Agenda

• IEEE Conformity Assessment Program (ICAP) - Certification
• International Collaboration
• Standards for Current Nuclear Power Operating Fleet
• Standards for Future Reactors
IEEE-SA Rigorous Standards Process

The widely respected IEEE-SA standards-development process produces results that reflect the collective, consensus view of participants and enables industry to achieve specific objectives and solutions.
Benefits of IEEE Conformity Assessment Program (ICAP) -- Certification

- Mitigate the uncertainties 1E electrical equipment procurement.
- Cost savings on source verification and audits
- Limit fraudulent product issues
- Independent assessment on compliance to the standard and in turn to the regulatory requirements
Industry Issues

- Counterfeit, Fraudulent & Sub-Standard parts
  - USNRC Notice 2008-04
    - Plant Hatch – Counterfeit Stator Water cooling stop check valves
    - CPSC recalls counterfeit circuit breakers labeled “Square D”
  - CNSC in February 2014 acknowledged increased occurrence of CFSI and the proactive measures they were putting in place
  - In 2012 Executive Director of IEA indicates that countries should be vigilant and well resourced to take appropriate decisions

- Investigations conducted in 2012 concludes that:
  - More than 8000 parts found in the past decade
  - Impacted 11 nuclear power units
  - Doctoring of test reports, false certificates and misrepresented test data
Impact

- Time delays
  - Construction delays
  - Shutdowns from faulty equipment
- Added expenditure from independent Quality Assurance Audits, inspection & verifications
- Potential loss of public trust
Goals of NPEC Conformity Program

- Class 1E devices used by end users in nuclear power facilities should conform to IEEE 323 standard
- Class 1E device conformity should be certified
- Conformance should be assessed by third party authorized independent experts and/or authorized test laboratories
- Certified devices may bear an IEEE certification logo and listed on a public registry managed by IEEE
Major Stakeholders

- **Utility & Plant owner Benefits**
  - Ability to leverage a common, shared resource for certification and testing
  - Expanded base of compliant suppliers
  - Interoperability to minimize risks of deployment choices
  - Lower occurrence of fraudulent and non-compliant products

- **Vendors**
  - Expanded potential national and global market
  - Reduced burden for utility required testing

- **Regulatory Agencies & Local governments**

- **Plant designers and engineers**

- **EQ testing facilities**

- **Insurers**
SEAMLESS INTEGRATION
BETWEEN
IEEE CERTIFICATION PROGRAM PARTICIPANTS

IEEE Process

Accredited Labs  Certified Products  Nuclear Power Plants
NPEC Conformity Assessment Steering Committee

- ICAP Committee of invited subject matter experts from utilities, regulators, manufacturers, testing laboratories and independent consultants
  - Formed in October 2014
- Chaired by Jonathan Cornelius (Tyco) and John White (Past SC2 Chair)
- Participation from North America, China and Europe
- Developing Lab auditing and qualification process
- Developing Equipment certification process
- Developing test report template
- Determining requalification and re-testing frequencies
Conformity Assessment Certification Scheme – Single Scheme

- Products
- Laboratory(ies)
- Certification Body(ies)
- Accreditor(s)

ISO/IEC 17011 + Competency requirements
ISO/IEC 17065 + competency requirements
ISO/IEC 17025 + competency requirements
Performance/Design Requirements

Scheme Owner harmonizes technical requirements

Oversight & Communication Agreement

Courtesy of G. Gillerman @ NIST
Lab Accreditation – Planned Process

- All IEEE Approved testing facilities will be:
  - Audited for their technical competence and quality systems
    - Utilizing ISO/IEC 17025 standard and relevant IEEE NPEC stds.
  - Qualified to one of THREE categories
    - Category 1 – Lab can perform testing independently
    - Category 2 – Lab can perform testing after IEEE approval of test plan
    - Category 3 – Lab can perform testing under IEEE witness
  - Audited every 3 years
  - Published and listed on the IEEE Certification Program website
Lab Accreditation – Planned Process

- Three labs have been identified as pioneer labs
  - Curtiss Wright, Kinetics & NTS
  - MoUs were signed in 2015
  - Planning for IEEE audits in Q3/4 2016

- IEEE Audit Checklist
  - Encompasses NUPIC, NQA-1, NAIC, 10 CFR 50 Appendix B requirements
  - Assessment of laboratory quality systems based on ISO/IEC 17025

- Audit Process
  - Documentation audit - conducted before onsite
  - IEEE will assemble audit team – composed of QA & technical experts
  - To assess lab’s technical competence to test to IEEE stds
Audit Scope

IEEE 323
- Aging
  - Pressure and temperature profile
  - Relative humidity
  - Thermal Aging
  - Thermal Cycling
  - Radiation environment *
  - Non-seismic vibration
  - Operating cycles
  - Mechanical Cycling
  - Electrical loading and transients
  - Qualified Life
- Design Basis Accidents
- Condensation, chemical spray, and submergence
- EMI/RFI and power surges
- Flammability (where applicable)*

IEEE 344 – Seismic
- Seismic operating basis earthquake (OBE)
- Seismic Safe Shutdown Event (SSE)
Product Certification – Planned Process

