

Ångturbiner Energiforsk

Ryaverket

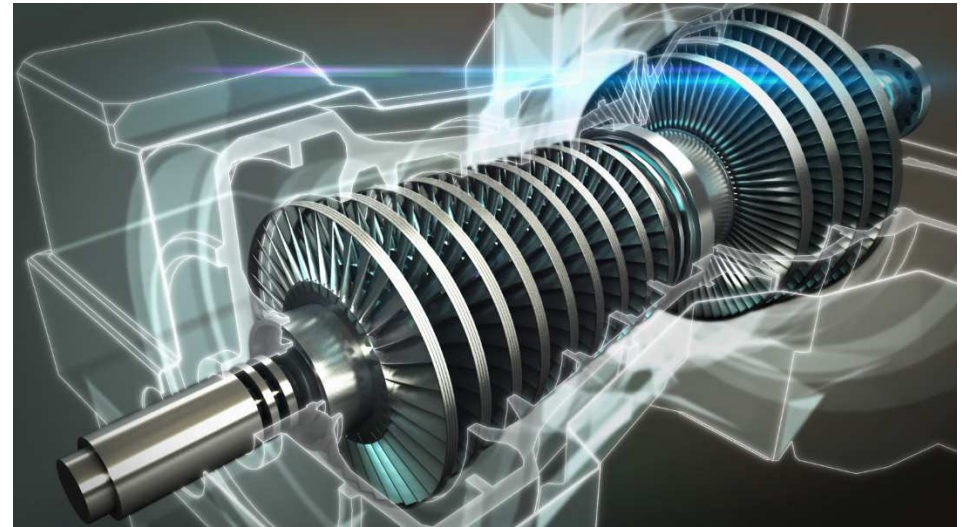
19:e oktober 2017



Agenda



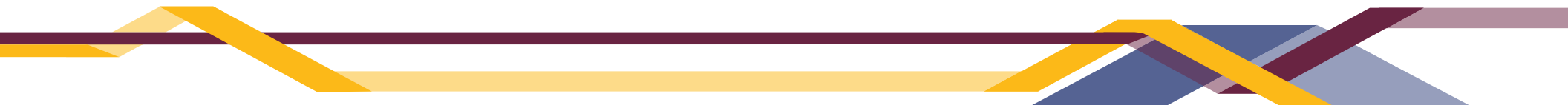
- **FM Global**
- **Global skadehistorik**
- **Utvärdering av maskinrisker**
- **Brandskydd för turbiner**
- **Prioritering av riskförbättringsåtgärder**



- Etablerades 1835
- Egendomsförsäkring inom komersiell industri
- 5,300 anställda, 1/3 ingenjörer.



FM Globals forskningslab för skadeförebyggande verksamhet



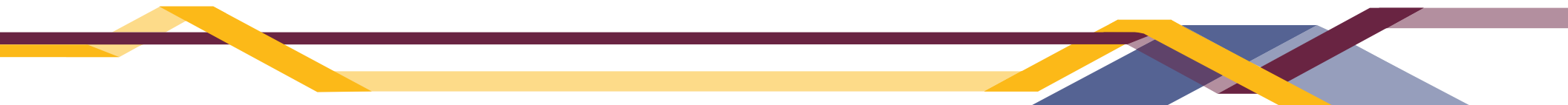
FM Global – Ett unikt företag



1 Majoriteten av alla skador kan förebyggas

2 Ömsesidighet har sina fördelar

3 Ett fokus, ett ändamål



Några nordiska kunder

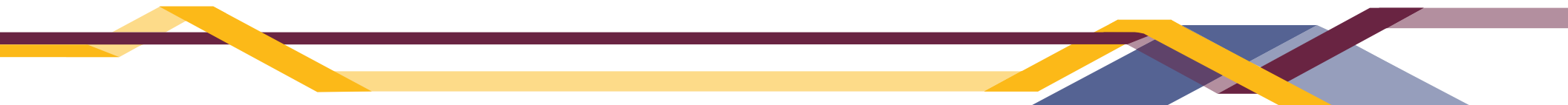


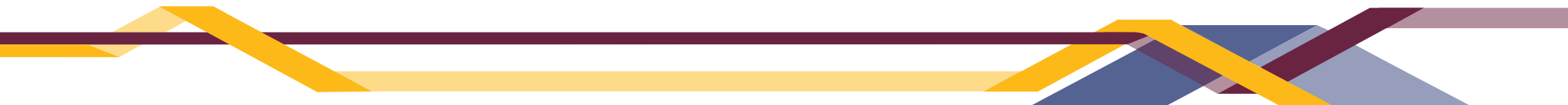
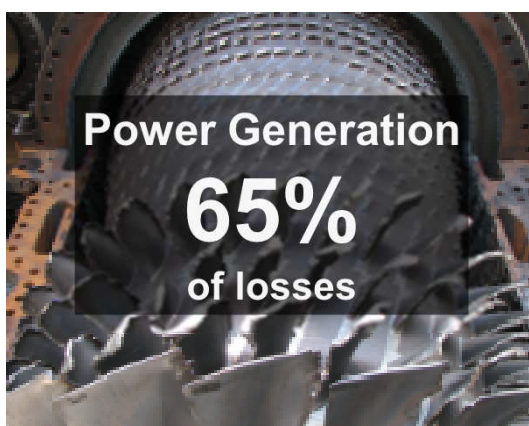
Expertis inom kraftgenerering

