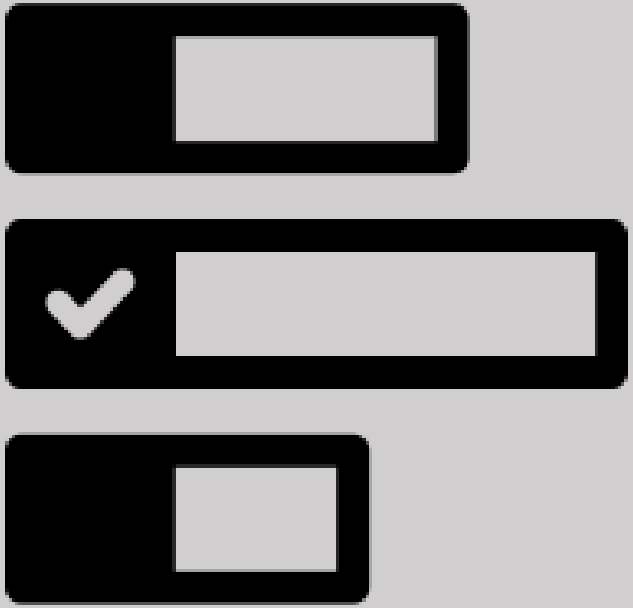
Agenda

- Introductions – Exelon Powerlabs and Paragon PQI partnership
- Why INPO IER 21-4 was issued
- Discuss INPO IER 21-4 Recommendations
- Strategy to address Recommendation 3
- Strategy for Recommendation 6
- How we can help
- Questions

Instant Survey

- Does your utility already have a plan for INPO IER 21-4 compliance?



PQI Partnership between Exelon Powerlabs & Paragon Energy Solutions

- Together we are uniquely qualified to assist with recommendations 3 & 6 (and part of 7) of the IER
  - We have implemented a PQI program at most US Nuclear Power plants
    - More than 15 years experience developing this process
  - Our PQI process goes above and beyond just testing of parts and exceeds the requirements of IER 21-4
  - Results Count – more than 5,300 proactive failures of critical parts caught and prevented installation in plants since PQI implementation, more than 1000 in the past two years alone
  - Minimal compliance is not the goal, just the expectation – we want to achieve results

PQI Process Receives 2018 NEI TIP Best Practice Award

*2018: Exelon won "**The Best of the Best Top Innovative Practice Award**" from NEI for Parts Quality Initiative (PQI). Two of the main architects of Exelon's PQI program who have since retired from Exelon, are now working for Paragon, and have been implementing the PQI process with enhancements at many other US plants with great success.*

PQI Partnership between Exelon Powerlabs & Paragon Energy Solutions

- PEAKs database – inventory data and beyond from the US Nuclear Industry
- Our team has extensive Supply Chain, Equipment Reliability, Operations, and Performance Improvement Experience
- Powerlabs – PQI testing and Failure Analyses data includes more than 108,000 items tested or evaluated
- Our Technicians have more than 15 years experience testing and analyzing critical parts

Why was INPO IER 21-4 issued?

INPO 2021 Equipment Reliability Department Areas of Focus

- Area of Focus: Reduce impacts to nuclear generation due to parts quality issues

- Current State: Parts quality issues on important balance of plants SSCs provided by the OEM or authorized distributor are not being identified prior to installation and are adversely impacting nuclear generation

  - Desired End State: By the end of 2022, the number of OEM parts-related impacts to generation reported through IRIS annually will be reduced by [25%] from years 2018 thru 2020 values (nominal 22 events per annum). Scrams and Operationally Impact Equipment Failure Events (> 20% down power with < 10 days planning) attributed to parts quality will also be reduced by [25%]

Recent Parts Quality Area For Improvement (AFI's)

- Deficient parts resulted in an unplanned power reduction, deferral of critical preventive maintenance, and delays in returning critical equipment to service.
  - Contributing: Procurement personnel do not have necessary information to identify the key characteristics for some critical parts.

- Shelf-life controls are not established for replacement parts on some equipment important for reliable operation. This has contributed to a critical relay failure and issuing deficient parts that could not be installed in the plant.
  - Contributing: Supply chain personnel have not performed thorough shelf-life evaluations when applying stock codes to replacement parts important to plant operation.

