Status of IEEE Reliability Society Standards

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The IEEE Reliability Society develops and sustains IEEE standards, and encourages IEEE members and non-members to participate in the working groups and ballot groups. The IEEE Reliability Society Standards Committee (IEEE-RS-SC) is developing 2 new standards and sustaining 5 existing standards. The 2 new standards being developed are:

1. IEEE P1856 (Standard Framework for Prognostics and Health Management (PHM) of Electronic Systems)
2. IEC/IEEE P61014 (Standard for Programmes for Reliability Growth (RG))

PHM Standard and Working Group

The new PHM standard is titled: "Standard Framework for Prognostics and Health Management (PHM) of Electronic Systems". A Project Authorization Request (PAR) was submitted to the IEEE Standards Board and was approved. An IEEE PHM Working Group is being formed under the leadership of Dr Michael Pecht and Dr Sony Mathew to complete the draft standard. The first meeting of this working group is scheduled in June 2012 at the IEEE PHM Conference in Denver, CO. The following are detailed descriptions of the scope and purpose clauses for the new PHM standard, excerpt from the latest PAR.

Scope of this PHM Standard

This guide covers all aspects of prognostics and health management of systems, including definitions, approaches, algorithms, sensors and sensor selection, data collection, storage and analysis, anomaly detection, diagnosis, metrics, life cycle cost of implementation, return on investment and documentation.

Purpose of this PHM Standard

The purposes of this guide is to classify and define the concepts involved in prognostics and health management of electronics, and to serve as a guide to practitioners for the development of a business case, selection of approaches, methodologies, algorithms, condition monitoring equipment, and strategies for implementing prognostics for electronic systems.

Need for this PHM Standard

In the field of reliability practice, prognostics and health management has been widely recognized as the means to protect the integrity of equipment and avoid unanticipated operational problems leading to mission performance deficiencies, degradation, and adverse effects to mission safety. Researchers have developed a variety of approaches, methods, and tools that are useful for these purposes, but applications to real-world situations may be hindered by the lack of real visibility into these tools, uniformity in application of these tools, as well as consistency in their demonstrated results. There is a need for documented and favorable guidance that will encourage practitioners to invest the resources necessary to put these techniques into practice. This standard will act as a guide for those who wish to implement prognostics for electronic systems.

Stakeholders for the PHM Standard

Companies manufacturing Commercial, Industrial and Military electronic systems, Telecommunications, Medical Electronics, Transportation, Information technology, Defense Industries.

Items to be covered in this PHM Standard

1. The Levels of Electronics and application of Prognostics at these levels
    a. Device level
    b. Component level
    c. Board level
    d. Sub-system level
    e. System level
    f. System-of-systems level
    g. Cyber physical systems
2. Approaches to Prognostics
    a. Model Based
        i. Physics of Failure Models
        ii. Empirical Models
    b. Data Driven
    c. Knowledge-based (e.g., graphical models)
    d. Fusion
    e. Canary structures
3. Failure Modes, Mechanisms, Effects and Criticality Analysis
4. Failure precursor identification
5. Sensors for health monitoring
6. Data collection for prognostics
7. Data storage
8. Data processing and analysis
9. Diagnostics algorithms
10. Prognostic algorithms
11. Relationships between Prognostics and Diagnostics
12. Software
13. Prognostic metrics and specifications
14. Return on Investment on prognostics
15. Life cycle costs
16. Prognostics implementation

RG Standard and Working Group

The DoD community emphasized the need for reliability growth for defense-related systems and the IEEE Reliability Society was listening. IEEE RS Standards Committee Chair began discussions with the International Electro-technical Commission (IEC) TC-56 (Technical Committee on Dependability) US TAG (Technical Advisory Group) lead, Ms. Milena Krasich, to collaborate on a standard for Reliability Growth (RG) in 2009. The IEEE RS Standards Committee formed an agreement with the IEC to adopt an existing standard without creating a new and redundant IEEE standard. An initial PAR was drafted in early 2010, and submitted to the NesCom as P1467 for approval in March 2010. This PAR was rejected when it was determined that 2 existing IEC standards related to this same topic were being revised, and that these existing IEC standards could be leveraged for IEEE use, co-developed as a joint IEC/IEEE standard, and provide more value to the DoD as well as suppliers to the DoD, rather than adoption of the

current IEC standard. A second draft PAR (IEEE P61014) was written for this new project, and was approved by NesCom and the IEEE Standards Board on October 21, 2010. This PAR is planned for completion in December 2014. At that time, a working group was formed under the leadership of Ms. Milena Krasich.

