

If P&C Insurance Company Ltd.

PANNDAGARNA 2018: POWER PLANT ISSUES

17 April 2018



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TOPICS

Panndagarna 2018

**POWER
PLANT
RISKS**

**STEAM
TURBINE**

**LOSS
TRENDS**

STATISTICS

**FIRE
HAZARDS**

**CASE
EXAMPLES**



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STEAM TURBINE PORTFOLIO

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OUR STEAM TURBINE PORTFOLIO

Large spread in terms of age, size and quality.

STEAM TURBINE PORTFOLIO

FINLAND

- 33 Steam turbines
- 2 000 MW

SWEDEN

- 63 Steam turbines
- 1 800 MW

NORWAY

- 38 Steam turbines
- 550 MW

HIGHLIGHTS

Biggest steam turbine: 254 MW

Biggest single shaft: 452 MW

Smallest steam turbine: 0,8 MW

Biggest turbine claim paid: 9,4 MEUR

Oldest steam turbine: 1952

In addition, co-insurance turbines from large power company accounts.
Overall we insure more than 300 steam turbines



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TRENDS IN POWER PLANT LOSSES

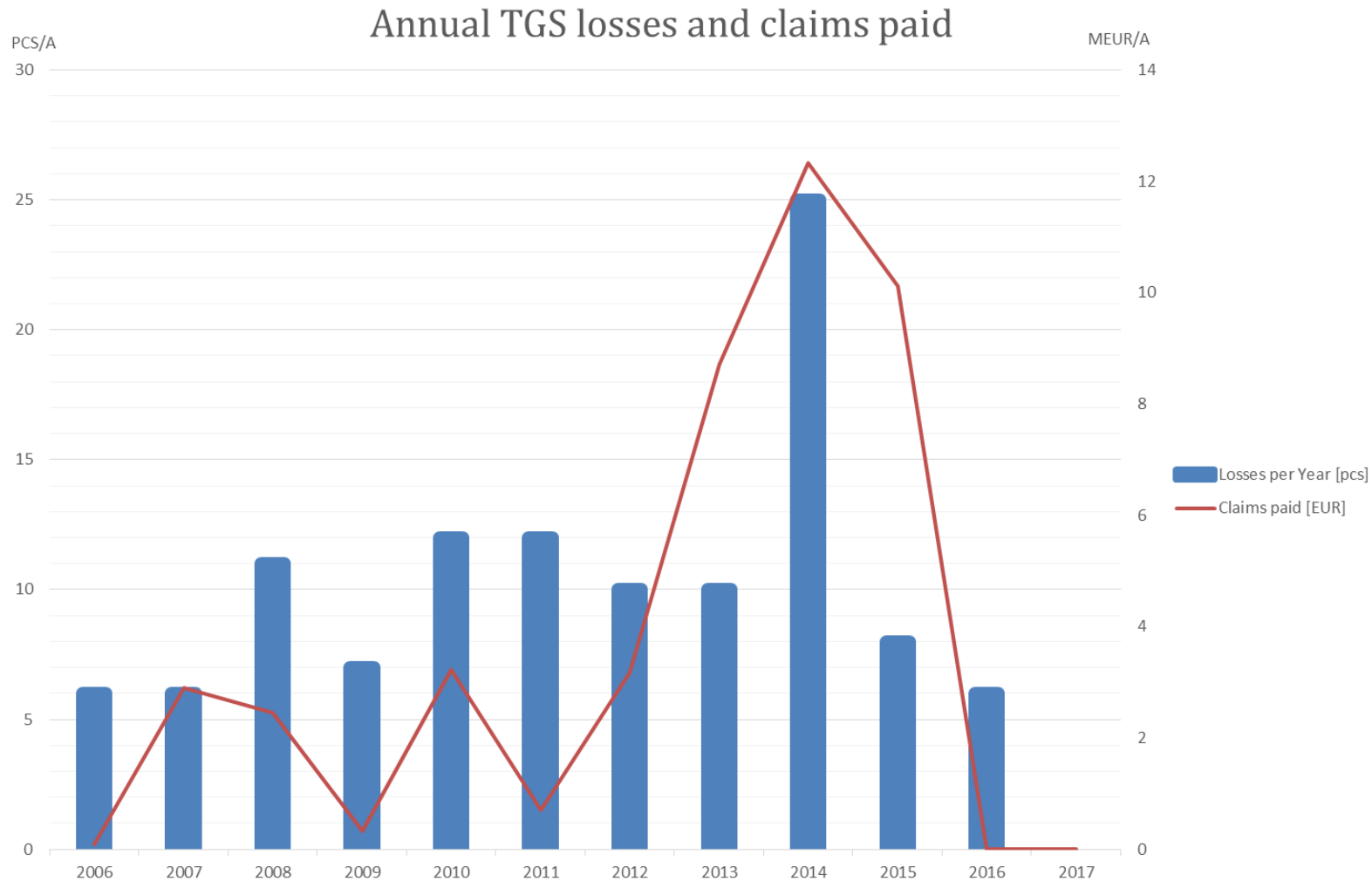
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DEVELOPMENT OF THE TURBOGENERATOR LOSSES