- Engineers and supply chain personnel do not provide reliable spare parts for some components important to safety and generation. This resulted in a reactor coolant system pressure transient and increases the potential to extend planned maintenance activities.
  - Contributing Cause: Managers do not ensure that receipt testing programs adequately identify quality issues and that minimum stocking levels are maintained for some critical spare parts.

INPO Industry Event Report 21-4 Improving Plant Reliability

The primary focus of the IER and its recommendations is to improve the behaviors of corporate and site leaders and staff in support of plant reliability.

Seven (7) recommendations designed to embed Equipment Reliability into the fabric or culture of the organization

INPO Guidance for IER Recommendation Responses

(From IER response template)

Each IER recommendation should be analyzed for actions, and, at a minimum, the following should be documented:

- the applicable station standard, process, or procedure
- an explanation of whether there is a gap between these and the IER recommendation
- actions, owner including corrective action number and due date, to close any identified gaps

- Note: Future INPO E&As will be evaluating the responses to the IER recommendations – looking for results not just compliance

Suggested Strategy for Addressing IER Recommendations

- Identify the GAPs between your current practices/programs and the IER recommendations
  - Benchmark recognized high performing organizations
  - Perform a Self-Assessment of your existing EQ/Parts Quality programs
  - Evaluate the INPO bubble chart for Parts Quality/Availability issues especially ER.3
  - Review all significant events
  - Review IRIS reports
  - Review AFIs from your utility and all others in the area of Equipment Reliability and make sure your corrective actions you are committing to in your IER response will prevent or mitigate the AFIs
  - Review the last INPO E&A advanced information package sent to INPO

Suggested Strategy for Addressing IER Recommendations (con't)

Strategy:

- Don't over commit in your response, you can always add additional commitments internally if further gaps are identified
- Although some level of specificity is required in the responses, allow flexibility to learn as you go
- Make your response results based – expected outcome not just efforts

Suggested Strategy for Addressing IER Recommendations (con't)

Focus on Non-Safety Critical Components and Parts

- Until recently, there has been a lack of rigor in the identification, purchase, receipt, storage and handling of this population of parts – this is why this population is causing most of the events and issues
- In some ways, treat these as Safety Related
  - NUPIC audits mainly evaluate for regulatory compliance – not vendor performance
  - Actual supplier performance improves the quality of these items through feedback to the supplier and/or selective sourcing of these parts and components
  - Although used in critical applications, to suppliers, these parts a just regular non-safety related parts that can be used anywhere and therefore are treated as such by the manufacturer/supplier

IER 21-4 Recommendations – Non-Parts Quality

1. SET DIRECTION - Functional Area: Organizational Effectiveness Senior corporate and site leaders establish a clear expectation that solutions to equipment shortfalls that could lead to consequential events are addressed cross-functionally.
2. APPLY CONTINUOUS LEARNING Functional Area: Organizational Effectiveness - Senior leaders ensure that managers and site staff fully leverage operating experience (OE) and industry best practices when determining solutions to equipment shortfalls that could lead to consequential events
4. STRENGTHEN RISK RECOGNITION AND MITIGATION WHEN PREPARING FOR AND PERFORMING TASKS Functional Area (4a.): Operations/Operational Focus Functional Area (4b.): Equipment Reliability Functional Area (4c.): Engineering/Configuration Management
5. ENHANCE RISK-ELIMINATION BIAS IN DECISION MAKING - Functional Area: Organizational Effectiveness: Ensure corporate and site leader's decisions demonstrate a risk-elimination bias when addressing degraded conditions that may result in a consequential event. Verify that governance and agendas for forums that address emerging equipment issues, such as work management, strategic plant health, and operational decision-making are addressed
7. ESTABLISH HIGH STANDARDS IN VENDOR AND SUPPLEMENTAL PERSONNEL OVERSIGHT

   (7a): Engineering/Configuration Management Functional Area - Oversight of Vendor Workmanship

   (7b): Maintenance, Work Management, and Outage - Oversight of Supplemental Workers:

