

*Batteries, Maintenance Similarities?  
Nuclear / Non-'N'*



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# *Purpose of Batteries*



- Provide filtering of normal power to critical loads (Chargers are intended to provide for normal house loads)
- Provide required electrical loads on loss of normal power without interruption
- Meet all instantaneous DC system demands

# *Why Perform Battery Maintenance?*



- Reliability
  - Be available to perform its intended function for the pre determine duration when called upon
- Liability
  - Reduce our exposure and its associated cost
    - E.g. personal hazard, equipment cost, service down time, insurance cost

# *Effective Battery Maintenance Program Objective*

- There is no single right maintenance approach that applies equally to all battery types and installations

# *Effective Battery Maintenance Program Objective*



- The degree to which a battery and its installation is maintained are due to
  - its function (how critical)
  - required reliability
  - how much exposure can be tolerated

# *Effective Battery Maintenance Program Objective*



- What is needed to ensure that the correct and appropriate maintenance is performed on each battery and its installation on a timely basis

# *Effective Battery Maintenance Program Objectives*

- Maintain each installation in an appropriate state of reliability for its entire service life
  - By demonstration performance capability (Tests)
  - By demonstrating performance and parameter trending
  - By establishing efficient and cost-effective maintenance practices
  - By reviewing and updating practices with industry standards and recommended practices periodically

# *Effective Battery Maintenance Program Objectives*



- Maintaining each installation within applicable regulatory and industry requirements
  - By showing the state for each installation
  - By record keeping for the life of the installation

# *Effective Battery Maintenance Program Objectives*



- Training Personnel
  - To use and recognize all safety precautions and equipment for working on all different types of batteries within their area of responsibility
  - Personnel must have an understanding of battery operation and maintenance pertaining to the particular technology

# *Maintenance Program Should*



- Emphasize consistency and completeness in the recording of inspection and performance test data to support the trend of data
- Trend all inspection and performance test data
  - Include all baseline information

# *Maintenance Program Should*



- Be able to anticipate into the future end of life of replacement need of the installation any corrective/preventative maintenance needed to keep the system running
- Trending and analysis of battery inspection and performance data is crucial to a successful battery reliability program

# *Maintenance Program ...*

## *(HOW)*



- Maintenance, in the form of periodic inspections, testing, preventive and corrective maintenance is a necessity for all stationary batteries.

# *Maintenance Program ...*

## *(HOW)*



- The level of maintenance and its periodicity should be dictated by the function of the installation, its required reliability, and its associated liability.
- Keeping in mind the difference in technologies available (VLA, VRLA, NiCad, etc) and regulatory and industry commitments.

# *Vented Lead Acid (VLA)*

- See IEEE 450 1995

General Inspection	Monthly
Detail General Inspection	Quarterly
Complete Inspection and Ohmic Testing (Optional)	Annually
Performance Testing	See 450 25% of Service Life

# *Valve Regulated Lead Acid (VRLA)*

- See IEEE 1188 & 1184

TYPE	PERIODICITY
General Inspection	Monthly
Detail General Inspection	Quarterly
Complete Inspection and Ohmic Testing (Optional)	Annually
Performance Testing	See 1188 & 1184 Annually

# *Nickel Cadmium (NiCad)*

- See IEEE 1106

TYPE	PERIODICITY
General Inspection	Monthly
Detail General Inspection	Quarterly
Complete Inspection and Ohmic Testing (Optional)	Annually
Performance Testing	See 1106 25% of Service Life

# *Periodicity for Corrective Actions*



- **Minor Infractions**
  - Dependent on technology and application
  - In general, conditions which do not effect the operability and reliability of the installation

# *Periodicity for Corrective Actions*



- Major Infractions
  - Dependent on technology and application
  - Conditions which will have a detrimental effect on the installation and its function, and create a safety hazard to personnel (necessitating immediate action)

# *Well, Much Said for Similarities Any Differences?*

- Not as obvious as you thought, Huh?
- What are the Differences?
- **COST!**
- Yes but, why?
- **PAPER, Nuclear Loves Paper**
- The other part is regulatory agencies have much more of a direct impact on all areas
- At least for Now

# *Well, Much Said for Similarities Any Differences?*

- What Do We (Nuclear) Ask For & Require?
- Calculations
- Testing; FAT & 100% capacity from the start
- Qualification levels of battery & Vendor is higher
- Actual Testing & Its Frequency
- Much more rigorous in the documentation and maintaining the records of Maintenance & Testing

# *Industry and Regulatory Issues of Concern/Interest*

- NEIL (Nuclear Electric Insurance Limits)
  - New switchyard standards requiring use of IEEE standards for the appropriate battery technology
- IEEE (Institute of Electrical and Electric Engineering)
  - Documents under revision of review 450, 1184, 1187-89, P1491
- NRC (Nuclear Regulatory Commission)
  - Maintenance Rule looks at DC systems inside and outside of the plant (switchyard)

# *Industry and Regulatory Issues of Concern/Interest*

- NFPA (National Fire Protection Association)
  - Article 1/UFC - Chapter 35 Stationary Lead Acid Battery Systems
  - Article 70 (NEC) – Chapter 480 Storage Battery
  - Article 76 – Standard for the Protection of Telecommunications Facilities