Reliability, Availability & Reliability Centered Maintenance (RCM)

The Mission Critical Triangle

Outline

- Brief overview of RCM design considerations
- RCM simulation (software demonstration)
- Questions

RCM – Theory in Practice



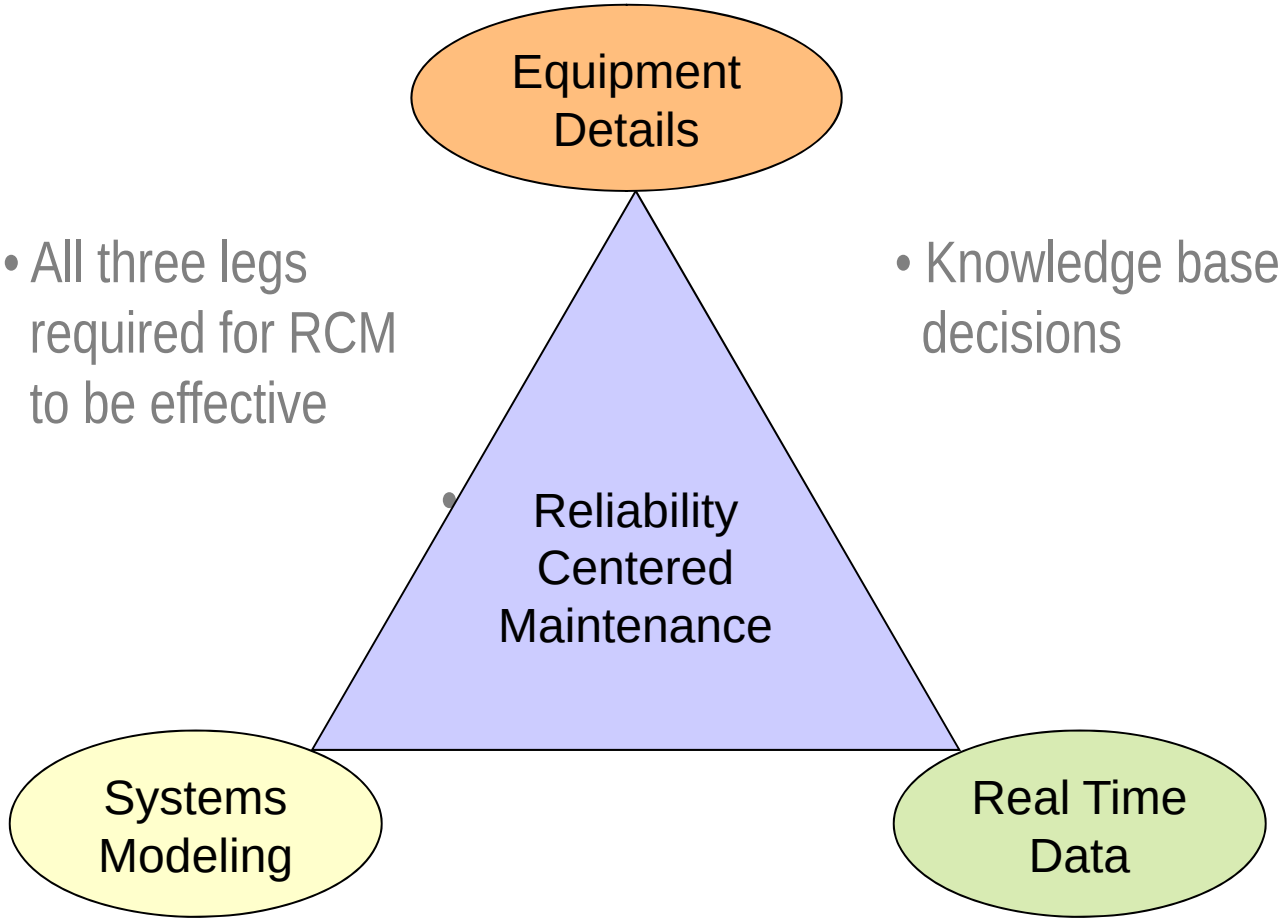

- The MAJOR cause of mission critical product failures is caused by human factors (scheduled maintenance etc.).
- 80% of outages and facility shut-downs are caused by internal power problems, not external sources: they are identifiable and predictable
- A key of RCM is running to the “edge”.

