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Improving Nuclear Safety by Maximizing the Benefits of Flex

Roy Linthicum (Exelon)
Chairman, PWROG Risk Management Committee

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Flex in Risk-Informed Decision Making

Why would we do this?

- Leverage resources spent to implement Flex to maximum safety benefit without undue additional cost:
 - Consistency in use and treatment
 - Develop common industry guidelines for use in risk-informed regulatory activities reviewed / endorsed by NRC
 - Minimize regulatory burden/uncertainty/risk associated with the use of FLEX
 - Treatment under the Maintenance Rule

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Alternative Uses of FLEX Equipment

- Reduce outage risk and duration
 - Provide additional alternatives for maintaining functions while performing maintenance
 - Improves familiarity with deployment of equipment
- Risk reduction during on-line maintenance
 - Planned and unplanned Maintenance
 - NOEDs – compensatory actions
 - Improves familiarity with deployment of equipment

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Alternative Uses of FLEX Equipment

- Crediting FLEX in the PRA and/or for defense-in-depth is beneficial for:
 - ROP processes:
 - Significance Determination Process
 - Mitigating Systems Performance Indicator
 - Security
 - Risk Informed Licensing activities:
 - Risk-Informed Tech Specs
 - NFPA 805
 - Risk-Informed Special Treatment
 - Other Risk-Informed changes

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Flex Modeling Considerations

- It should not be assumed that Flex will provide a significant reduction in core damage frequency (CDF)
 - Flex design is not Risk-Informed
- Modeling of Flex still faces several hurdles
 - Human Reliability Modeling
 - Current techniques assume detailed procedures are required to provide high reliability
 - Longer times available for deployment are treated conservatively
 - EOP steps for Typically only in for Station Blackout Procedures
 - Not generally included in Functional Recovery Procedures
 - Impact on other regulations may reduce value of Flex by limiting treatment in EOPs
 - Reliability/Unavailability Data for portable equipment is limited

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Flex Modeling Considerations

- Flex benefits can be estimated using existing techniques following feasibility assessment for specific accident scenarios
 - Use of bounding Human Reliability Values
 - Limiting credit to internal events/fires/design basis external events
 - Use of reliability values for portable equipment from other (e.g. military) applications

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Feasibility Assessment

- Equipment Capability
- Equipment Availability
- Reliability, Testing, and Maintenance
- Location and Transportation Capability
- Time Availability and Margin
- Procedures and Written Instructions
- Training
- Staffing and Communications
- Environment Challenges

For some applications (e.g., On-line/Outage Risk Assessments, NOED, etc.), pre-staging can provide significant benefit

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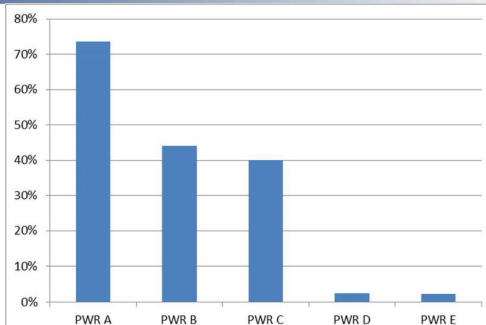
Flex Equipment Readily Credited in Internal Events Models

- FLEX pumps for Core Cooling Heat Removal
- FLEX pumps for RCS inventory control
- ESF Bus connections for FLEX 480 VAC generator(s) to supply power to 480 VAC buses
- Procedures for cross-tying DC buses between units
- Essential Service Water Short Circuit Modification

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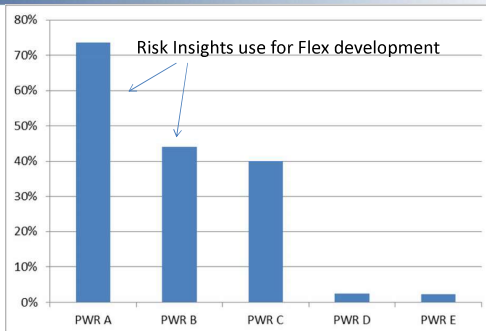
Flex Improvement to Internal Events CDF



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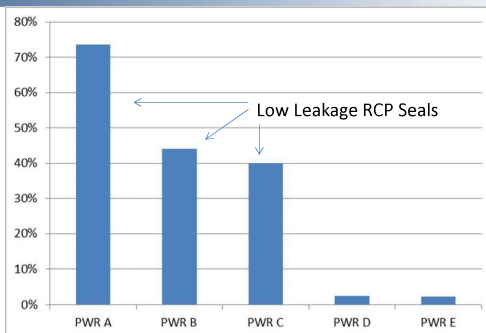
Flex Improvement to Internal Events CDF



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Flex Improvement to Internal Events CDF



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Lessons Learned from Modeling Flex

- Low Leakage RCP Seals provide significant benefit (regardless of hazard)
- Use of risk insights in development of Flex strategies can significantly improve risk benefits
 - Ability to provide feed to the Steam Generators without the need for initial use of the Steam Driven Auxiliary Feedwater
 - Incorporation of Flex in other EOPs (e.g., Function Recovery Procedures) in addition to SBO procedures
 - Shorter time lines for connecting equipment
 - Could conflict with requirements for Flex equipment protection
 - Pre-staging Flex equipment for during equipment outages

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Lessons Learned from Modeling Flex

- Full impact of Flex should be considered, even if Flex equipment is not modeled
- EOP changes could change sequence of events (e.g., early load DC load shed) which could complicated future recovery actions that are already modeled.

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Conclusion

- Plants should take advantage of the option to expand the use of FLEX to further manage plant risk. This can result in substantial safety improvements related to:
 - During shutdown operation
 - During normal plant operation
 - For additional accident scenarios
 - In Risk-Informed Applications

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