Basic Reliability Engineering

Course Description

Course Duration
The duration is 3 days.

Audience Profile
Asset owners, Asset Managers, Engineers, Planners, Trades people, Operators, Finance Managers, Safety Officers and all those who contribute in their roles of first-line (operators and maintainers) and second-line (engineering, designers, logistics, admin, workshops, etc.) asset managers to asset performance.

Course Objectives

To provide the participants with:

- the knowledge, understanding and skills to perform reliability analyses to optimise the quality and quantity of asset outputs (revenue), minimise risk and the use of inputs (costs);
- knowledge for the most effective and efficient design, operation and maintenance of assets;
- methods and examples to assist with the easy implementation of the various technique and achieving the changes espoused in the theory.

The value of the course will come from implementing the practical techniques presented in this course.

What makes this course different?
We provide a practical approach and provide many examples that assist in understanding and implementing the various techniques, without covering an overwhelming variety and depth of techniques of which a small percentage is needed. We also provide exercises that further assist in understanding the various techniques.

Main Topics – Day 1

- **Reliability Engineering Explained**
  - Historic development of reliability engineering
  - What is Reliability Engineering?
  - What are the objectives and goals of reliability engineering
  - How does reliability engineering link to asset management?
  - What are the benefits of reliability engineering?
  - Why should you consider using reliability engineering?
  - What is the reliability engineering process?
  - How should you implement reliability engineering?
- **What Are the Reliability Principles?**
  - Introduction
  - How does quality compare to reliability?
  - How does reliability link to Life Cycle Costs?
  - How to design for mechanical reliability?
  - What are the effects of installation on mechanical reliability?
  - What are the effects of operability on mechanical reliability?
  - What are the effects of maintainability on mechanical reliability?
  - Which reliability measures are available?
  - Quality
  - Reliability, availability and maintainability
  - Main outcomes of chapter two
  - Exercise 1
- **What Are Asset Faults and Failures**?
  - What are faults and failures?
  - What are the six patterns of failure?
  - What is wear-out failure?
  - What is the bathtub curve or hazard function?
  - What is slowly aging?
  - What is the best new failure mode?
  - What is random failure?
  - What is wear-in failure?
  - What are characteristics of age-related failures?
  - What are characteristics of non-age-related failures?
  - Failure analysis
  - What data do you use in maintenance analysis?
  - What is the generic parts count method?

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- What data to collect?
- What is the failure rate?
- How to work out the mean life of items?
- Main outcomes of chapter three
- Exercise 2

- **How to Perform Descriptive Data Analysis?**
  - What is the purpose of quantitative techniques?
  - What decisions do you make in maintenance?
  - Classification of maintenance problems
  - Purchasing decisions
  - Replacement decisions
  - Inspection decisions
  - Overhaul and repair decisions
  - Resourcing decisions
  - How to analyse failure data with descriptive statistics?
  - What is tabulation?
  - How to graphical represent data?
  - How to perform trend analysis?
  - What are failure distributions?
  - Main outcomes of chapter four

Main Topics – Day 2

- **What Can You Do with Statistics?**
  - Numerical characterisation of data
  - Which measures of central tendency are available?
  - Which measures of variation can you use?
  - What is inferential statistics?
  - What are populations and samples?
  - How to determine confidence levels?
  - Main outcomes of chapter five
  - Exercise 3
- **What Is Probability**
  - Introduction
  - What are permutations and combinations?
  - What are probability and probability theorems?
  - What is probability?
  - Which symbols appear in probability theory?
  - What are the probability axioms and theorems/
  - Main outcomes of chapter six
  - Exercise 4
- **What Are Probability Distributions?**
  - General cautions
  - Probability distributions
  - What are the discrete distributions?
  - What are the continuous distributions?
  - Which distribution to choose?
  - Main outcomes of chapter seven
  - Exercise 5
- **What Is the Weibull Distribution?**
  - How to perform a Weibull analysis?
  - What is the Weibull slope or shape parameter ß?
  - What is the scale parameter or characteristic life ?
  - What is the location parameter or minimum life ?
  - How to use Weibull distribution graph paper?
  - A large sample Weibull analysis
  - How to deal with grouped data?
  - What is the plotting age for grouped data?
  - How to rank data?
  - Large sample Weibull analysis 2
  - Small sample Weibull analysis
  - How to calculate Weibull results?
  - What do you do with suspended items?
  - Main outcomes of chapter eight
  - Exercise 6

Main Topics – Day 3

- **How to Calculate System Reliability?**
  - What are static reliability models?
  - What are functional and reliability block diagrams?
  - Conventions
  - How to work out series systems?
  - System reliability
  - The equivalent part probability pc
  - Series of identical parts
  - Grouped parts or part families
  - Series systems using the failure rate ②
  - How to work out parallel or redundant systems?
  - System reliability
  - The MTBF for parallel systems
  - How to work out an active parallel configuration with partial redundancy?
  - How to work put inactive parallel or stand-by redundancy?
  - Perfect changeover and identical parts
  - Imperfect changeover with identical parts
  - Perfect changeover with n operating components and n stand-by's
  - What are the effect of parallel units?
  - How to work out parallel and series combinations?
  - Low level or part redundancy
  - High level or system redundancy
  - Reliability analysis with system reduction
  - Writing formulas
  - Main outcomes of chapter nine
  - Exercise 7.

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- **What Are Industrial Applications of Reliability Analysis?**
  - Introduction
  - What types of reliability analyses can you use?
  - What are reliability audits?
  - What are reliability reviews?
  - What are reliability assessments?
  - Which reliability analysis techniques should you use?
  - What are reliability aspects in contracting?
  - Accurate reliability specification
  - Avoid ambiguity in contracts
  - What is reliability testing?
  - Test terminates once a pre-assigned number of failures occur
  - Test terminated at pre-assigned time
  - Successive reliability testing
  - 'Testing' with the binomial distribution
  - Main outcomes of chapter ten
  - Exercise 8
- **How to Manage Risk?**
  - What is risk analysis and management?
  - What is risk?
  - What is the definition and measurement of risk?
  - Risk statistics
  - What risk analysis techniques are available?
  - What is the probabilistic risk assessment methodology?
  - What are hazard & operability analyses?
  - At what time do you perform hazards and operability analyses?
  - How to perform the HazOps analysis?
  - The standard HazOps sheet
  - The extended HazOps analysis sheet
  - What are the benefits and disadvantages of HazOps?
  - Is a HazOps analysis consistent?
  - What are time-sequence models?
  - What are the gate/logic and event/terminal symbols?
  - What are fault or success trees?
  - What are event trees?
  - What are cause-consequence analysis?
  - What are logic trees?
  - What are cause and effect diagrams?
  - Main outcomes of chapter eleven
  - Exercise 9
- **Bibliography**

All delegates will receive a textbook that sets new standards for industrial training materials that will reinforce the training experience for many years to come.

Seminar Leader – Emile Eerens

Emile Eerens holds a doctoral degree in Engineering and a Grad.Diploma in Business Management.
Emile has experience in planning and managing shutdowns in power stations and mines in Australia and is extensively involved in “training for excellence” in the wider business of asset maintenance and management.
Emile has over 22 years experience as an Asset Maintenance and Management Engineer, Trainer and Consultant. In his career he worked in the Power Generation, Electricity Distribution, Mining, Health Facilities, Construction and Petrochemical Industries and has experience in Supervision, Design, Engineering, Research & Development, Training and Management.
He is in demand as a developer and presenter of various public and in-house Asset Maintenance and Management courses.