Setting the Standard for Automation™

ISA Delhi Section

FERTILIZER MEET 2017
16TH DECEMBER 2017

Steam Turbine Control Upgrades

Standards
Certification
Education & Training
Publishing
Conferences & Exhibits

The International Society of Automation Delhi Section

Mechanical Governor & Overspeed Trip

Why Upgrade ?

- Improved System Safety
- Improved System Availability
- Improved System Reliability
- Economic obsolescence
- Technical obsolescence
- Plant Operating changes

Safety

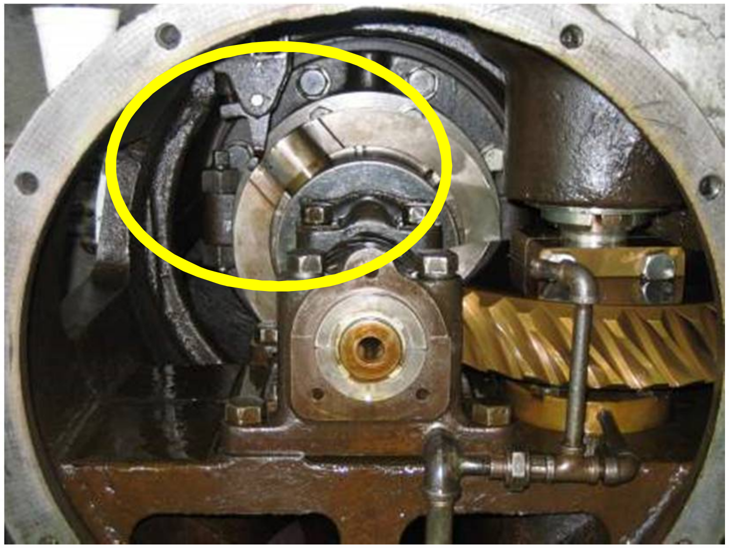
Many turbomachinery control systems in use today are no longer able to safely control the turbine within the original design constraints of the OEM. This leads to reduced life of the turbine components, major turbine failure, and costly downtime. A few reasons may be:

- Retirement of key operating personnel familiar with operation of the older turbine.
- Retired turbines being reactivated for service after long periods of time without maintenance or proper storage.
- Inability of older controls to maintain calibration, increasing the probability of failure due to recalibration errors

Safety

Mechanical Overspeed Bolt

- Calibration
- Nuisance Trip
- Mechanical Wear of Components
- Mechanical Failure
- Diagnostic Indication
- Remote Trip, Trip Output
- Operator Safety



Availability

Availability can be defined as the probability that a system will be operable for a given period of time.