Running to the Edge

- The RCM Triangle
  - Detailed equipment information, modeled for exacting performance.
  - System knowledge of performance and “aging”.
  - Actual performance (so called “real-time” data) compared to predicted performance

- EDSA RCM Paradigm
  - Extensive, detailed “name plate” data via the EDSA DesignBase equipment data base.
  - *Modeled for Performance* based *Power Analytics*
  - High performance enterprise data acquisition compares and contrasts predicted vs. actual data.

RCM Delivered



- All three legs required for RCM to be effective
- Knowledge based decisions

Power Analytics™

1. Enables organizations to engineer potential electrical problems out of their infrastructure during the design stage.
2. Provides a real-time, expert assessment about the system-level electrical power essential to RCM.

Predict	Learns to identify conditions that precede power failures
Prevent	Isolates impending points-of-failure
Present	Reports potential problems and recommended actions to owner/operator

Routine Facility Planning

- Maintenance is based on real-time insight into system capacity, availability, configurability and reliability
- Modeled system allows "what-if" simulations so that maintenance impact can be simulated before the start of system maintenance procedures
- Knowing exactly how your infrastructure will respond to both routine and non-routine events

Predicting Non-Routine Problems

- Constantly monitoring "actual" and "as-designed" specs, to diagnose potential problems in the formative stages
- Ascertaining the seriousness of potential problems – and their fixes – before they strike
- Maintaining a constantly-updated awareness of all changes made to your electrical infrastructure, and any potential they introduce for electrical systems failures

RCM Process

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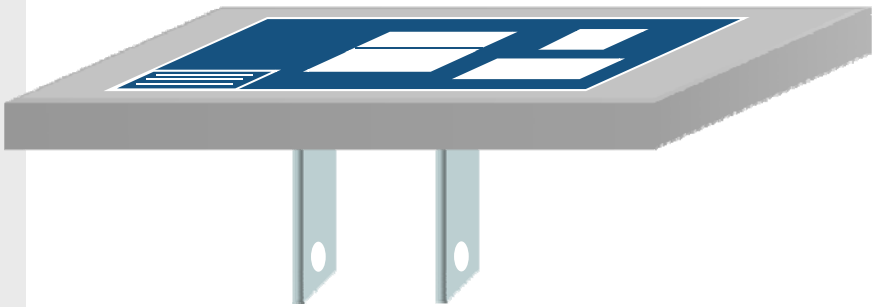

