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Abstract

The IEEE Standards Association (IEEE-SA) and the IEEE Nuclear Power Engineering Committee (NPEC) formed the NPEC Conformity Assessment Steering Committee (NPEC CASC) in September 2014.

The NPEC CASC boasts an outstanding constituency of members in the domain of nuclear power technology who share a common vision to accelerate IEEE standards adoption through conformity assessment and certification programs. Participants in NPEC CASC include representatives from device manufacturers, test laboratories and the end-user community.

IEEE-SA Conformity Assessment Program (ICAP) creates and implements initiatives that drive and accelerate certification programs throughout industry addressing a broad range of technologies. ICAP, along with the NPEC CASC, is looking into development of a conformity assessment program to support IEEE Std 323™ and other related standards. This paper will provide readers with an in-depth look at the current state of equipment qualification in the nuclear industry globally. It will also present the benefits of a comprehensive certification program. It will provide a varied perspectives ranging from a utility, plant owner, and manufacturer to regulators.

The following are considered key activities of the NPEC CASC:

- Recommend and consolidate program structure for the certification of Class 1E devices
- Recommend and establish compliance levels
- Provide guidance on test methods
- Recommend and establish test lab requirements and audit processes
- Recommend and establish test tool validation
- Act as certification program advocates
- Validate Test Plan/Report template

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The Institute of Electrical and Electronic Engineers (IEEE) is the world's largest professional association and a premier developer of global standards. Worldwide, IEEE has more than 425,000 members spanning more than 160 countries. The IEEE is composed of 45 Technical Societies that are active in 160 countries. Annually IEEE has at least 1,600 conferences and in its history has issued more than 3.7million technical documents.

The standards development organization within IEEE is the IEEE Standards Association (IEEE-SA). IEEE-SA develops standards that are globally recognized, in an environment that operates in an independent community and has an open standards process. This helps ensure the development of independent and consensus standards, which can be broadly applied and adopted. The IEEE-SA process has resulted in the issuance of over 900 active standards that have been developed by more than 20,000 standards developers located on every continent. This process is widely recognized and respected, and aligns with

the World Trade Organization (WTO) and Open Stand principles. The process is transparent, open and cooperative, resulting in openness and consensus standards that are based on current scientific and technological knowledge.

The IEEE Nuclear Power Conformity Assessment Program is being developed collaboratively by the IEEE Nuclear Power Engineering Committee (NPEC) and the IEEE-SA Conformity Assessment Program (ICAP). NPEC is a committee consisting of more than 300 members operating under the IEEE Power and Energy Society. This partnership will implement certification program initiatives for both Class 1E (IEEE) and Important to Safety (IEC) components to nuclear qualification standards. Class 1E and Important to Safety components are crucial to operation and safe shutdown of nuclear power generating stations.

In 2002, IEEE and the International Electrotechnical Commission (IEC) entered into an agreement to allow the adoption of IEEE standards by IEC. In 2008, this agreement was expanded to allow the joint development of standards. The agreement now allows the two organizations to work collaboratively to develop new or revise existing IEEE or IEC standards and issue them as a dual logo document.

Draft Standard IEC/IEEE P60780-323 *Nuclear facilities—Electrical equipment important to safety—Qualification* represents the most significant dual logo standard addressing qualification of electrical equipment within each organization. The standard is applicable to electrical equipment important to safety and its interfaces. This includes components that are necessary to perform a safety function, or whose failure could adversely affect the safety function of other equipment thus diminishing plant safety. The IEC/IEEE dual logo document now represents the only qualification standard for electrical equipment that is both a consensus document and has worldwide acceptance and recognition.