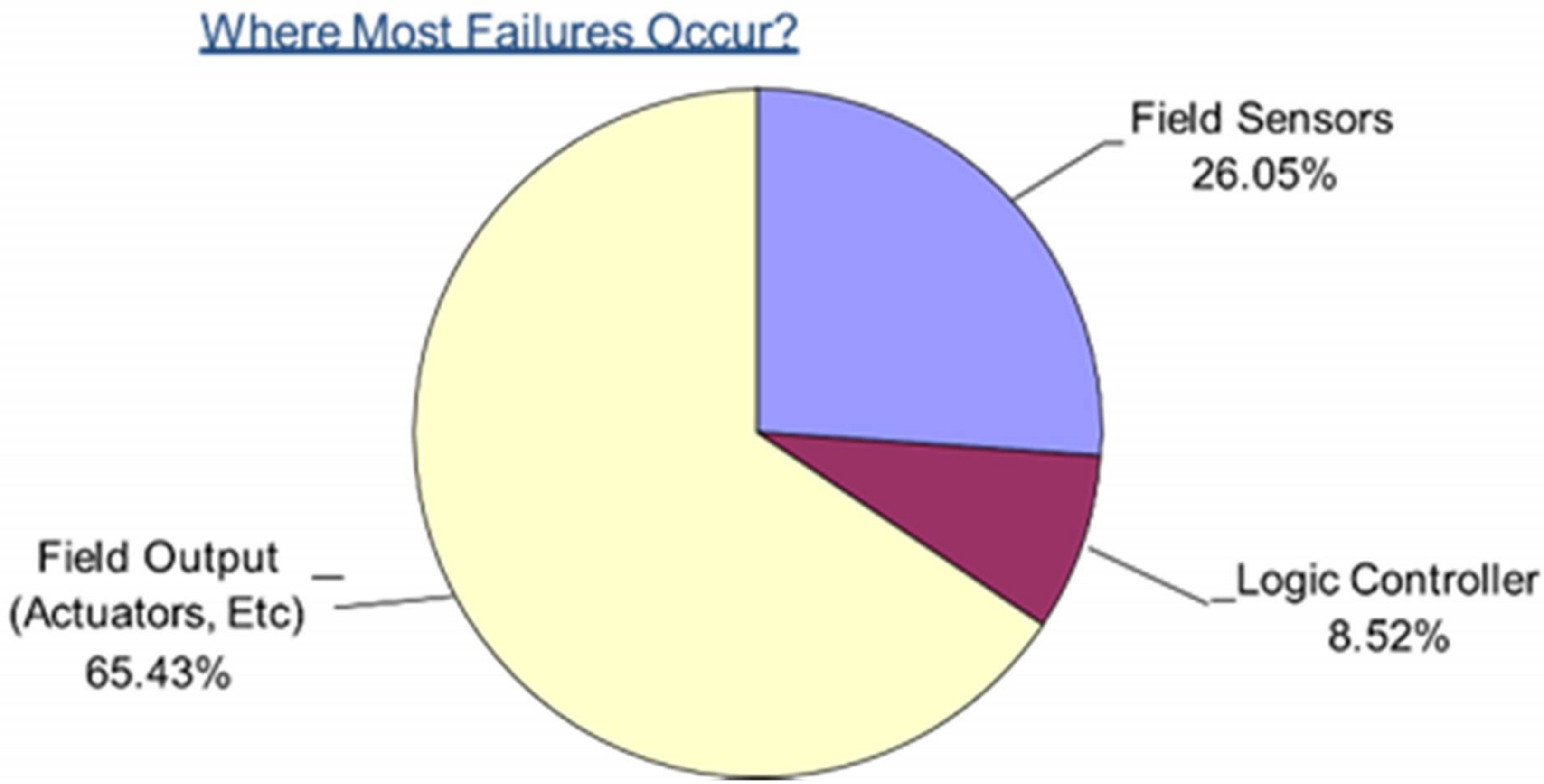
$$\text{Availability} = \frac{\text{Total Operating or "UP" Time}}{\text{Total Time Expected in Service}}$$

- Input/Output (I/O) - wiring, sensor age and availability.
- Lack of timely and cost effective OEM spare parts, engineering, and field support.
- Control design improvements available, i.e., analog vs. digital.

