

## Today 4 Topics

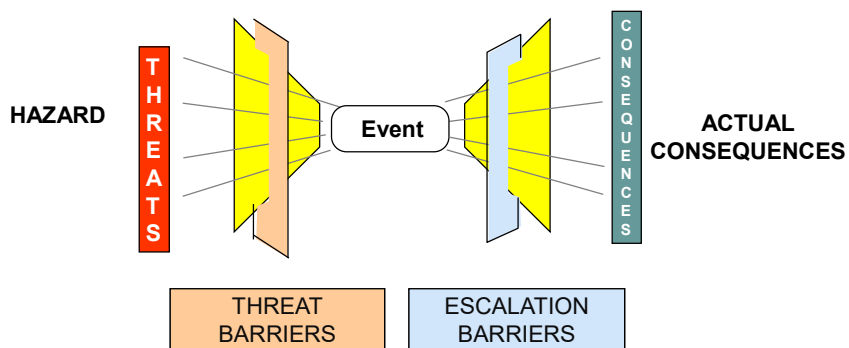
- Risk Reduction Strategies in RE Design and Operation
- Design, Operation and Cost Total Optimisation Review
- Lifting Lifetime Reliability
- RE Root Cause Failure Analysis
- Finding the Evidence
- Applying RCFA in the Workplace
- Rotating Equipment Integrity Management



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Day 4 list of topics to present and simple exercises to do. Most of the day is about systems and processes that provide and support rotating equipment excellence. The mechanics of what must be done to get RE reliability was covered in Days 1 to 3. Today you will learn how to put them into business systems that make them happen.

## What is a High Potential Incident?



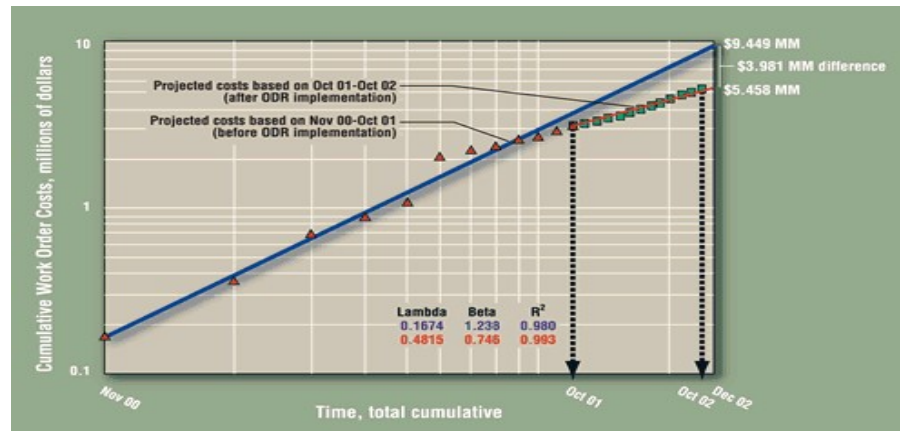
**“high potential incident” means an incident not causing loss or damage but, under different circumstances would result in an accident.**



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## Crow – AMSSA Reliability Growth Plotting

AMSAA = Army Materials Systems Analysis Activity



Monitoring the effect on refinery reliability of mobile hand-held computers to improve work flow.