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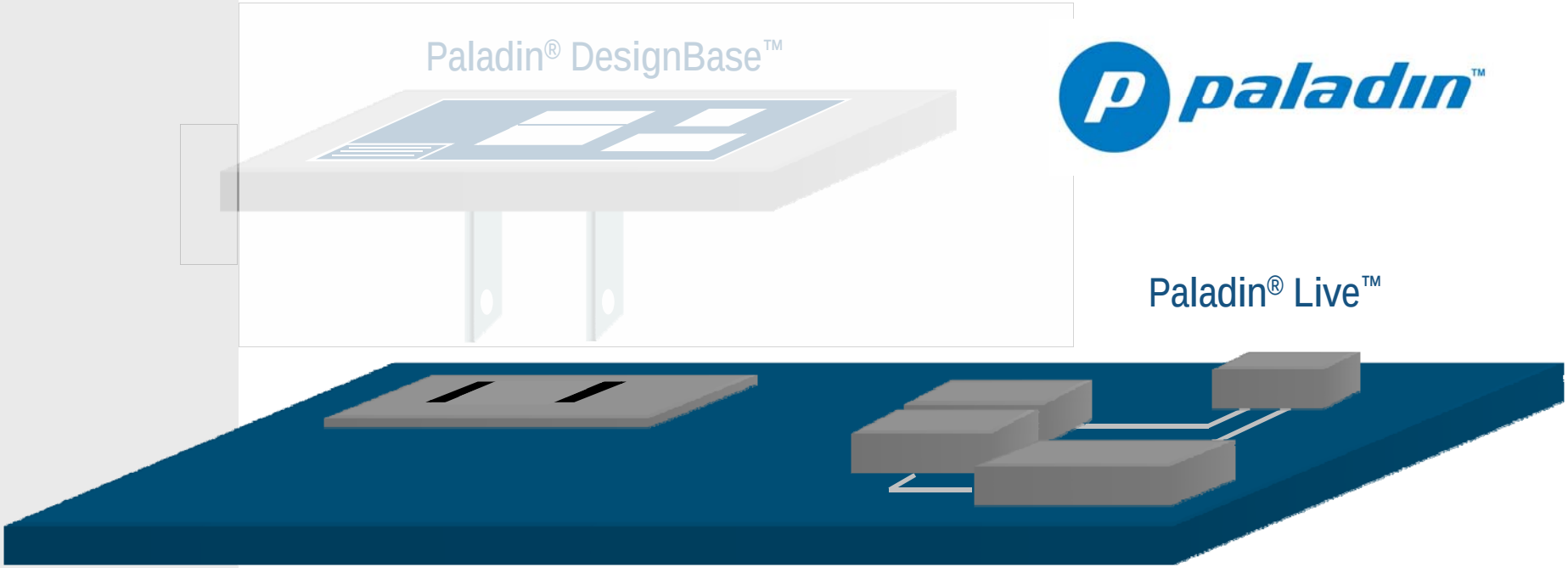
- A robust knowledge base containing performance and behavioral specifications for all equipment and components (so called name plate data).
- Expert level analytical tools establish the base line for performance
- Ensures that system design is **“Perfect on Paper”**



- Insert the expert design into the real time environment.
- Immediately identify and report on variations in *desired vs. actual* performance.
- Decisions are based on expert design compared to actual performance.

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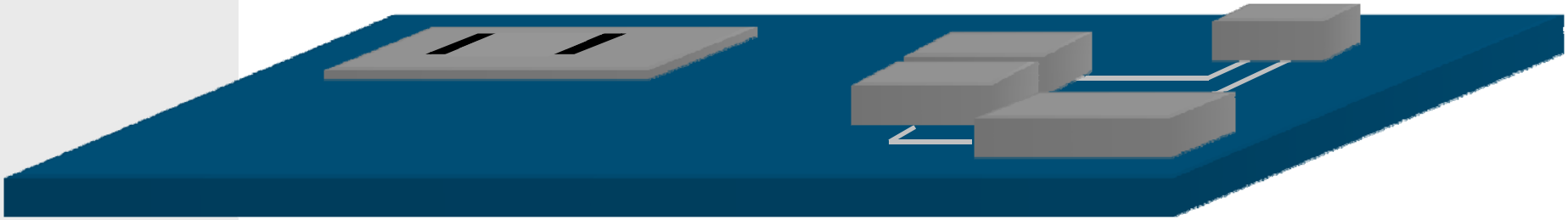