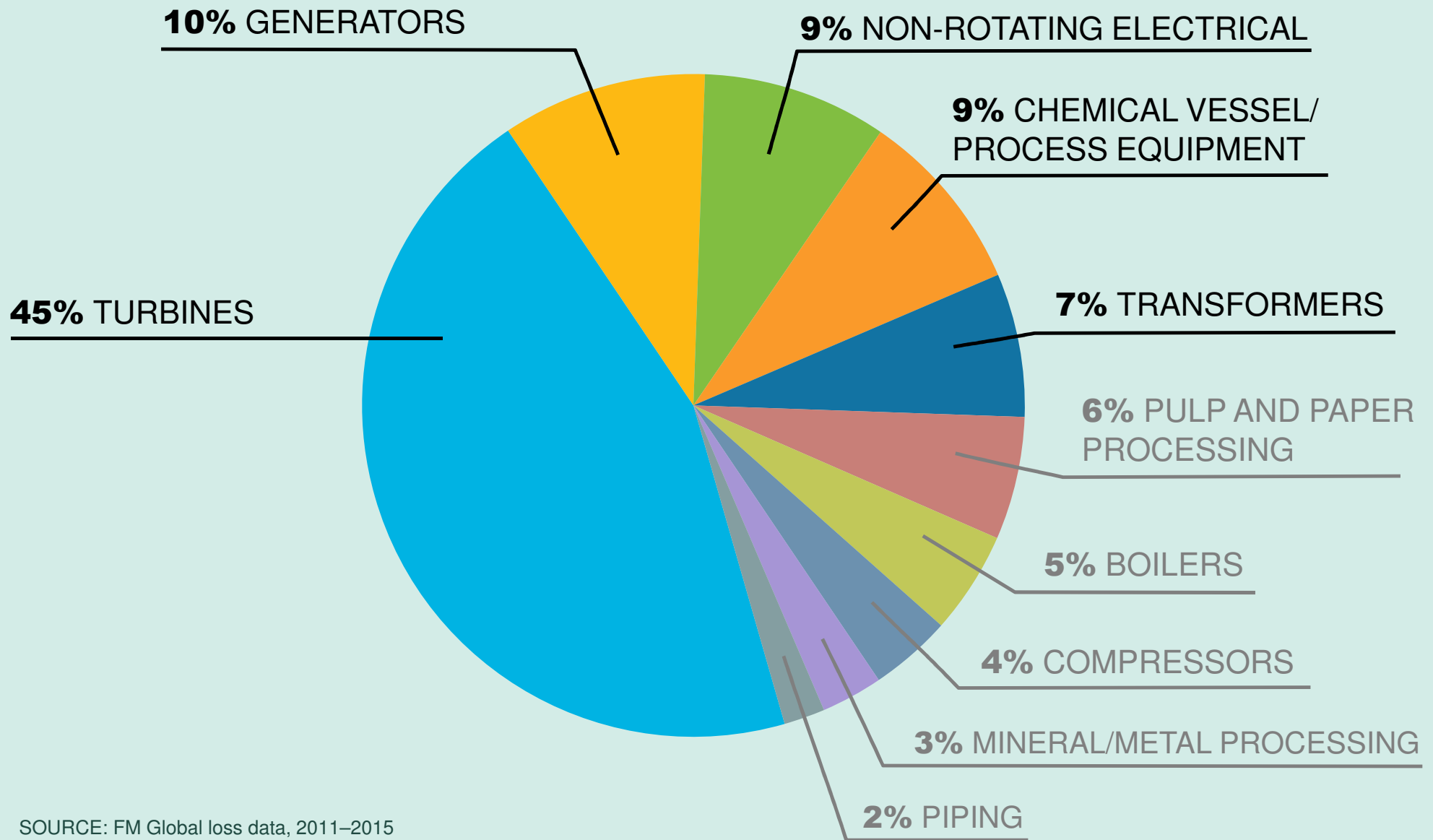
Portfölj

- **Över 130 kunder**
 - 15,5 år medel
 - 60 år längsta
- **2,000+ anläggningar**
- **23 länder**
- **7% marknadsandel**