IER Recommendation 3

1. IMPROVE SELF-AWARENESS AND SELF-CORRECTION Functional Area:
    1. (3a.): Equipment Reliability
    2. (3b.): Equipment Reliability Functional Area
    3. (3c.): Organizational Effectiveness Functional Area
    4. (3d.): Training

a. Conduct cross-functional analysis of systems, structures and/or components that have been the predominant contributors to equipment-related consequential events at your utility/station over the past three years, including extent of condition. Analyses should consider data from other stations (based on fleet membership, Nuclear Steam Supply System (NSSS) design and vintage) to identify equipment populations that are most likely to contribute to equipment-related consequential events

b. Validate that equipment-related event trending includes cross-functional stakeholders (including vendors) and that periodic cross-functional management-level reviews

c. Ensure organizational and programmatic evaluations include cross-functional stakeholders (e.g., supply chain for parts failures, OEMs, vendors) and identify the drivers for equipment-related consequential events. At a minimum, employ GDAR techniques for completeness

d. Conduct training performance analysis whenever appropriate

Addressing Recommendation 3

Ensuring the correct causes were identified when the issues were previously evaluated is the first step to addressing this recommendation

- When Significant failures occur, utilize formal independent failure analysis to help get to the right cause – 50 percent of investigations don't get to the correct Root or Contributing causes
- Utilize a formal CAP evaluation whenever a significant ER failure occurs which will automatically drive use of OPEX, ID of Extent of Condition and will ensure these events show up in site trending, and will drive site ownership (not just ER or Supply) of significant EQ failure events
- Ensure all issues included in the ER bubble chart have formal CAP evaluations tied to them, ensure Supply Chain leadership is on the ER bubble chart approval committee
- When performing Extent of Condition review, it needs to be broad enough to evaluate similar not just the exact items across the system, site, and fleet

Addressing Recommendation 3

- Utilize near misses in your trending, as causes of less significant events are same causes as significant events however, fortunately a barrier mitigated the outcome
- Integrate Parts Quality Into the Utility or Site Management Model
- Utilize Powerlabs Onelab and Paragon PEAKS data capabilities when evaluating Operating Experience or performing equipment trending
- Utilize data from existing programs such as CAP, Component, and Plant Health gather the information that is needed to address this recommendation
- Some utilities perform a common cause analysis of all Equipment Failure related events that are deemed significant based on CAP significance level either from a Nuclear Safety Perspective or from an Equipment Reliability perspective