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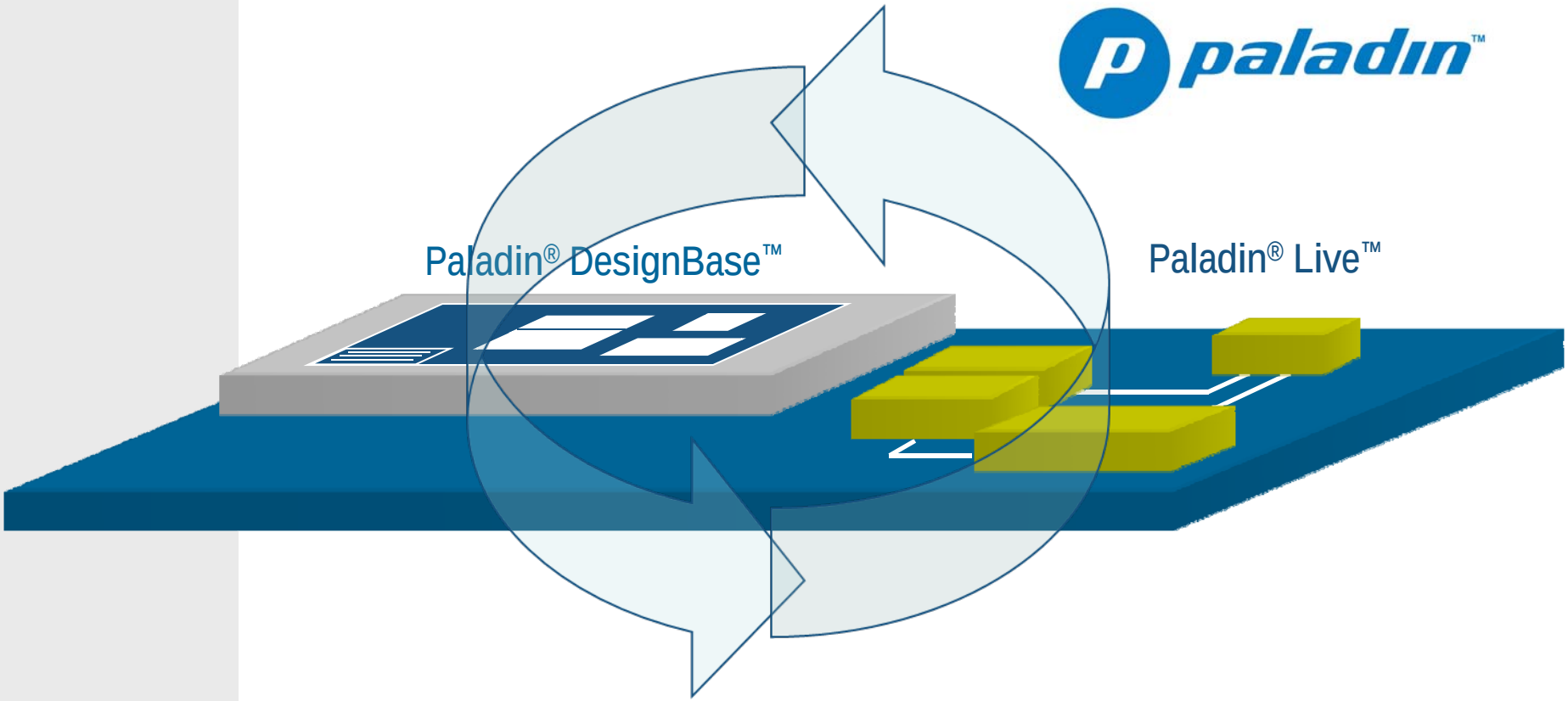

- *"Design drives operation, and operation informs design"*

Predictive Operations Intelligence

Virtual

Virtual Facility Model

Simulation

Predicted Measurements

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Actual

Actual Physical Facility

Sensors and Monitoring

Actual Sensor Measurements

Facility

Process

Equipment

- Paladin “connects” the **virtual** and **actual** worlds, to ensure that facilities operate precisely as they were engineered to