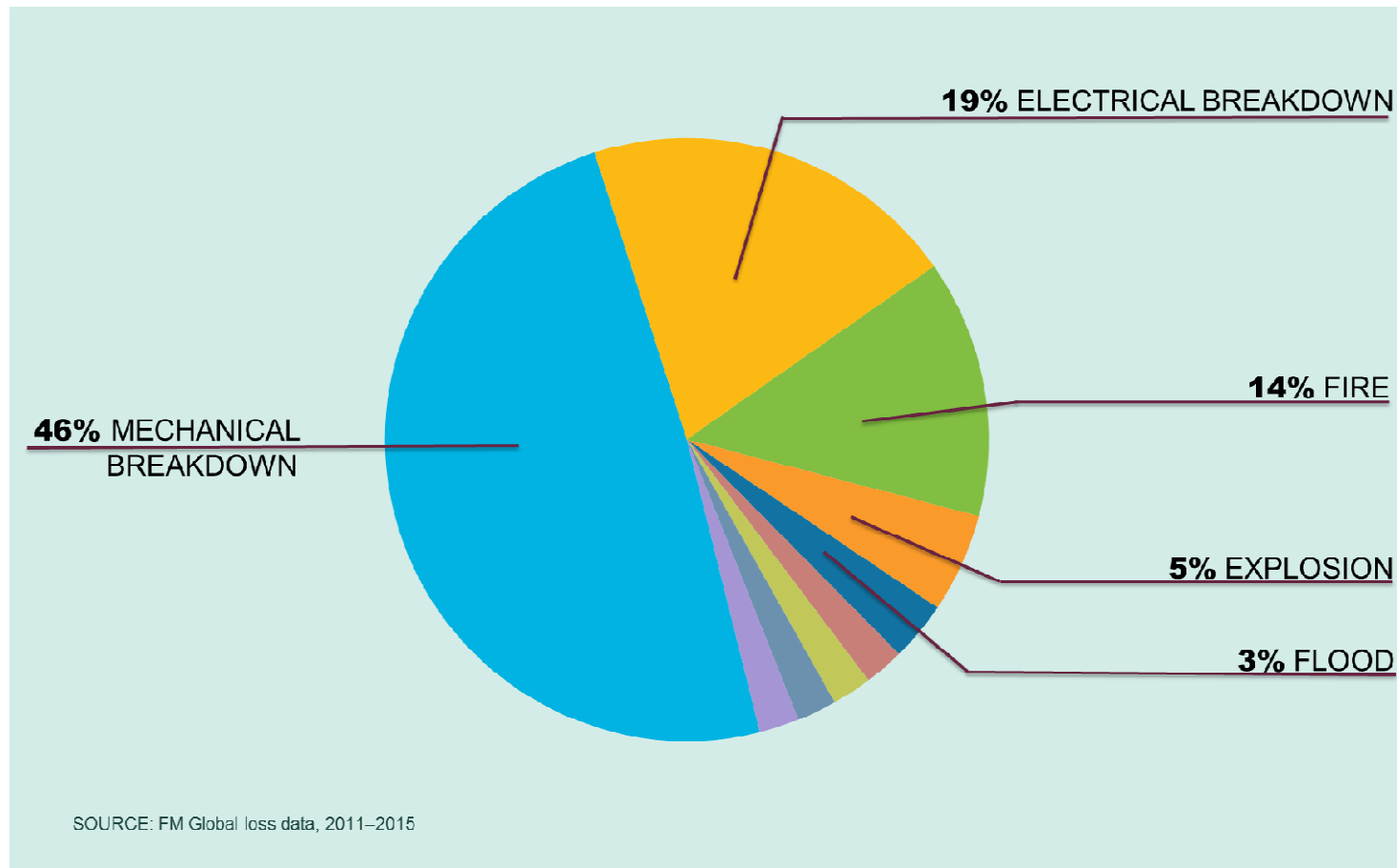
Kunder (Europa)







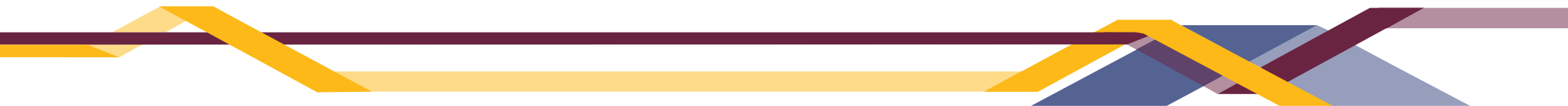
Steam Turbine Loss Drivers



Equipment Resilience



- ☒ **Designed**
- ☒ **Installed**
- ☒ **Operated**
- ☒ **Maintained**
- ☒ **Protected**



What are Equipment Factors?