2006...2017



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LESSONS FROM LOSSES

Trends and root causes

Loss trends

- High operating hours
- Prolonged overhaul schedules
 - Unexpected overhaul findings
- **Errors made during revision**
- Condition monitoring level and interpretation of the data
- Problems with new machinery, Infant mortality
- **Oil systems**

Examples of typical root causes

- Process condition changes / operational parameter changes
- Assembly and installations
- Operating procedures / know-how / generation changes
- Design defects
- Component wear out and age

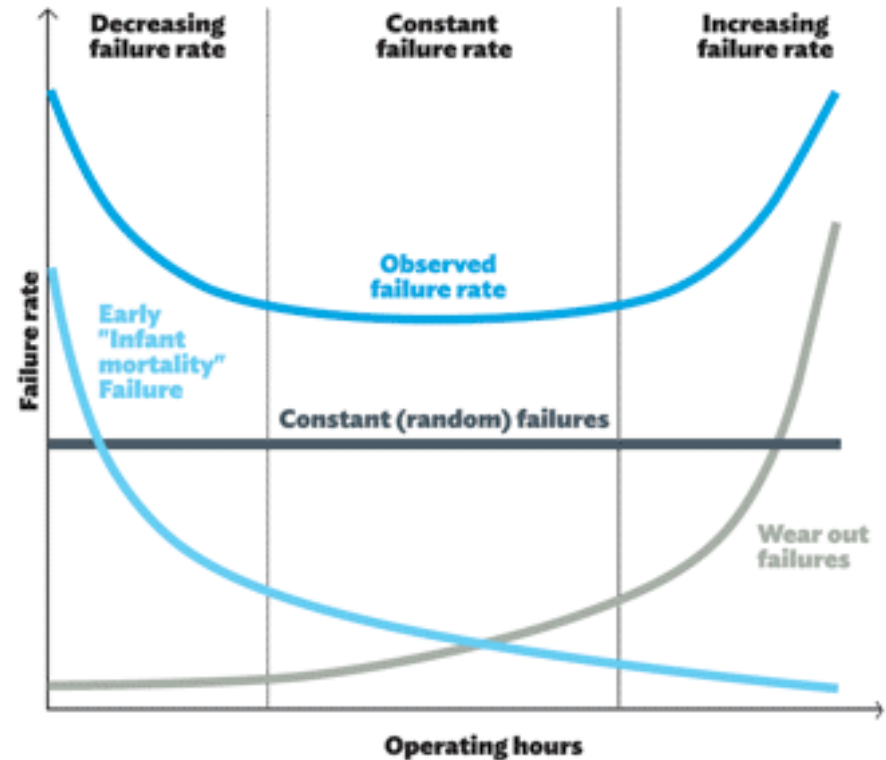


AGING MACHINERY

These issues should be quite clear?

Actions

- Probabilities indicates increased risks
 - Bath-tub curve
- Inspections and -schedule of aged machinery
 - Instrumentation coverage and condition
 - Endoscope inspections
- Operating parameter inspections
- Documentation update
- Protection is usually non-existent



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POSTPONED OVERHAUL SCHEDULES

Overhauls shouldn't come as a surprise

Actions

- Do not skip or postpone overhauls

But...