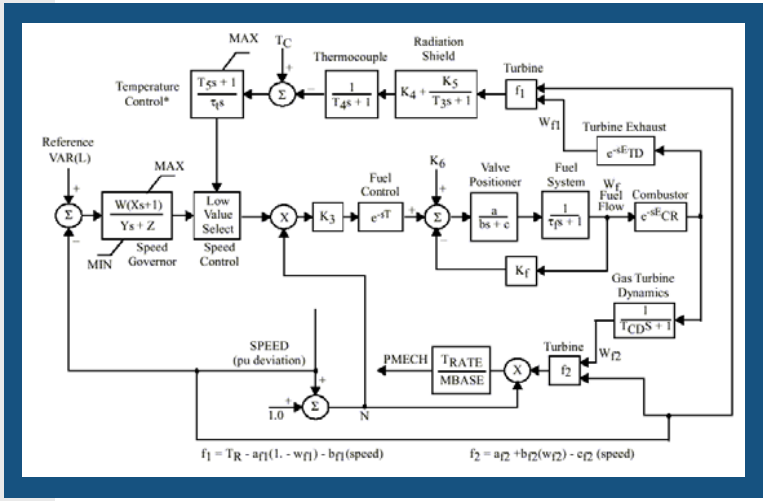
RCM Concept Demonstration

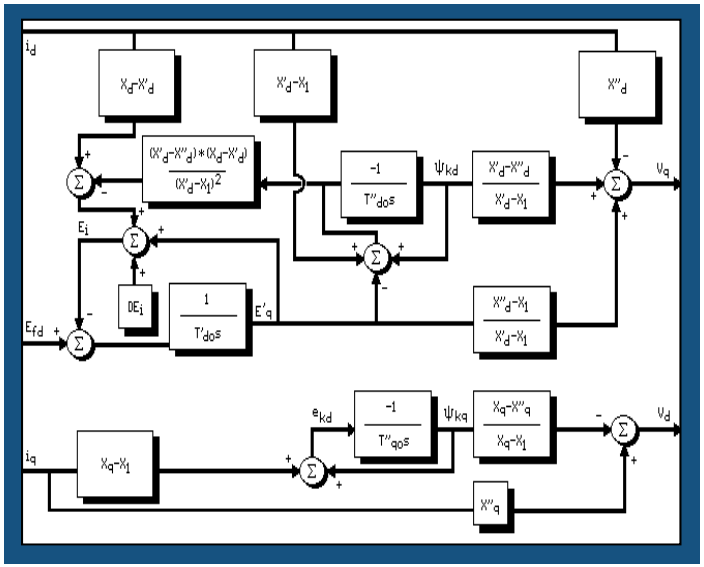
Technically Superior

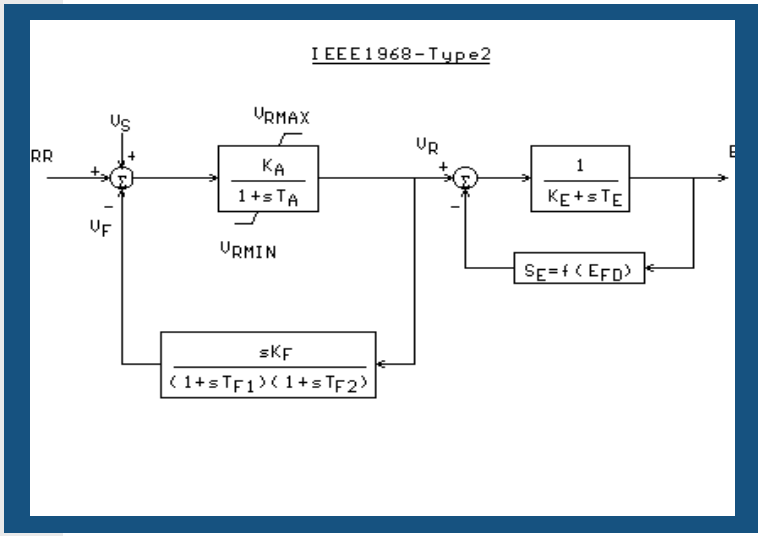
To validate electrical system dynamic simulations, measurements of direct on-line starting of existing 6.8 MW induction motors were carried out.

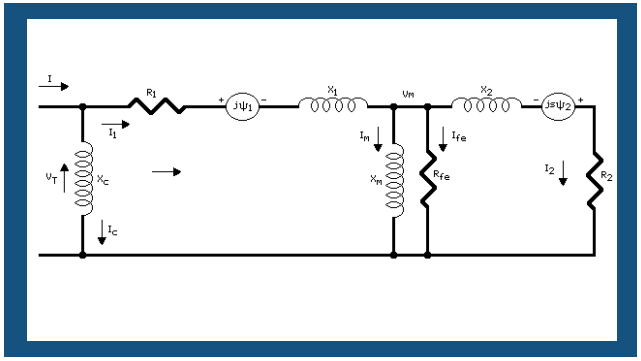
- 13.8 kV bus voltage
- Bus frequency
- GT/G electrical power
- Cooper Rolls gas turbines, 24 MW, 4940 rpm
- Woodward governor
- Siemens generator, 30 MVA, 1800 rpm
- Siemens AVR RG3 - 15