**Impact the frequency and severity of
equipment breakdown risk**

Identify equipment most at risk of breakdown

Improve asset integrity and reliability

Equipment Factors



Frequency Risk Indicators

Maintenance

**Operating
Conditions**

Environment

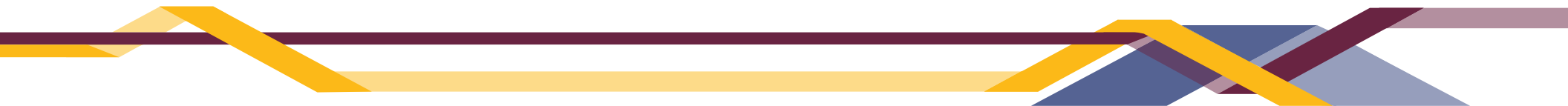
Operators

History

Severity Risk Indicators

**Safety
Devices**

**Contingency
Planning**



Equipment Factors



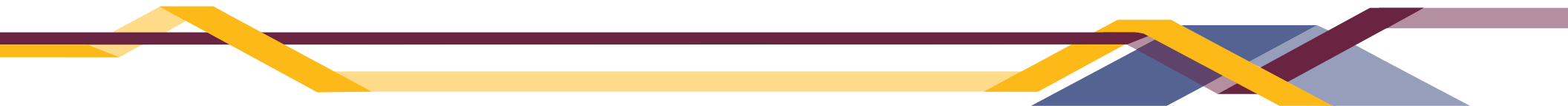
Frequency Risk Indicators

Maintenance	Adequacy of inspection, testing and maintenance programs to verify asset integrity, reliability and fitness for service.
Operating Conditions	Actual operating conditions vs. design conditions, including overloading, cyclic use and/or process upsets outside of design limits.
Environment	External operating environment and physical conditions/surroundings in which the equipment is operating, considering the suitability of the equipment for the service environment.
Operators	Effectiveness/adequacy of training, qualification and retraining programs to standard and emergency operating procedures to ensure operation of equipment and processes within design limits during normal and upset conditions.
History	Operating history including failures/breakdowns/process upsets resulting in deterioration and service aging, impacting remaining life.

Maintenance



- Outage as per OEM frequency and scope
- Address known fleet issues
- Lube oil analysis