Availability

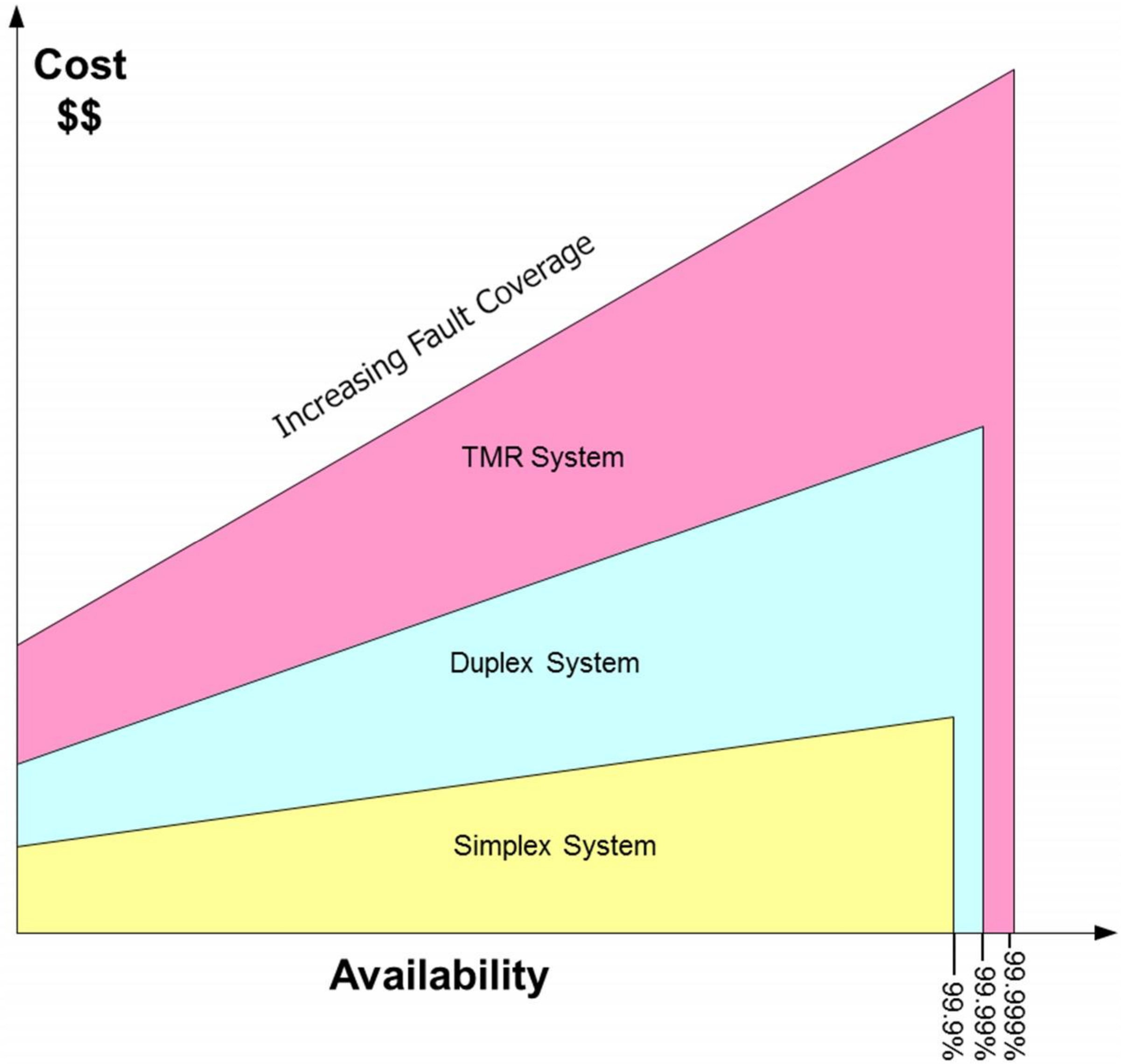
- Lack of present controls to provide accurate and helpful turbine diagnostic information before, during, and after trips.
- Remote operation
- Redundancy of control hardware to prevent nuisance trips due to single point failures.

Availability



Source: Gobel and van Beurden, A Statistical Study of SIF Designs – Distribution over 8,917 SIFs – as shown in Hydrocarbon Processing, January 2006 SIF = Safety Instrumented Functions

Availability



Reliability

We expect to operate the turbine as specified by the OEM without frequent operator intervention. Unplanned shutdowns are not only costly in terms of manpower and possible loss of revenue, but also with regard to the overall life of the turbine.

- Improved state-of-the-art, supportable, digital control hardware and software.
- Improved control design philosophy.

Reliability

- Reduction of high maintenance control hardware items with high failure rates.
- Increased maintainability, optimizing manpower and maintenance planning.
- Consolidation of control systems support

Economic Obsolescence

For safety reasons, older control systems operate turbines below the point of maximum efficiency. The *vintage* mechanical/hydraulic and electronic controls require larger safety margins because of setpoint drift, ambient effects, as well as slower load and transient response times.