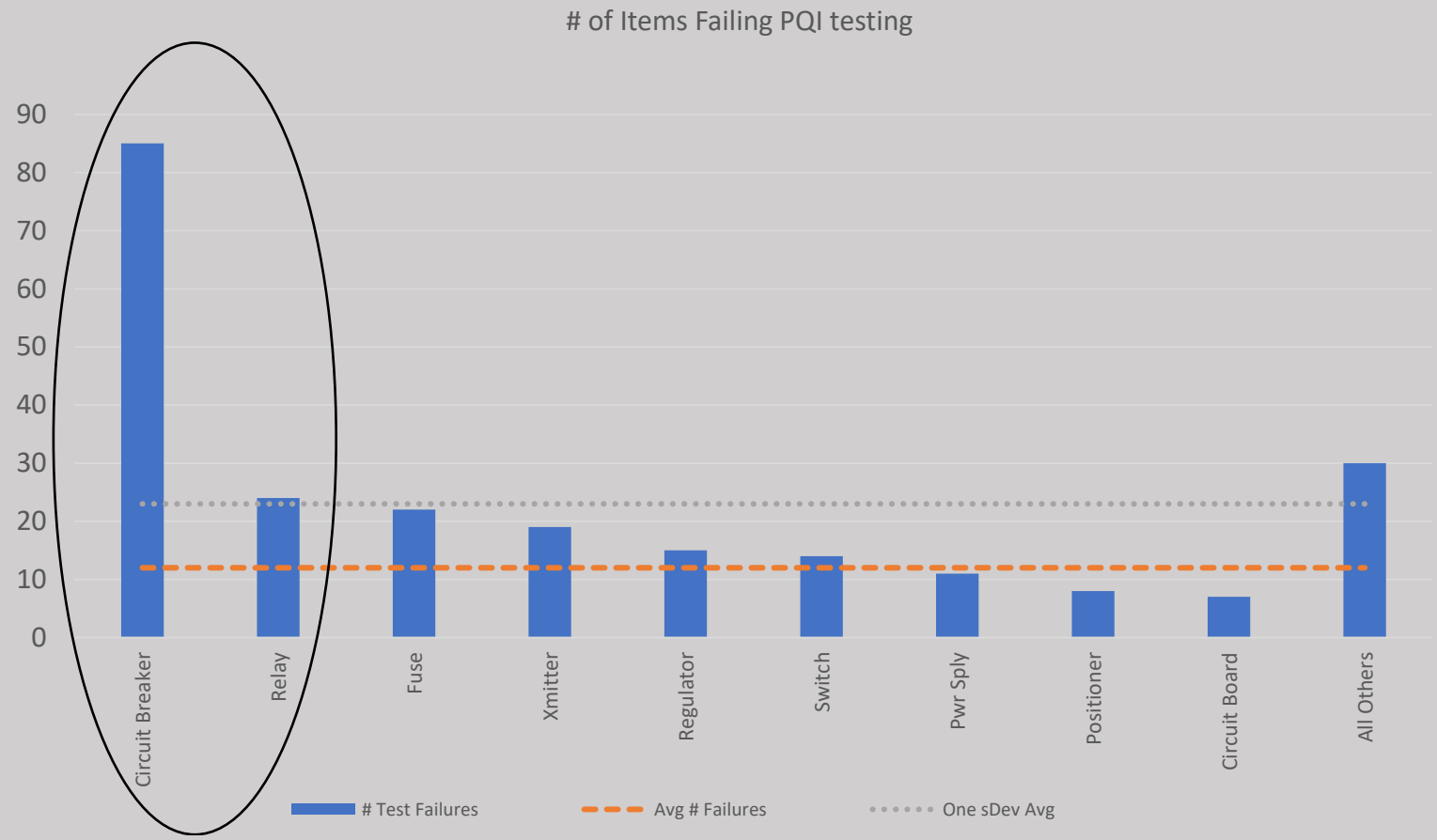
Addressing Recommendation 3 - Trending

Effective trending should include all sources of equipment failure information including:

- Cap data including condition reports, investigations and evaluations
- Work Order information
- OSD&D – specifically damaged items or non-conformances
- Work Management information
- System and Component Health
- Internal and External OPEX
  - IRIS Reports
  - Powerlabs Failure Analyses
  - Powerlabs PQI Failures

- Analyze trends using a formal CAP process such as common cause analysis – ensure that the final product is evaluated and approved by Station Sr. Leadership, not just managers from your department

Example of a Utility's CCA on Parts Quality



IER Recommendation 6

Recommendation 6: ESTABLISH A SUSTAINABLE PARTS QUALITY PROCESS
Functional Area: Equipment Reliability