- All Certified Devices:
  - Shall be tested at an IEEE Approved testing lab
  - Have test reports that are reviewed by an IEEE technical reviewers prior to certification
  - All manufacturers undergoing certification shall sign the IEEE certification agreement
  - Shall undergo periodic evaluation to ensure compliance
  - Shall be published and listed on the IEEE Certified Products Registry
  - Will utilize the IEEE Certification Logo on the product and marketing materials
  - Unique, traceable certification number will be provided by IEEE
Product Certification – Grandfathering

- Product must be available for sale
- Report must be in IEEE format and reviewed by IEEE Technical reviewers
- Equipment used to perform testing must have been calibrated with NIST certification or equivalent
- Product has to be previously qualified by:
  - An IEEE accredited lab or their predecessors or
  - An original equipment manufacturer (OEM) with a qualified product, can submit product as an accredited vendor for IEEE certification under their QA program.
    - Any manufacturing changes (including locations) must be addressed;
    - Change in materials must be identified and addressed
    - NRC Part 21 notices (including sub-components must be reviewed and addressed
    - Design changes evaluated (changes in parts and sub-components) and determined not to impact qualification
    - Change in owners
    - Changes in form, fit and function must be evaluated
Product Certification
Grandfathering

- Test anomalies must be IEEE reviewed and disposition concurred with
- Radiation certificates must be provided
- Test samples must be specifically identified, including part numbers of what was tested e.g. auxiliary switch, auxiliary contacts, etc.
- IEEE registry to differentiate grandfathered vs. newly tested product.
IEEE Certification Mark

- Suggested Certification Mark for Class 1E product certification

[Image of IEEE Certification Mark]

FILE # / Category

NPEC XXXXX
Other reading materials

- Proposed IEEE Conformity Assessment Program White Paper available

- EnergyBiz Article

- Recent Press Releases
## International Collaboration - International Electro-technical Commission (IEC)

### Joint Standards Issued

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<thead>
<tr>
<th>Standard</th>
<th>Year</th>
<th>Title</th>
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<tbody>
<tr>
<td>62582-1</td>
<td>2011</td>
<td>Nuclear power plants - Instrumentation and control important to safety - Electrical equipment condition monitoring methods - Part 1: General</td>
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<tr>
<td>62582-2</td>
<td>2011</td>
<td>Nuclear power plants - Instrumentation and control important to safety - Electrical equipment condition monitoring methods - Part 2: Indenter modulus</td>
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<td>62582-3</td>
<td>2012</td>
<td>Nuclear Power Plants - Instrumentation and control important to safety - Electrical equipment condition monitoring methods - Part 3: Elongation at break</td>
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<td>62582-4</td>
<td>2011</td>
<td>Nuclear power plants - Instrumentation and control important to safety - Electrical equipment condition monitoring methods - Part 4: Oxidation induction techniques</td>
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<tr>
<td>P60780-323</td>
<td>2016</td>
<td>Qualification of Electrical Equipment Important to Safety for Nuclear Facilities REGULATORY GUIDE 1.89 - to be revised</td>
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### Joint Standards with IEC Under Development

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<th>Type</th>
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<tr>
<td>IEEE-344</td>
<td>Revision</td>
<td>Seismic Qualification of 1E Equipment</td>
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<tr>
<td>IEEE-1082</td>
<td>Revision</td>
<td>Human Action Reliability Analysis for Nuclear Power Generating Stations. THE NEW REVISION WILL BE ADOPTED BY IEC</td>
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<tr>
<td>P62582-5</td>
<td>New</td>
<td>Nuclear Power Plants - Instrumentation and control important to safety - Electrical equipment condition monitoring methods Part 5: Optical time domain reflectometry</td>
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International/ National Collaborations

- IEEE membership collaboration in NPEC with Japan, Germany, China, India, Sweden, etc.
- Joint Committee with ANS
- Nuclear Energy Institute Participation
- EPRI
- Nuclear Utility Group on Equipment Qualification
NRC Utilization of IEEE Standards

- Incorporated into Regulations
- Endorsed through Regulatory Guides
- Referenced in Standard Review Plan for license applications / amendments
Areas of Standards Endorsed Through Regulatory Guides

- Battery, sizing, maintenance
- Electrical Control Systems (Analogue & Digital)
- Class 1E Electrical Power System
- Primary Guidance for Environmental Qualification and various daughter standards for qualifying electrical equipment
- Seismic Qualification
- Human Factors (in process)
- Post Accident Monitoring
### IEEE Standards Incorporated into Regulation by NRC

<table>
<thead>
<tr>
<th>Standard</th>
<th>Edition</th>
<th>Title</th>
<th>CFR Location</th>
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<tbody>
<tr>
<td>IEEE 279</td>
<td>NDG</td>
<td>Criteria for Protection Systems for Nuclear Generating Stations</td>
<td>10 CFR 50.55a(h)(2)</td>
</tr>
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</table>
Concepts Considered for Future Reactors

**Approach for Fault Tolerance**

- Consideration of Three Safety Trains (n+2)
- Channels and divisions contained within fire zone (zone of influence) with two instrument channels in a Division
- Power supplies contained within divisional zone (DC power, inverter, Emergency Diesel Generator)
- Process signals shared for logic cabinets only through fiber optic cables without any metal sheathing
Concepts Considered for Future Reactors

- Ideal Separation for fire, electrical, and train independence
- Worst failure takes out only one electrical train and two instrument channels and it is contained in a fire zone
- Use of qualified optical cables between divisions/channels to prevent propagation of energy or any other deleterious effects
Contacts

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