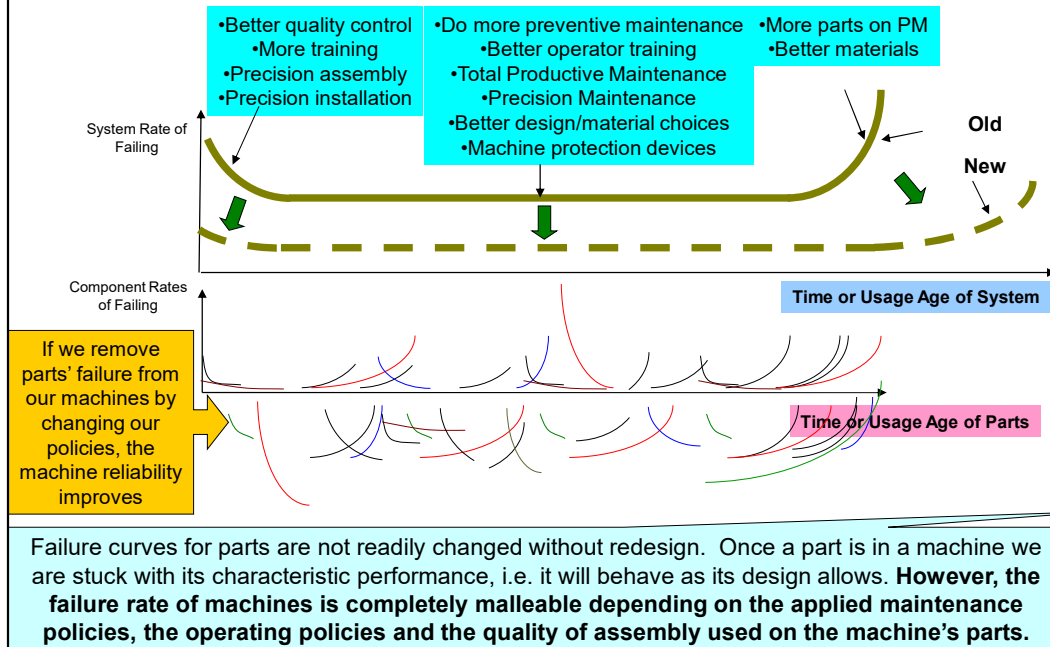


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Here we have a reliability growth plot showing the effects of introducing into an gasoline refinery a better means of communication and data gathering/analysis using handheld computers. The slope of the curve has dropped, indicating improved reliability. The triangle formed by the extension of the old line and the new line is the value of savings over a one year period produced by the use of computers.

With Crow/AMSSA plotting, as with any plotting of reliability, it is necessary to be sure that only one cause is attributable to the change. If other changes were introduced and not separable from the change under investigation the plot will not truthfully reflect the actual situation.

## Improving the Reliability of Machines



## Control of Asset Integrity

- Equipment failures cause injuries, waste and loss, both directly and indirectly across a business

### **Integrity is achieved by ...**

- Preventing loss of containment
- Preventing or detecting the loss of functionality of critical controls, safety systems (e.g. alarms, interlocks), emergency response equipment and critical utilities
- Preventing unnecessary shutdown and startup of processes in which shutdown and/or startup introduces a hazardous condition in the process.
- Managing/ maintaining inspecting properly to minimize the risk of failures



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## Reciprocating Compressor Example

### 7.4.2 RECIPROCATING COMPRESSOR OBSERVATIONS

- The table gives examples of Observations which would indicate Not Best Practice in the operation / maintenance of a Reciprocating Gas Compressor.

	TOPIC	KEY OBSERVATION	IMPACT	INFERENCE	ACTION
Equipment	Vibration	High vibration levels, particularly if unsteady	Machine damage. Compressor trip. High vibration levels can cause loosening of machine and connection bolting leading to accelerating collateral damage. Vibration can result in fatigue damage to connections.	There is damage to the motion works. Loosening or fatigue of process connection may result in a significant emission.	Carry out frequency analysis of vibration signals. Identify cause and plan remedial action.
	Flexibles	Flexible connections	Potential failure	Flexible connections are easily damaged	If a flexible connection is necessary, it should be of an appropriate grade and on an inspection register.
	Bearing temperatures	Bearing temperatures high (alarms in, check temperature instruments)	Bearing failure. Machine trip. Mechanical damage (as consequence). Process gas release.	Bearing or lubrication fault has not been identified by operators	Root cause analysis, appropriate remedial action
	Noisy compressor valves	Clattering can be heard and felt local to valve(s)	Loss in performance. Valve could fail or damage valve cover.	Valves are damaged or loose.	Monitor vibration at each valve, identify severity, trend to check for deterioration.