Dynamic Model Representations









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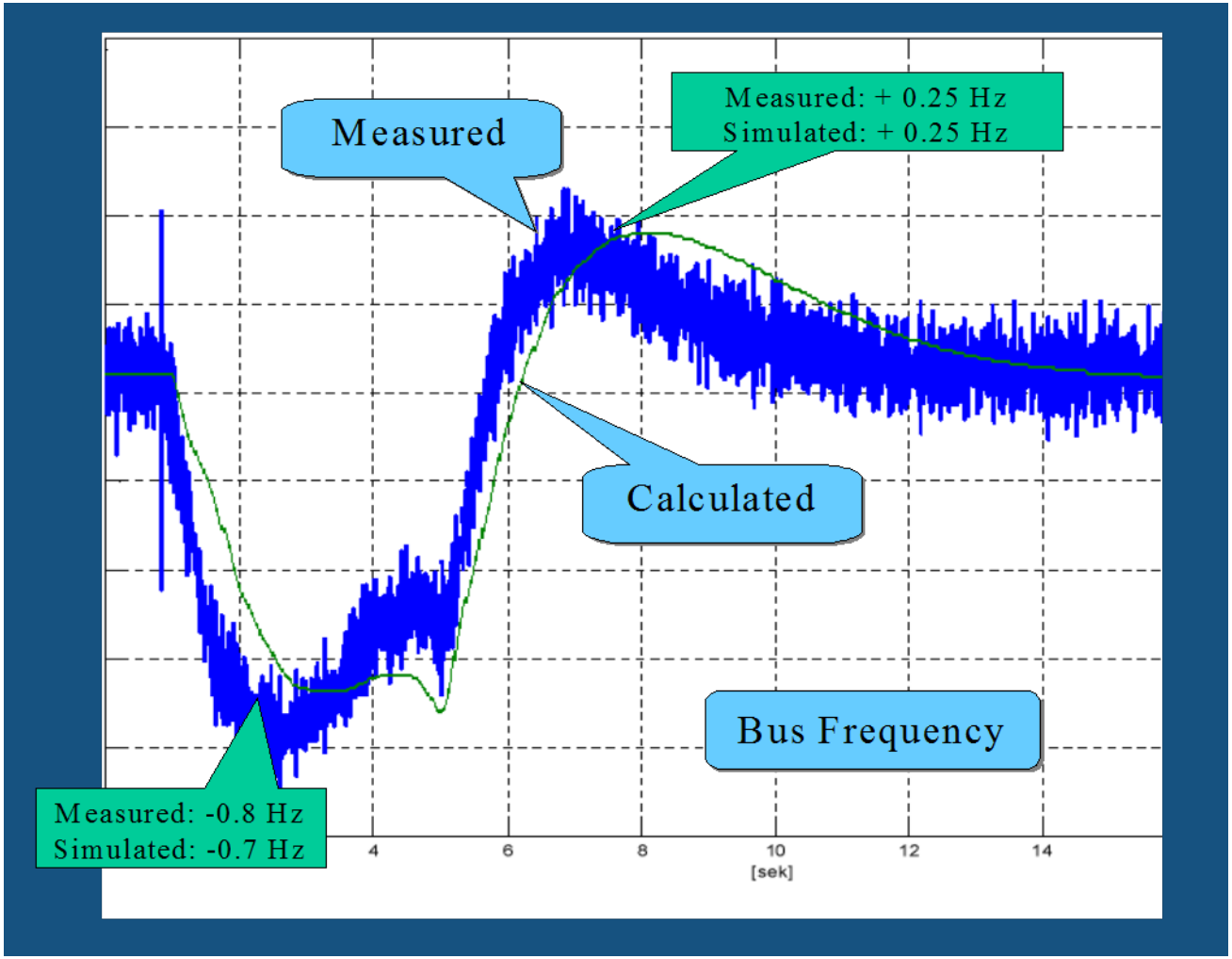