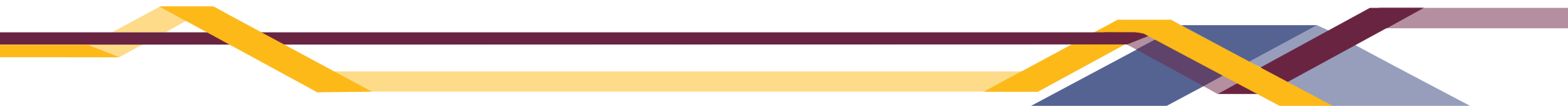
Maintenance



- **Foreign Material Exclusion (FME)**

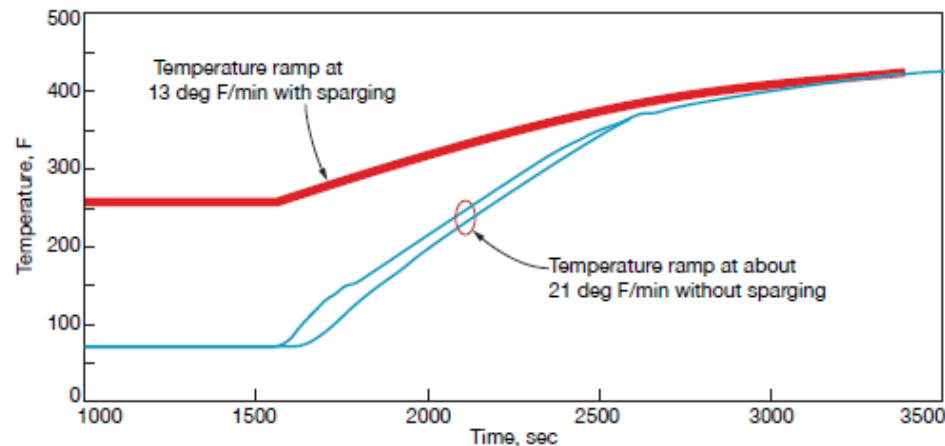


- **Is steam pipework maintained**



Operating Conditions

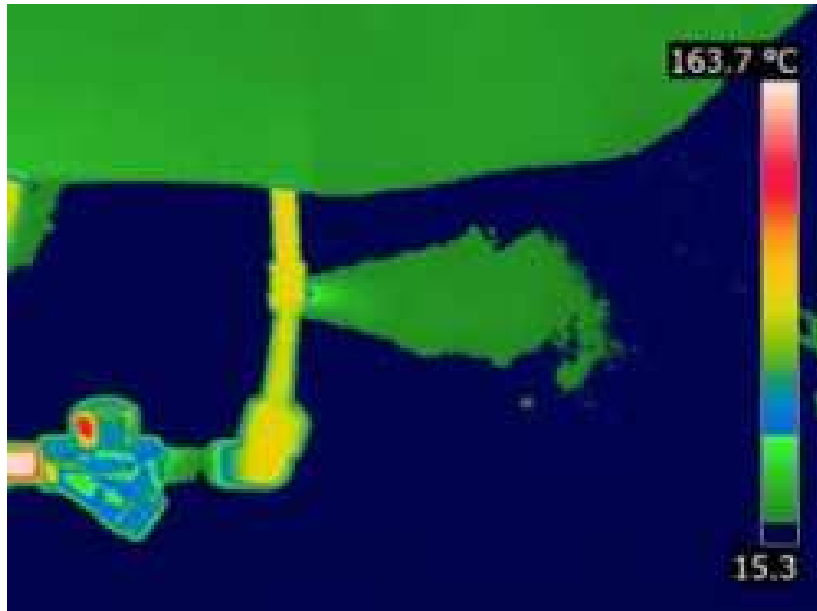
- Operating regimes (ramp up rate/soak times)
- Acceptable operating parameter



1. Sparge steam reduces thermal stress of thick-wall drum components by allowing a "softer" start

Environment

- No steam/water, vacuum or oil leaks



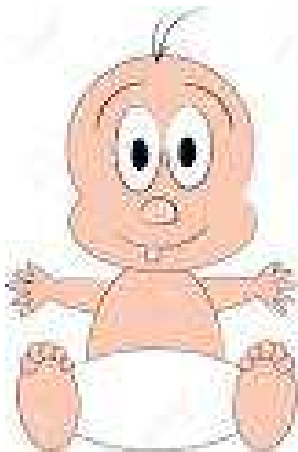
Operators

- Alarms
- Shutdown
- MOC
- Jumper/bypass
- Training & retraining



Age/History

- Understand fleet history
- If unit in preservation is this done properly



V



Equipment Factors



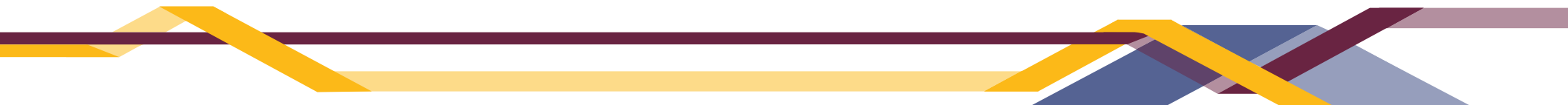
Severity Risk Indicators

Safety Devices

Protection devices (safety or control) are adequately designed, installed, maintained and functional to protect equipment during normal and upset operating conditions.

Contingency Planning

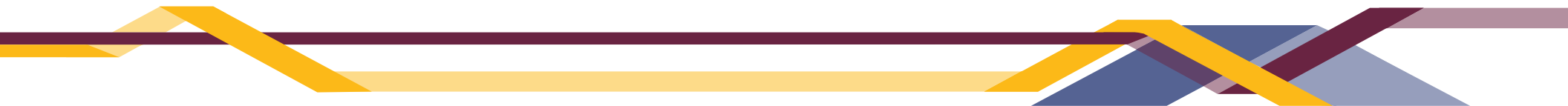
Preparedness in advance to respond to and recover from an unplanned breakdown of equipment resulting in a significant interruption to key site processes, including viability of sparing where provided.



Safety Devices



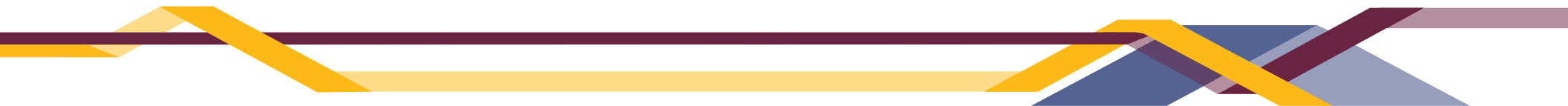
- **Operational testing of ESV, NRV, DC oil pump and overspeed protection**
- **OEM defined controls and protection installed and working**
- **DC lube oil systems properly designed and installed**



Contingency Plans



- **Spares properly stored**
- **Is there a bypass around the turbine**
 - **Is it accessible in an emergency**