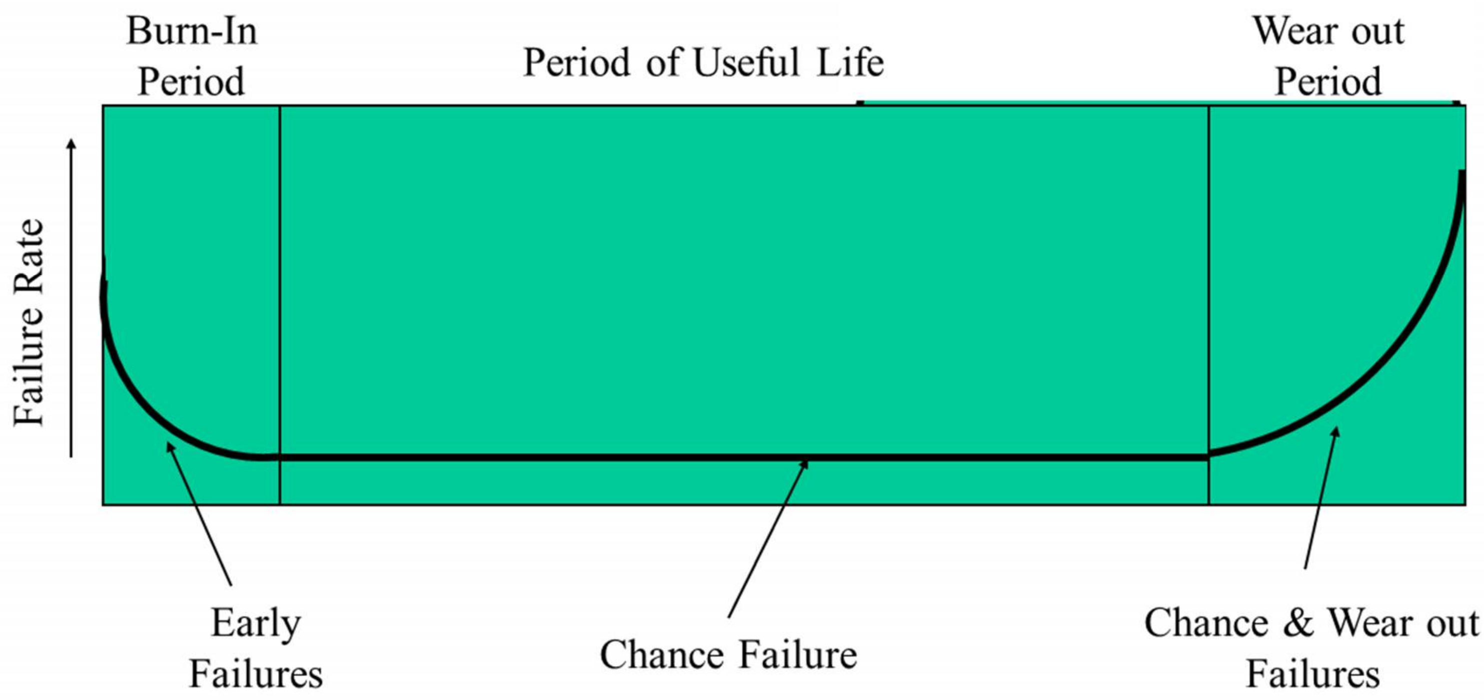
Modern digital controls are able to play an ever-increasing role in improving turbine efficiency as they reliably and accurately operate the turbine closer to optimum running conditions.

Economic Obsolescence

- Reliable and accurate control.
- Automation and improvement of load and transient response.
- Ease of calibration or self-calibration.
- Increased monitoring and trending capabilities.
- Increased operating flexibility.

Electrical System Mortality Curve

The curve shows that control system failures will increase as the control ages and its useful life is reached.



Technical Obsolescence

- Older mechanical/hydraulic and analog electronic controls do not lend themselves to system changes without the addition of expensive hardware.
- Enhanced alarm and trip detail.
- Faster, more accurate access to operating details.
- Hard copy of logs and sequence of events.

Operating Change

To meet changing needs turbines at times are used in ways other than those originally intended.

- Turbine relocation
- Turbine hardware/actuation retrofit
- Projected changes in control philosophy
- Turbine re-rating
- Emission requirements

Retrofit Justification

A “must” is a condition in which existing controls have reached a state of real concern, and could be threatening the operation of the plant.

A “want” is a condition that may not be critical at this time for plant operation, but a new platform is needed for future instrumentation and information system demands.

Retrofit Evaluation

- Capital investment - direct and indirect costs
- Replacement costs - retrofit cannot be completed during scheduled outage and plant is not available for operation.
- Availability costs - Downtime
- Efficiency savings
- Manpower savings - reduced manpower operational needs or reduced maintenance.

Retrofit Benefits

Control system retrofits yield benefits of varying nature and degree. Experiences indicate derived benefits fall into two general categories:

- Monitoring and control
- Economic

Monitoring & Control

Performance

- Predict the efficiency of the turbine between overhauls
- Ability to log and trend data over time.

Accuracy

- Enhanced monitoring and control accuracy increases efficiency.

Monitoring & Control

Automatic Startup

- Start sequence to insure controlled starts with less thermal stress to the turbine. Less stressful starts result in extended turbine.

Flexibility

- Hardware flexibility in that many options exist for I/O configuration, communications interface, and configurable control loop rates.
- Software modifications are relatively simple.

Economic

In the case of turbine retrofits the economic benefit generally comes in the form of cost savings, rather than revenue generation.

- Reduced Operating costs.
- Reduced downtime.
- Reduced manpower during starts.
- Cost of spares.

Upgraded system

THANK YOU