The IEEE Certification program will apply to all IEEE 323 qualified components, including daughter standards. The family of standards will include the following:

a) IEEE Std 323™—Equipment Qualification
b) IEC/IEEE 60780-323—Equipment Qualification
c) IEEE Std 334™—Qualification of Motors
d) IEEE Std 382™—Qualification of Actuators
e) IEEE Std 383™—Qualification of Cables and Splices
f) IEEE Std 344™—Seismic Qualification
g) IEEE Std 627™—Qualification of Safety Equipment
h) IEEE Std 572™—Qualification of Connectors
i) IEEE Std 650™—Qualification of Battery Chargers/Inverters
j) IEEE Std 649™—Qualification of Motor Control Centers
k) IEEE Std 1682™—Qualification of Fiber Optic Cables

In the second decade of the 21st century, the nuclear power industry is facing new challenges. Both countries and companies that did not participate in the first generation of nuclear power plants are now taking leadership positions in the development of the next generation of nuclear power plants. The challenge to the nuclear industry is how to effectively transfer knowledge and lessons learned onto this new generation of nuclear engineers. One aspect of nuclear power implementation that has withstood the test of time is IEEE standards.

IEEE standards have been successfully used as a basis for qualification of equipment for more than 40 years. As this new era begins, the effective use of IEEE standards will help continue to provide assurance

that new reactors are designed, built, and maintained to the highest levels for continued safe and reliable operation.

The resurgence of nuclear power is being driven by the increase in the global demand for power. This tremendous need for power is also being balanced by demands for a cleaner environment. As a result, more and more countries are looking toward nuclear power as the solution. The current designers of nuclear power plants must not only ensure that nuclear safety is maintained, but that plants are designed, constructed, licensed, and maintained economically. The huge cost overruns that plagued the first generation must be avoided with this new generation of plants.

Due to the significant advancements in technology over the past forty years, the new generation of plants will have more advanced safety features than previous designs. The advancements in technology have also led to different technical challenges. Conformity Assessment could be a viable method to help address these challenges.

Globally, the nuclear industry has always had to deal with counterfeit, fraudulent, and sub-standard parts. Ensuring that issues such as these were addressed was at the heart of why qualification standards were developed more than 40 years ago. But as technology has changed to the benefit of better plant and equipment designs, it has also introduced new challenges to address the following:

- Counterfeit parts can be more easily built and they are more difficult to detect.
- Components have become more complex and have new failure modes that must be evaluated.
- Strict adherence and compliance with qualification standards is more important than ever due to common mode failure and the implications on a greater number of operating units.

In 2008, the United States Nuclear Regulatory Commission (USNRC) issued Information Notice 2008-04 to inform nuclear power plant owners of the potential for counterfeit parts entering the supply chain [4].[1] The information notice was issued due to then two (2) recent events. In 2007, Plant Hatch discovered that the stator cooling water stop check valves were counterfeit. One valve was installed in the plant and one was in the warehouse. The notice further stated that the USNRC was aware that the U.S. Consumer Product Safety Commission (CPSC) had announced a recall of counterfeit circuit breakers labeled as "Square D". The recalled circuit breakers labeled “Square D” were manufactured in China and distributed from 2003 through 2006.

In 2012, the nuclear industry experienced the most significant occurrence of counterfeit parts and fraudulent quality assurance documents to date. The investigations that began in late 2012 eventually determined that over a 10-year period more than 8,000 parts, that affected 11 nuclear power units, had been used. The investigations revealed the doctoring of test reports, falsification of certificates, and misrepresentation of test data. These types of incidences resulted in significant costs, time delays, and loss of public trust. The corrective actions forced modifications in construction schedules, shutdown of operating units for component replacement, and added expenditure to institute independent verification. (Refer to [1], [2], [3], and [5])

[1] Numbers in brackets refer to references found at the end of this document in the “Citations” section.

Counterfeit and fraudulent parts have been identified as affecting electronic components, circuit breakers, relays, fuses, fan motors, and control cables. The impact that counterfeit and fraudulent parts may have on safety and non-safety related equipment poses a significant safety and economic concern for the nuclear power industry. The potential for counterfeit and fraudulent parts to enter the nuclear supply chain will continue to grow. In the decades to come, more worldwide suppliers with no nuclear experience will enter the market. This growth will be driven by a need to support the growing demand for components to aid in new power plant construction.