Equipment Factor Loss Study



10-year study

Over 1,200
equipment losses

US\$8B
(gross) loss

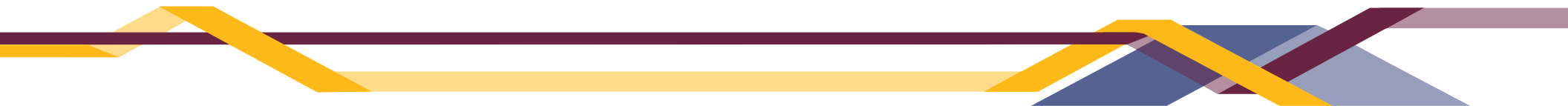
27
different types of
equipment analyzed

45,000
pieces of equipment
in the database

Loss Study Takeaways



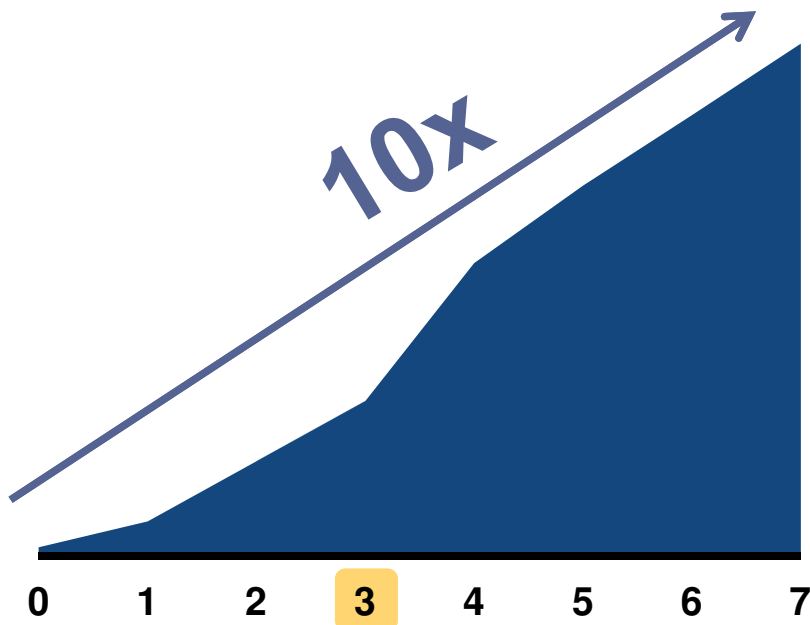
- Frequency and severity of loss increases with the number of unsatisfactory Factors
- Equipment with 1 or 2 unsatisfactory Factors can have **significant exposures**, particularly when the Factors are loss drivers for the equipment
- Equipment with both a frequency and severity Factor rated unsatisfactory is a **contributing factor for loss**



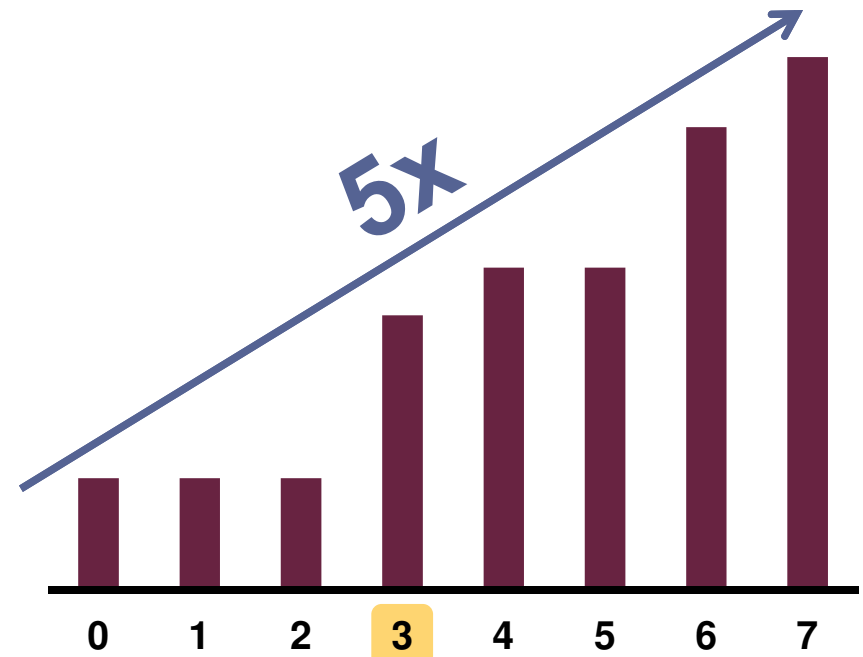
Equipment Factors and Losses



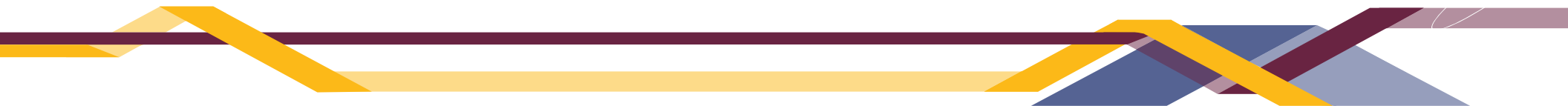
Frequency (%)