- Overhaul schedule should be based on reliable data and recommendations
- For altering the overhaul schedule, the inspection, operation and maintenance work must be golden
- This goes both ways, aged machineries should be inspected at reduced intervals



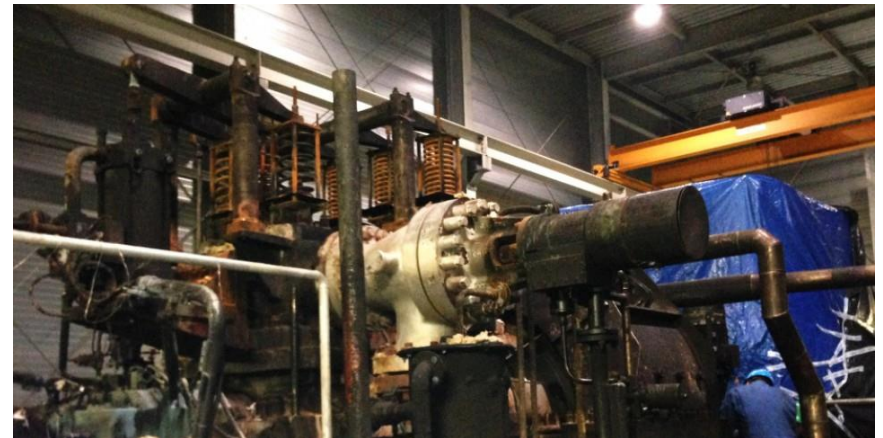
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MEASUREMENTS, INSPECTIONS AND TESTING

How to ensure correct operation of safety equipment?

Safety inspections

- Absolute minimum is after overhauls or major works
 - Should be checked during operation and shutdowns with suitable scope
- Hazop –study for process changes
 - Make sure that the scope is correct
 - Proper functioning of the equipment within the safety equipment
- Signal testing & Actuator testing



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LUBRICATION OIL SYSTEMS

Good place to start inspections

Actions

- Update documentation
- How changes in system affects the rest of the plant
 - Delivery limits
 - System dependencies
 - Understanding the system and parallel equipment
- Work instructions, training, understanding
- Every component in the system must be inspected
 - Bathtub curve
- Inspection of aging machinery
- MTBF



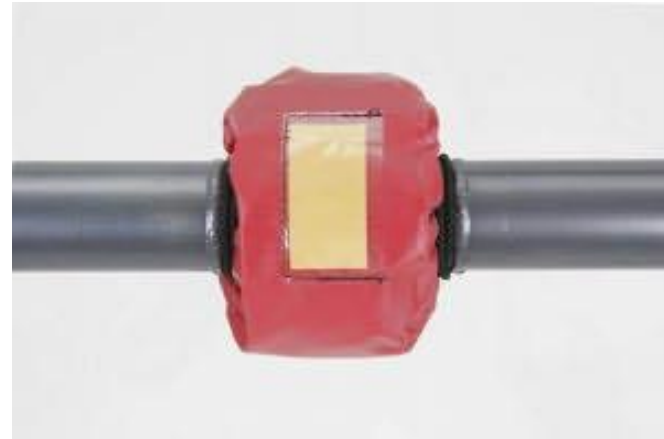
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LUBRICATION OIL SYSTEMS

Good place to start inspections

Actions

- Emergency systems
 - Safety features off!
 - Power feed fire protection
 - Power feed
 - Overcurrent protection
 - Motor protection
 - Battery capacity
 - Emergency generator and connections
- Lubrication Vs. Fire
 - Flange guards
 - Fire protection
- **TESTING!**



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CHANGES IN PROCESSES AND CHANGES IN PROCESS VALUES

- Update documentation
 - Does the documentation reflect reality?
 - Boundaries & limits
- Deep understanding of process
 - Hazop



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FIRE HAZARD

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TYPICAL FIRE HAZARD AREAS IN POWER PLANT

Many areas with unique hazards

- Fuel handling & Conveyors
 - Receiving stations, crushers, sieves, conveyors, dust
- Boiler building
 - Bunker, silos, pulverizers, burner fronts, air preheaters, multi-level solutions
- Turbine hall
 - Deep beam pockets, obstructions, high temperatures, steam, lube oil systems
- Cooling towers
 - Often overlooked, combustible material and electrical equipment
- Electrical equipment
 - Critical bottlenecks, high voltage, cable trays
- Transformers
 - Electric failures, huge fire load



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TURBINE FIRE PROTECTION

- Local and under-floor area automatic sprinkler protection
- Restrict oil spillage with containment and drainage
- Emergency shutdown plan and adequate operator training
 - Lube-oil pump shut-down as quickly as possible
- Provide operators the opportunity to take action during a fire
 - View to turbine hall or CCTV
 - Note! correct positioning of fire protection launch
- Protection of power and control cables



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