

Status of IEEE Reliability Society Standards for July 2012

The IEEE Reliability Society Standards Committee (IEEE-RS-SC) is developing 2 new standards and sustaining 5 standards. The 2 new standards are being developed:

1. Prognostics and Health Management (PHM) Standard (P1856)
2. Reliability Growth (RG) Standard (P61014)

PHM Standard and Working Group:

The first new standard is titled: “Prognostics and Health Management (PHM) of Systems: Definitions, Approaches and Considerations for Implementation”. A Project Authorization Request (PAR) was approved by the IEEE Standards Board earlier this year. An IEEE PHM Working Group has been formed under the leadership of Dr Michael Pecht and Dr Sony Mathew, and held its kick-off meeting at the Reliability Society sponsored IEEE PHM Conference in Denver in June 2012. The working group has started to develop the new draft.

The following are detailed descriptions of the draft sections for the new PHM standard, excerpt from the 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 management 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 management
 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, Lou Gullo, 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. This working group is preparing to discuss this standard in Pau, France at their yearly meeting. The working group officially started their efforts this month (August 2012), even though preliminary work on the draft began almost 2 years ago. The working group completed their greatest challenge of merging two IEC documents into a single draft. Now, they are supplementing the draft with new topics, such as Physics of Failure (PoF) reliability growth and fixed duration tests, and their acceleration factors. They are also correcting an error in RG analysis of multiple test samples.

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 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

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 was 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 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 on February 9, 2012.
- The initial ballot of the P1332 draft started on February 15, 2012, and completed on March 15, 2012
- Comments from the ballot group were received and all comments adjudicated by the working group leadership on July 18, 2012
- The revised draft D3 was submitted for IEEE Recirculation Ballot on July 23, 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 working group has started meeting regularly to revise the standard. The ballot process for IEEE P1413.1 should start after the ballot process for IEEE P1332 ends.

IEEE **1624-2008** and IEEE **1633-2008** are not due for refresh until 2018, however, activities have begun to work a new 1633 PAR, form the software reliability standards working group, and consider an updated draft of IEEE 1633 before the refresh due date.

IEEE Standards Team Involvement

If you have an interest in being involved in maintaining an existing Standard, want to participate in one of the new Standards development, or want to gain IEEE approval for the development of a specific new Standard, please contact Lou Gullo, IEEE RS Standards Committee Chair.

Best Regards,
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