Severity (\$M)



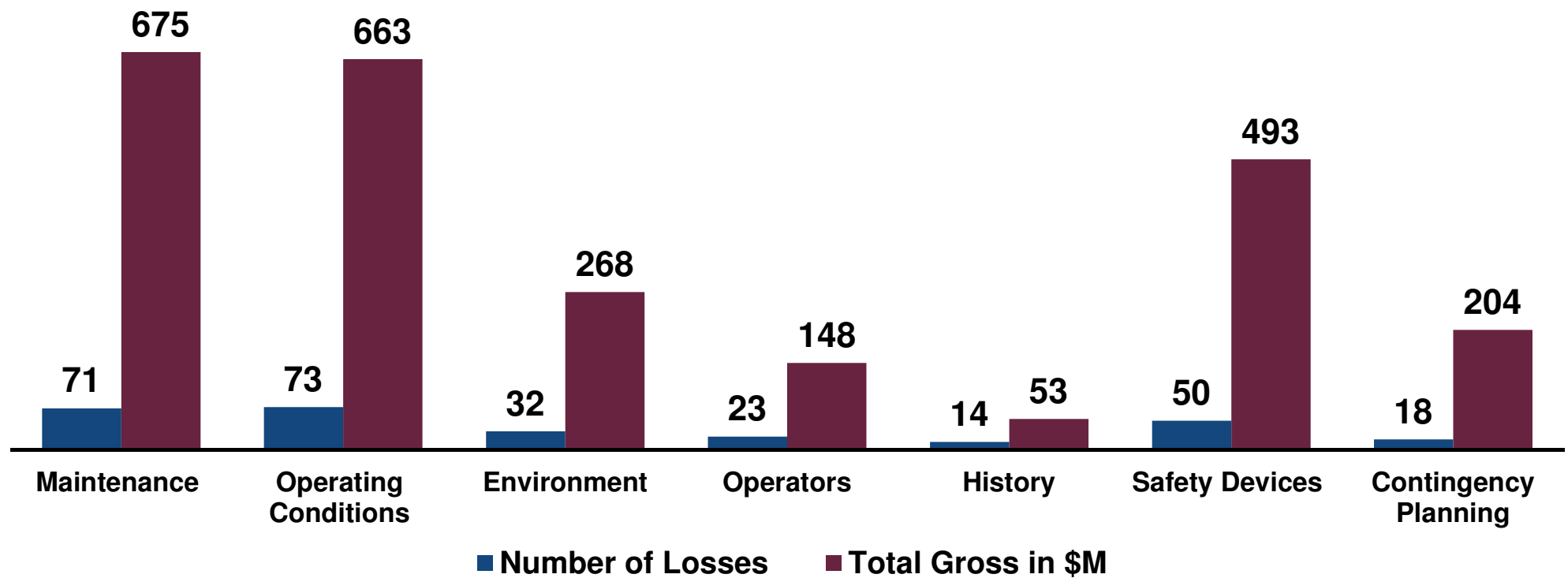
Equipment Factors



Equipment Factors and Losses



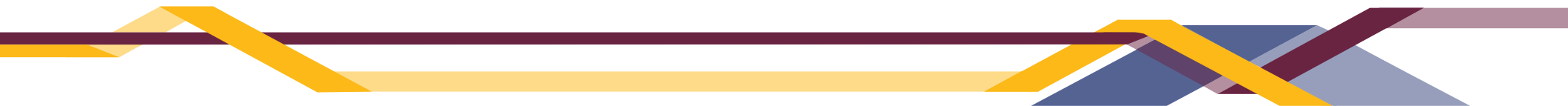
Steam Turbines Loss Data



Equipment Factors



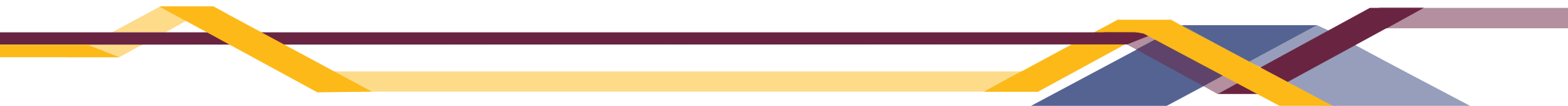
- **Leverage this predictive analytics tool to identify the equipment most at risk of breakdown**
- **Focus equipment risk improvement efforts as part of the risk improvement plan**
- **Improve asset integrity, reliability and resilience of your operations**