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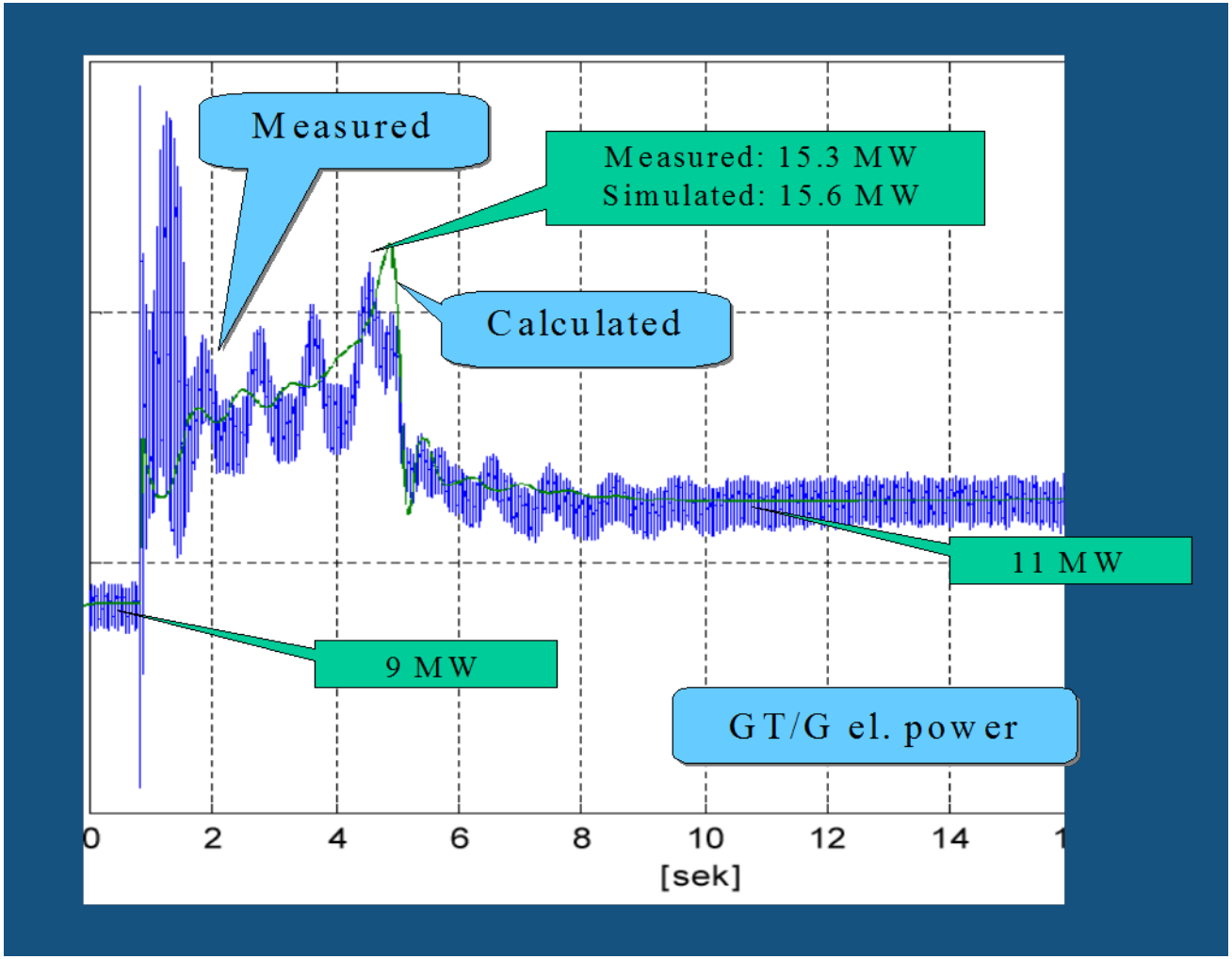

Software Demonstration

- Paladin DesignBase
- Paladin Live

Summary

RCM has well documented cost savings over traditional equipment maintenance strategies (annual routine or vendor programs) ***IF*** you understand thresholds for performance and impact of planned maintenance.

Thank You