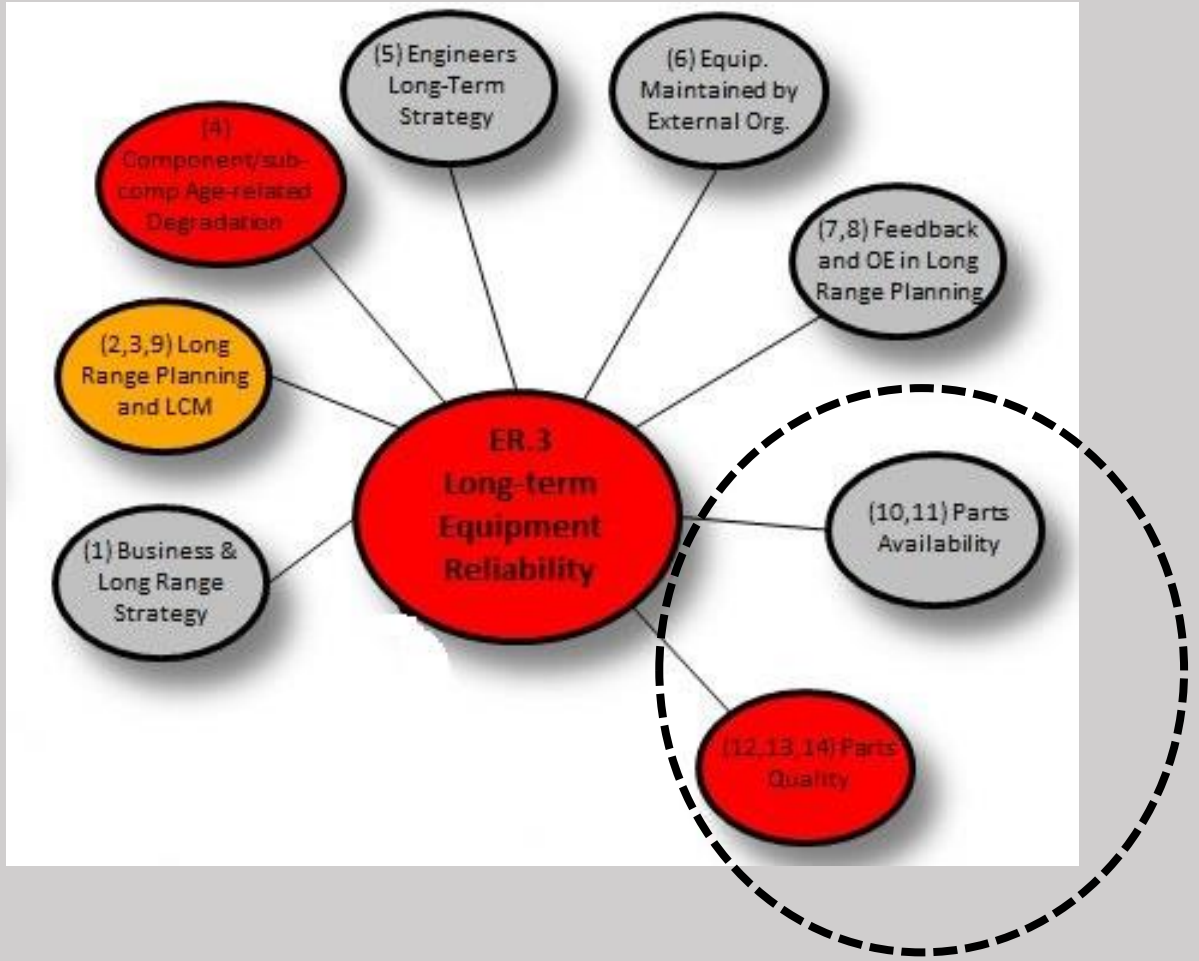
Validate that standards to procure, inspect, and test parts for equipment whose failure may result in a consequential event, consider the consequence of degradation or failure of that specific part. Ensure the resulting treatment of the part is tiered according to its consequence determination, such that higher consequence parts undergo increased scrutiny in procurement, inspection protocols, and testing to minimize their probability of failure. Both internal and vendor trending data, if available are important elements in this determination.

What is a Parts Quality Process?

The Parts Quality Initiative (PQI) is dynamic continuous learning process that utilizes internal and external Operating Experience to ensure that critical parts and components important to nuclear safety and reliable plant operation can perform their critical or important functions once installed.

- This is accomplished through:
  - Additional Pre-receipt testing of Critical Parts and Components
  - Enhanced Receipt Inspection
  - Improved Purchasing Rigor
  - Better Identification, Storage, and Management of Critical Parts
  - More accurate equipment failure cause identification and problem correction
  - Continuous monitoring of Parts Quality through Performance Indicators and Trending
  - Effective Supplier Performance Process