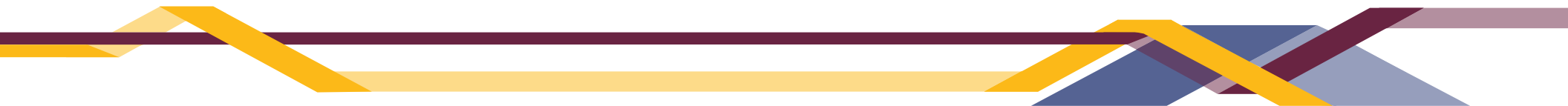
Turbine Fire Protection



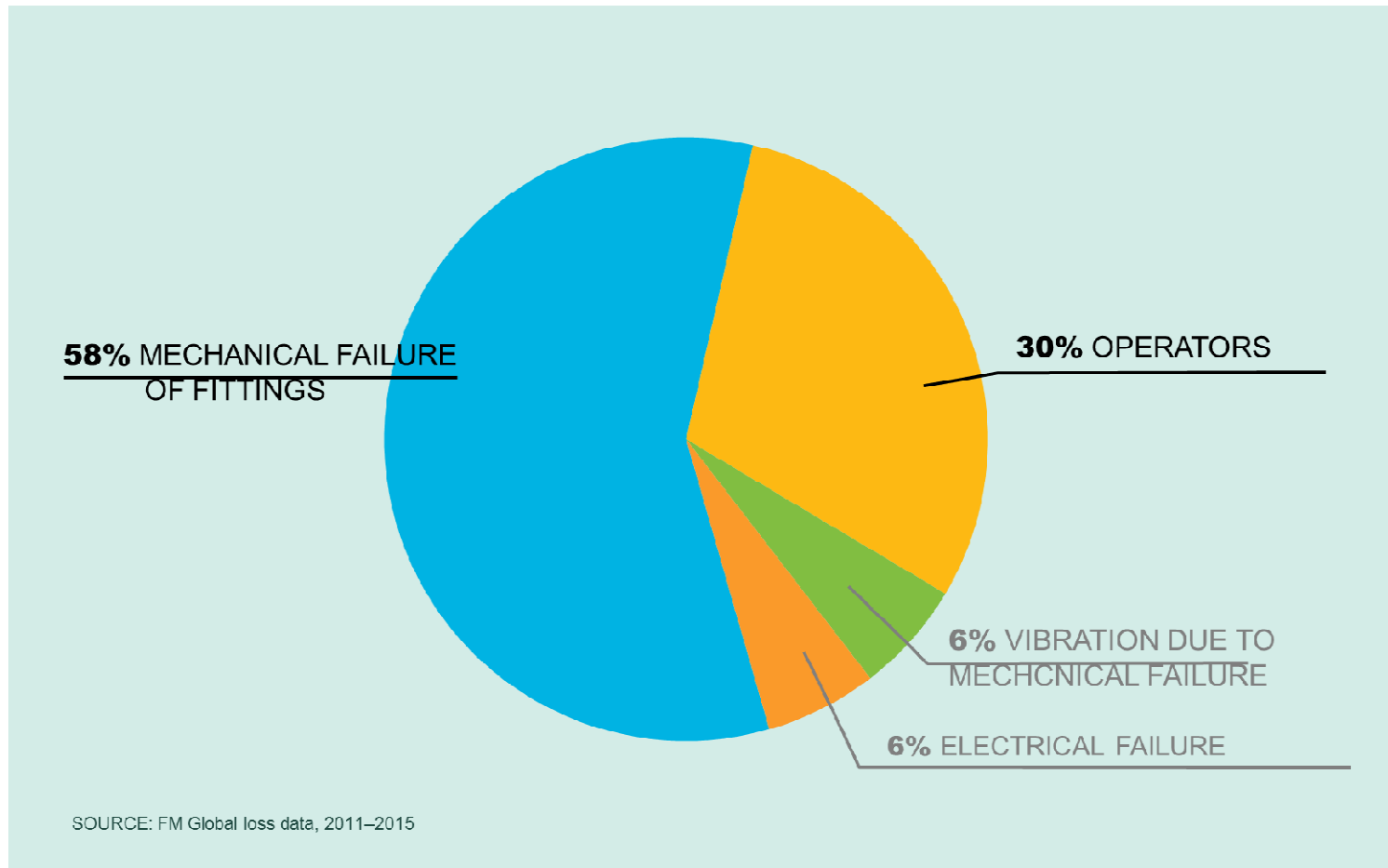
- **It's all about the oil**



Turbine Fire Protection



Causes of Oil Release



Reducing Turbine Fire Losses



- **Automatic turbine shutdown linked to fire protection**
 - **Must include lube oil depressurisation**
- **Flange Guards**
- **Automatic protection over potential release points**
- **Automatic protection beneath operating floor**
- **Drainage and containment**