The IEEE and IEC agreed to collaborate on this joint standard and base this development on 2 existing IEC standards: IEC standard 61164 and IEC standard 61014. IEC 61014 is the standard titled: "Programmes for reliability growth". IEC 61164 is titled: "Reliability Growth – Statistical Test and Estimation Methods". These International Standards specify requirements and guidelines for the exposure and removal of weaknesses in hardware and software items for the purpose of reliability growth. These standards apply when the product specification calls for a reliability growth program of equipment (electronic, electromechanical and mechanical hardware as well as software) or when it is known that the design is unlikely to meet the requirements without improvement. This new IEC/IEEE standard will be titled: "Standard for Programs for Reliability Growth".

Scope of this RG Standard

This Standard specifies requirements and gives guidelines for the exposure and removal of weaknesses in hardware and software items for the purpose of reliability growth. It applies when the product specification calls for a reliability growth program of equipment (electronic, electromechanical and mechanical hardware as well as software) or when it is known that the design is unlikely to meet the requirements without improvement. A statement of the basic concepts is followed by descriptions of the management, planning, testing (laboratory or field), failure analysis and corrective techniques required. Mathematical modeling, to estimate the level of reliability achieved, is outlined briefly.

IEEE RS Standards Sustainment

The 5 standards that are being sustained are:

1. IEEE 1332-1998 (Standard Reliability Program)
2. IEEE 1413-2010 (Standard Framework for Reliability Prediction of Hardware)
3. IEEE 1413.1-2002 (Guide for Selecting and Using Reliability Predictions Based on IEEE 1413)
4. IEEE 1624-2008 (Standard for Organizational Reliability Capability)
5. IEEE 1633-2008 (Recommended Practice on Software Reliability)

These 5 standards are sustained on a 5 year refresh cycle. One standard, IEEE-1332-1998 is going through a refresh now. A PAR has been approved by the IEEE Standards Board, and the draft for IEEE P1332 is created by the 1332 Working Group under the leadership of Dr Michael Pecht and Dr Michael Azarian. The revision of IEEE 1332 is planned for completion by December 2012.

The status of IEEE P1332 is

- PAR approved by the IEEE Standards Board New Standards Committee (NesCom) on March 26, 2008
- The IEEE 1332 working group held its kick-off meeting on January 31, 2008
- The IEEE 1332 revised draft was completed and ballot process began on December 12, 2011
- The ballot group formed on January 2, 2012, with 97 members
- Review by the IEEE Mandatory Editorial Coordination (MEC) Editor and Legal Committee was completed
- The ballot of the P1332 draft started in early 2012.

IEEE 1413-2010 completed a refresh last year. The IEEE standards board approved this update from the initial released version of the standard, IEEE 1413-1998.

IEEE 1413.1-2002 is going through a refresh with expected completion by December 2012. The ballot process for IEEE P1413.1 will start after the ballot process for IEEE P1332 ends.

A new process for sustaining active standards took effect on January 2, 2012. The IEEE-SA Board of Governors (BoG) and IEEE-SA Standards Board (SASB), comprised of volunteers who oversee the standards development process, approved and planned the implementation of a new process for maintaining active standards. The new process includes the following changes

- Extend the maintenance timeline for IEEE standards from 5 years to 10 years
- Phase out the reaffirmation and stabilization processes by year 2013
- Place the focus primarily on the revision process for standards that require maintenance action (revision or withdrawal will be the only available actions for maintaining active standards)
- Identify approved IEEE standards as either active or inactive

The IEEE-RS-SC considers these changes to be an improvement over the previous process, since this new process is more streamlined and simplified approach to standards maintenance, and makes it easier for standards working group participants to comply with the policies and procedures of both IEEE and the American National Standards Institute (ANSI).