Failures in design, qualification testing, or the validity of test results have a greater impact than ever on the nuclear power industry. Deficiencies in any of these areas can result in a large number of nuclear units being temporarily or permanently shut down. Entire countries can be adversely affected, and the economic and social cost would be devastating. The compliance, and validated compliance, with IEEE standards has never been more needed than it is today.

To address these issues, the IEEE nuclear power certification program is being developed to support equipment vendors who demonstrate compliance to IEEE standards and meet the requirements of IEEE's qualification standards. Once a product is IEEE certified, it is not only marked and identified as IEEE certified, but it becomes traceable via a web-based certified products registry that is maintained by the IEEE.

A nuclear power plant represents a substantial economic investment that must be operated in a safe and reliable manner in order for its full benefit to be realized. All major stakeholders benefit from IEEE certification. Compliance with IEEE qualification standards helps ensure that only certified components, meeting the most widely accepted qualification standards, are used. This benefits the following:

- Investors
- Local governments
- Regulatory agencies
- Insurance companies
- Plant designers
- Plant engineers

Investors, local governments, regulatory agencies, and insurance companies have greater confidence that only components certified as meeting the IEEE quality standards have been installed. Quality that is built into the design can help to protect the economic investment and help reduce operating risk.

The use of IEEE-certified components benefits plant designers and engineers during all phases of the plant's life cycle: design, construction, and operation. As previously stated, the use of IEEE-certified components can increase confidence in the quality of components used in the initial design. As the plant ages and replacement parts are required, the IEEE certification process provides plant engineers with a valuable tool to aid in the procurement and replacement process. The use of IEEE-certified parts allows plant engineers to expedite evaluation of components. If all evaluated equipment is IEEE certified, then cost and other non-critical attributes can be more effectively compared. It can help reduce inaccurate internal assessments of compliance.

The IEEE nuclear power certification program will address accreditation of test facilities and certification of devices intended to meet the nuclear industry's current best practices. For test facilities, the

accreditation process can be used to help verify that they have the design and quality assurance controls to perform testing to comply with IEEE's family of qualification standards. The result should help improve consistency between test facilities and may broaden their marketplace for services. An IEEE-approved facility providing testing services can also assist to add assurance that components have been tested in compliance with the current IEEE testing requirements. A periodic auditing process of testing facilities helps provide confidence in laboratory competency.

The IEEE conformity assessment program has successfully been used by the Telecom and Power and Energy Industry to demonstrate conformance to IEEE Std 1588, IEEE Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems and IEEE Std C37.118.1, IEEE Standard for Synchrophasor Measurements for Power Systems. The Telecom Industry has used the IEEE certification to demonstrate compliance to IEEE Std 1588, thus providing improved networking ability in factory automation, test and measurement, and other telecommunications applications that require very close time synchronization. The Power and Energy industry is gaining unprecedented value from having phasor measurement units undergoing testing and certification prior to deployment to help ensure smooth functioning of the power grid. The IEEE certification process is being used to improve quality control, interchangeability of parts, reliability, development of plug and play devices, and to help ensure global acceptance of products and services for these industries.

The adoption of IEEE Conformity Assessment Program for Nuclear qualification standards is the next step in improving nuclear safety worldwide. A stakeholder's requirement for use of the certification process can be implemented to help reduce the incidence of fraudulent parts and the likelihood for falsification of test reports, and to help improve reliability and safety. IEEE certification helps to ensure that quality is built into equipment qualification. Many of the challenges that have faced the nuclear power industry over the past several decades could have been ameliorated with a conformity assessment program. Use of equipment that is IEEE certified is an investment in the future, which will benefit future generations.

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