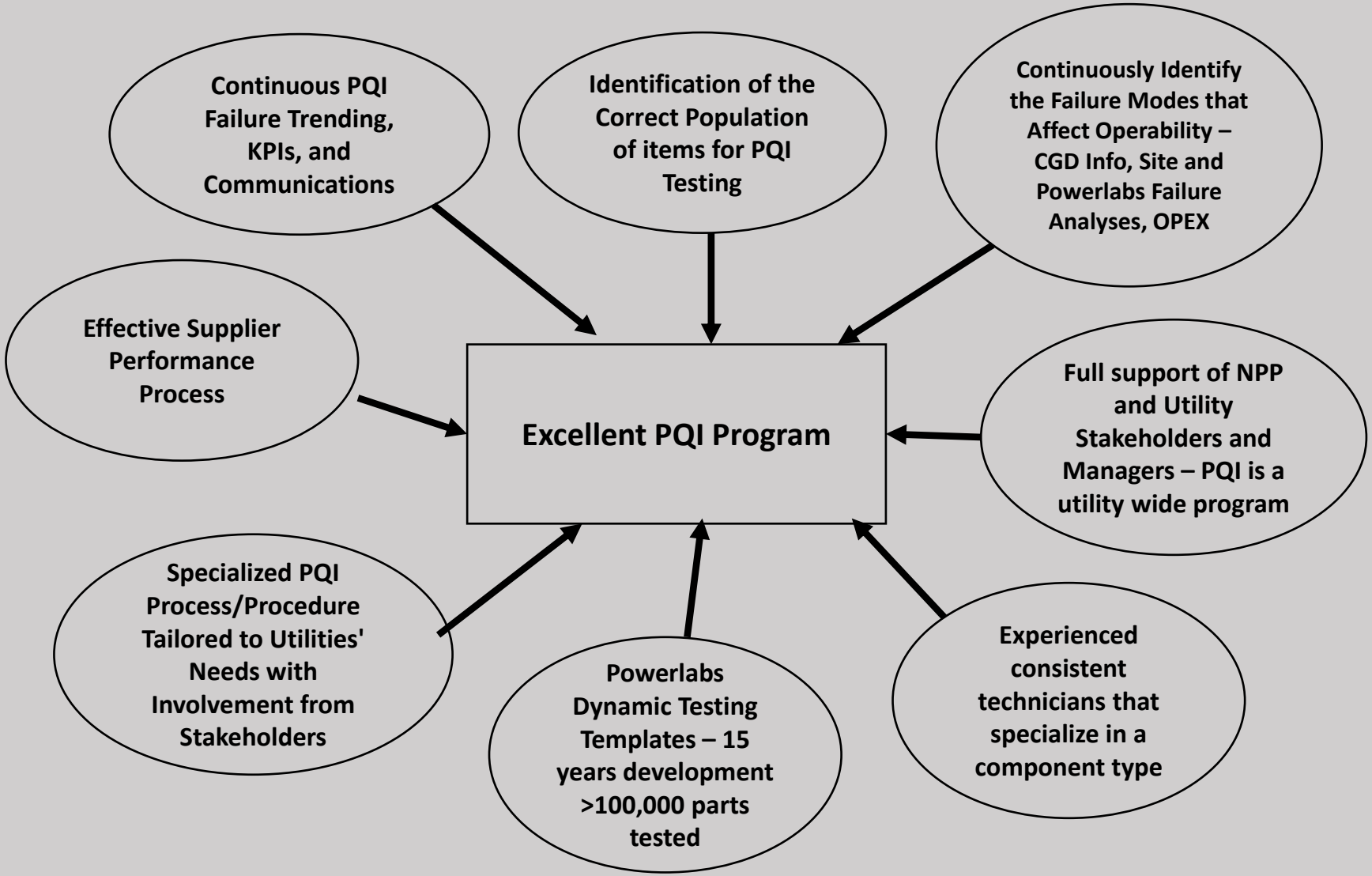
ER.3 Bubble Chart



Causes of Equipment Failures/Availability Issues

- Inadequate Management of Known Failures
- Maintenance Work Practices
- Improper Critical Characterization of Component/Part
- Inadequate or Lack of PM (Inadequate Maintenance Strategy)
- Inadequate Design or Mis-application of part
- Inadequate Operation of component
- Improper or Inadequate Purchase Specification
- Manufacturing Defect
- Inadequate Receipt, Storage or Improper Handling of parts/components

Elements of an Excellent Parts Quality Program



Implementing a Sustainable Parts Quality Process

- Identify the right population of parts for your PQI process (AP-913 helps provide guidance)
  - Utilize internal information and external Operating Experience to identify the parts that need to be PQI tested
- Implement tools that help to improve rigor in all aspects of the supply chain processes from procurement specification development through storage and part issuance
- Develop a PQI process procedure
  - Ensure end users are involved in the development of the procedure
- Perform pre-receipt testing of the PQI population
  - Suggest independent 3rd party testing such as PowerLabs
- Implement the new PQI process using change management techniques

