

Electrical Rotating Equipment- Dragline Reliability Approach

Dale Thompson-Senior Dragline
Electrical Specialist



Agenda

- Introduction
- Reliability Definition
- Approaches to Reliability
- Modeling
- Cost Controls
- Implementation Goals
- Questions



Reliability Defined

- ASQ-“Reliability can be defined as the probability that a product, system or service will perform its intended function adequately for a specified period of time, operating in a defined operating environment without a failure.”
 - ASQ.ORG
- Frequently defined as “The probability of success”
- Many define “Reliability” as the Mean Time Between Failure show by this equation:

$$\bullet \text{ MTBF} = \frac{\Sigma(\text{Start of downtime} - \text{Start of uptime})}{\text{Number of Failures}}$$

- The reliability of an item over a given period t having a failure rate of $(1/\text{MTBF})$ that produce a value as calculated between 0% to 100% where 100% will not fail and 0% will not work. A typical exponential formula is shown here:

$$\bullet R(t) = e - \left(\frac{t}{\text{MTBF}}\right)$$

Approaches to Reliability

- *Run to failure*
 - *No reliability principals applied*
- **General system analysis**
 - *Tribal knowledge and rudimentary technics)*
- *Failure Mode Effect Analysis (Failure Mechanisms, Fault Trees etc)*
 - *More advanced identification*
- **Computer Maintenance Monitoring System**
 - *Tracking of the maintenance activities*
- **Reliability Optimization-PM intervals, PM activities and Design Optimization**
 - *Advanced analysis with changes to design from identified failure modes*
- **Root Cause Analysis**
 - *Elimination of failure mechanisms*
- **Lifecycle Management**
 - *MTBF*
- **Statistical Analysis**
 - *Advanced identification for probability of success*

Modeling

- **Statistical Models**
 - Identifies the distribution of the component or system of interest
 - Relates the probability of success
 - Can be used for evaluation of components
- **Excel models using statistical analysis**
 - Combined Statistics with criticality of unit
 - Can add condition based monitoring
 - Can be used for budget or bad actor reports
 - Cheap to make, software is abundant, easy to use
- **Computerized models**
 - Arena, Simio, Simul8, etc
 - More complex systems
 - Creates KPI's or identifies bottlenecks
 - Can be expensive, software is specialized
 - Increased accuracy
 - Still only a model

Cost Controls

- Statistical models using Excel or add ons
 - Very inexpensive even with add on programs
 - Effective but narrow programs
- Minitab
 - Extremely effective statistical software
 - Easy to use, can create some models
 - Excellent for Lean/Six Sigma applications to reliability
- Condition based monitoring
 - CMMS can be expensive and if not used correctly ineffective
 - Engagement of Maintenance
- PDM
 - Effective, can be expensive
- Budget
 - Proactive vs Run to failure
 - Spares
- Mine Life
 - Dictates budget, strategy, available resources

Implementation Goals

- What is the cost/benefit of outsourced reliability?
 - Is it cheaper to create a program in house?
 - Can outsource solve the short and long term problems in the system
 - Integration of multiple sources
- Availability vs Operation
 - Is availability the driver of your program or OEE(Overall Equipment Effectiveness)
 - $OEE=A \times P \times Q$ (Availability x Performance x Quality) the most buckets as fast as possible with no stop time
 - PM workload from inspections, follow ups, modeling, real time data
 - Set intervals vs Work density
- Easy of use
 - Can it be condensed to a software package? Integrated into a single dashboard?
- Fitment to system
 - Is it designed for my system or adapted from a generic system?
- Production
 - Goal is to produce
 - Minimize overall downtime with acceptable safety factors

Questions

