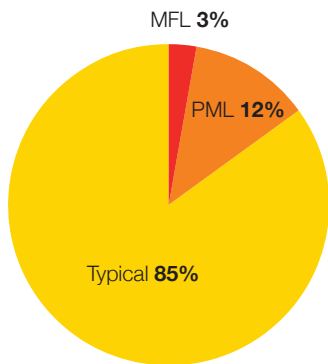


# Loss Control

## Steam Turbine Machinery Loss Events – an Insurer’s Perspective

### Steam Turbine Claims



AEGIS Loss Control regularly monitors and analyzes steam turbine losses to identify exposure trends and support Members in mitigating loss events. Understanding risk characteristics, including causal factors, is a key component to reducing steam turbine failure probability.

Upon review of our claim history over the past ten years, we have classified loss events into three categories: Typical Loss (TL), Probable Maximum Loss (PML) and Maximum Foreseeable Loss (MFL), as shown in the chart and table on this page.

Typical Loss Expectancy	Probable Maximum Loss Expectancy	Maximum Foreseeable Loss Expectancy
Generally < \$5,000,000 ≈ 10% Turbine Value 1 week outage Most Frequent	Generally > \$5,000,000 ≈ 20 – 30% Turbine Value 3 – 6 month outage Less Frequent	Generally > \$75,000,000 ≈ 130% Turbine Value 12 – 24 month outage Uncommon
Failure Modes <ul style="list-style-type: none"> <li>Localized Loss of Oil</li> <li>Blade Tip Liberation</li> <li>Rotor Deformation</li> </ul>	Failure Modes <ul style="list-style-type: none"> <li>Blade Liberation</li> <li>Water Induction</li> <li>Foreign Object Damage</li> <li>Emergency Oil System Failure</li> </ul>	Failure Modes <ul style="list-style-type: none"> <li>Disc Burst</li> <li>Overspeed</li> <li>Rotor Failure</li> </ul>

Each failure mode has multiple causal factors specific to each failure category:

Typical Loss Event Failure Modes		
<b>Loss of Lubricating Oil</b>		
Emergency Power Failure	Motor Control Circuit Failure	Human Error
<b>Blade Tip Liberation</b>		
Design	Erosion/Corrosion	Fatigue
<b>Rotor Deformation</b>		
Cool Vapor Induction	Procedural Compliance	Turning Gear Failure
Probable Maximum Loss Event Failure Modes		
<b>Blade Liberation</b>		
Operational Avoidance Zones	Poor Maintenance	Poor Steam Chemistry
<b>Water Induction</b>		
Leaking Valves	Leaking Attemperators	Leaking Feedwater Heaters
<b>Foreign Object Damage</b>		
Poor Maintenance	Poor Site Controls	Valve Components
Maximum Foreseeable Loss Event Failure Modes		
<b>Disc Burst</b>		
Material Aging (Creep)	Metallurgical	Stress Corrosion Cracking
<b>Overspeed</b>		
Valve Issues	Contaminated Electro-Hydraulic Control (EHC) Fluid	Water Induction
<b>Rotor Failure</b>		
Poor Maintenance	Torsional Vibration	Excessive Starts/Hours

A review of claims data shows a rise in lead time for unit repair due to supply chain disruptions, the lack of like-kind replacement or repair of aging units, and a shrinking pool of repair organizations, which all escalate costs. Workmanship errors, issues with OEM project management, and changing load profiles are also increasingly impacting loss events.

<b>Steam Turbine Red Flags</b>	
• Deferral of Major Maintenance	• Operating within Low Pressure (LP)
• Substandard Valve Maintenance and Testing	• Turbine Avoidance Zones
• Excessive Steam Temperatures	• Abnormal Vibration Levels
• Extreme Operating Profile	• Active Water Induction Indications
• Unresolved Rotor Cracks/Indications	

AEGIS Loss Control provides a host of steam turbine risk mitigation measures and resources available to members including:

- **Plant Risk Assessments:**

These assessments evaluate critical plant equipment located at a facility with regard to operations and maintenance. The evaluations are risk-based, with emphasis on the human element aspects of the loss control programs.

- **Turbine Rotor Assessments:**

These assessments evaluate individual steam turbines with a more in-depth review of rotor dynamics, operations and maintenance.

- **Water Induction Assessments:**

These assessments compare steam turbine water induction design, protection and maintenance to the current ASME TDP-1 Water Induction Standard. This process includes a training review and a demonstration of testing.

- **Fleet Sequential Tripping Assessments:**

These assessments validate the effectiveness of steam turbine sequential tripping schemes across an entire fleet. This is accomplished by reviewing the corresponding speed characteristics during normal shutdowns.

AEGIS Loss Control also offers various turbine risk mitigation publications and webinars including:

- [Quick Tips: Steam Turbine Water Induction](#)
- [Steam Turbine Overspeed Protection Systems](#)
- [Hardfacing Alloys – Cracking and Disbonding in Steam Valves](#)
- [Quick Tips: How effective is your Turbine Sequential Tripping?](#)
- [Quick Tips: Turbine and Generator Emergency Oil System Testing](#)
- [Turbine Lubrication Oil Systems – Operations and Maintenance Considerations](#)
- [Webinar: Steam Turbine Generator Sequential Tripping and Overspeed Protection Considerations](#)

AEGIS members are encouraged to access these resources via AEGISlink.com or contact their AEGIS Loss Control Professional or Gregg Basnight to schedule a risk assessment.