Implementing a Sustainable Parts Quality Process

- Use the CAP process whenever possible – this shifts ownership of parts quality to the station instead of just supply or ER
- Ensure formal management oversight of processes that affect Parts Quality
- Implement KPIs to help identify when Parts Quality issues are trending adversely
  - Availability of Critical Spares – all levels
- Formalize Supplier performance – not just NUPIC, but how is it improving performance
- Note: PQI testing is not all there is to a Parts Quality Process
  - Understand how Parts Quality issues are characterized in the bubble chart, evaluate the guidance on how equipment failures go into which bubble chart quadrant

Other Attributes of a Successful Parts Quality Process

- Improving Parts/Component quality is not just about PQI testing, its about ensuring they will perform their operable and safety functions until their next maintenance strategy window.
  - There are many tools that can help from design through purchase, receipt, stocking and issuance

- Measure and Communicate Return on investment for the PQI program:
  - Prevented replacement cost of failed parts
  - Monetized value of prevented events and issues

Avoided Parts Replacement Procurement/OSD&D for Failed Parts					
Event Avoidance Cost For Failed Parts					
Project Number	**Component Category**	**Qty Failed**	**Component category: SPV, Critical Component, CC Tech Spec, or High Crit Work Order?****	**If SPV, est. $1.5M/part failed, if CC, est. $500k/part failed, if CC Tech Spec, est. $150,000/part failed, if High Crit Work Order, est. $2,500/part failed**	**TOTAL Event Avoidance Cost for All Parts Failed in Project**
ABC-05919	Fuse-Fast Acting	1	Critical Component	$500,000.00	$500,000.00
ABC-13270	Fuses	1	High Crit Work Order	$2,500.00	$2,500.00
ABC-14874	Regulator- Precision	1	High Crit Work Order	$2,500.00	$2,500.00
ABC-15157	Fuses	29	High Crit Work Order	$2,500.00	$72,500.00
ABC-15390	Serial Card	1	Critical Component	$500,000.00	$500,000.00
ABC-91147	Master Trip	1	Critical Component	$500,000.00	$500,000.00
ABC-92908	Temperature Gauge	1	High Crit Work Order	$2,500.00	$2,500.00
ABC-01785	Protective Relays	1	High Crit Work Order	$2,500.00	$2,500.00
ABC-33685	Masoneilan-Dresser	3	High Crit Work Order	$2,500.00	$7,500.00
ABC-34337	ABB	1	Critical Component	$500,000.00	$500,000.00
TOTAL Avoided Costs for All Projects					**$2,090,025.00**

How can we help?

- We can help implement an effective PQI program for your utility/site
  - Several different approaches that meet staffing and budget constraints yet exceed the intent of IER 21-4
  - We can quantify the benefits or value of the PQI test failure
- We can perform objective 3rd party failure analyses
- We can help you with trending of failures from both internal and external data sources
- We can help prepare for your next INPO E&A
- We can assist with CAP Evaluations/Investigations for Equipment Failures

Pre-Webinar Comments and Concerns from Attendees

- Quality and cost
- How OPG will respond and comply
- Ensuring alignment with industry.
- So far we have not found any gap but an independent discussion will be an eye opener to consider additional aspects.
- Testing
- Lack of awareness and understanding
- Interested in learning more about this topic from industry leader for application at the station where I work.
- New program implementation
- The identification of the components that should be included in the population.
- Increased expectations in quality assurance for non-safety parts.
- Knowledge
- Alignment with the industry
- IER team member
- OPEX for SMR/New Build.
- Our actions improve plant reliability.
- IER 6 (Parts Quality)
- Parts Quality Initiatives
- Development and implementation of a PQI testing program
- Actually effecting sufficient change to prevent events with constrained resources.
- Changes in vendor community related to supporting Nuclear parts due to liability
- Parts quality and quantity
- Additional Costs and Delivery Timeline of Parts

Follow Up Discussion

If you have any other IER concerns that were not addressed in this webinar or would like to talk more, please let us know!

If you select ***yes*** in the poll, we will reach out to you directly.