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How PI Played a Key Role in Achieving Maximum Equipment Reliability

Presented by: Vlad Djuric

March 11, 2002

OSIsoft Users Conference

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Agenda

- Dofasco Background & Research
- Dofasco Response & Results
- New Failure Paradigm
- Integration with OSIsoft PI
- Case Study

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Dofasco Background

- Major North American metal solutions producer
- Annual revenue approximately $3 Billion
- Produce approximately 4.5 million tons of product per year
- Supply to automotive, manufacturing, construction and packaging customers
- $5 Billion equipment replacement value

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Dofasco Main Site

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Electric Arc Furnace

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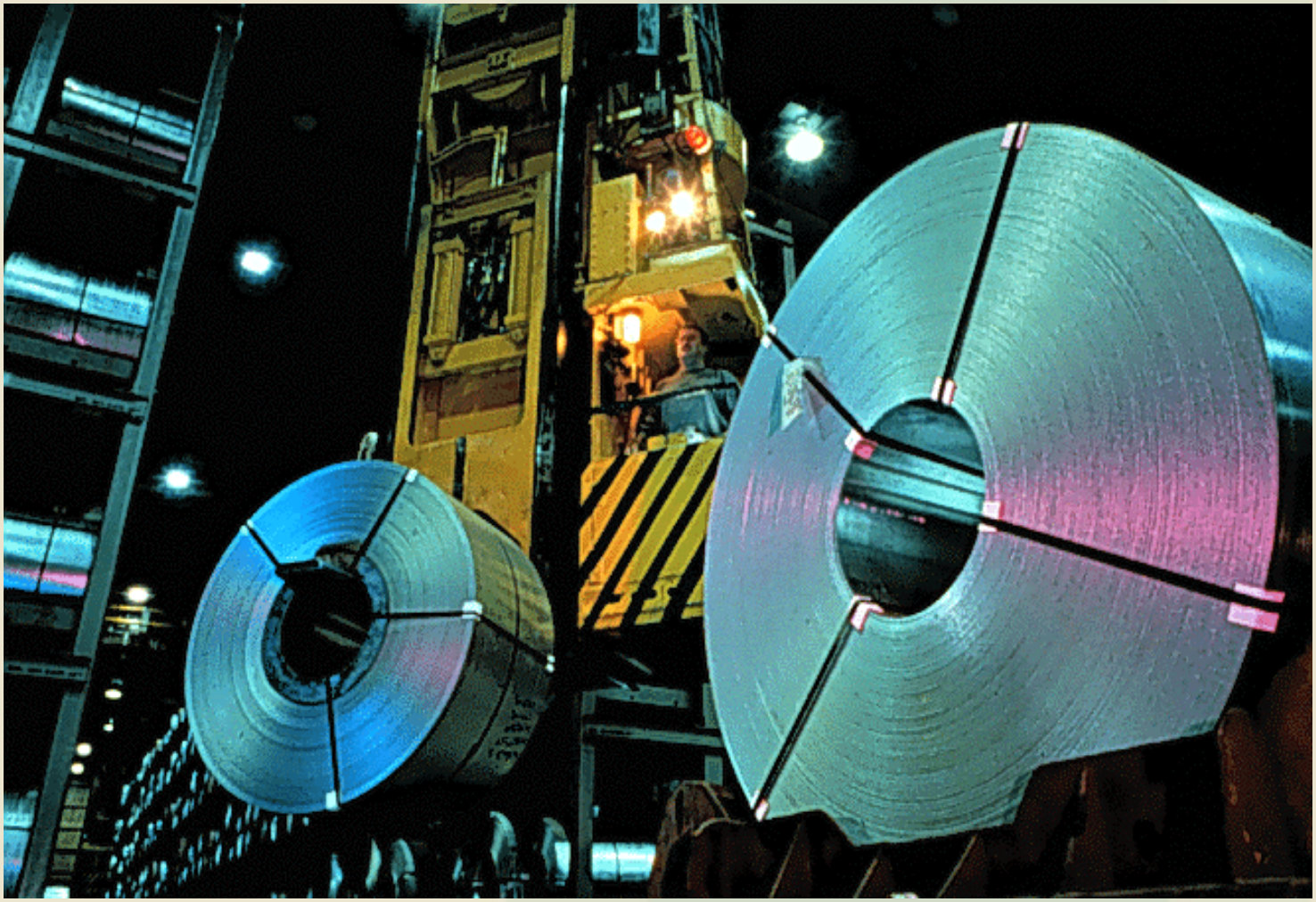
Central Shipping



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Challenges of the late 80's

- Inflation raised costs while market prices dropped
- Globalization
  - High quality Asian imports available at low price
  - Buyer's market
- Profit formula changed:
  - From: Price = Cost + Profit Margin
  - To: Price – Cost = Profit Margin
- Shareholder value substantially eroded
- Created an urgent need to improve results

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Responding to the Changing World of Maintenance

- Dofasco conducted global benchmarking research on:
  - Industry maintenance and reliability practices
  - Predictive maintenance technologies
  - Information systems
  - Reliability methodologies

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The Research Findings

- No single country, industry or plant had developed comprehensive best practices
- Pockets of excellence existed
- Reliability improvement efforts were inconsistent and short lived
- Information systems (CMMS, PdM) fell short of user expectations
- Equipment repair cultures were dominant
  - Rather than asset reliability cultures

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Dofasco Response

- A solution to the changing world of maintenance required a Reliability Driven Maintenance focus
  - Asset reliability business process
  - Maintenance & reliability practices
  - Enabling technologies
  - Sustained corporate commitment to reliability

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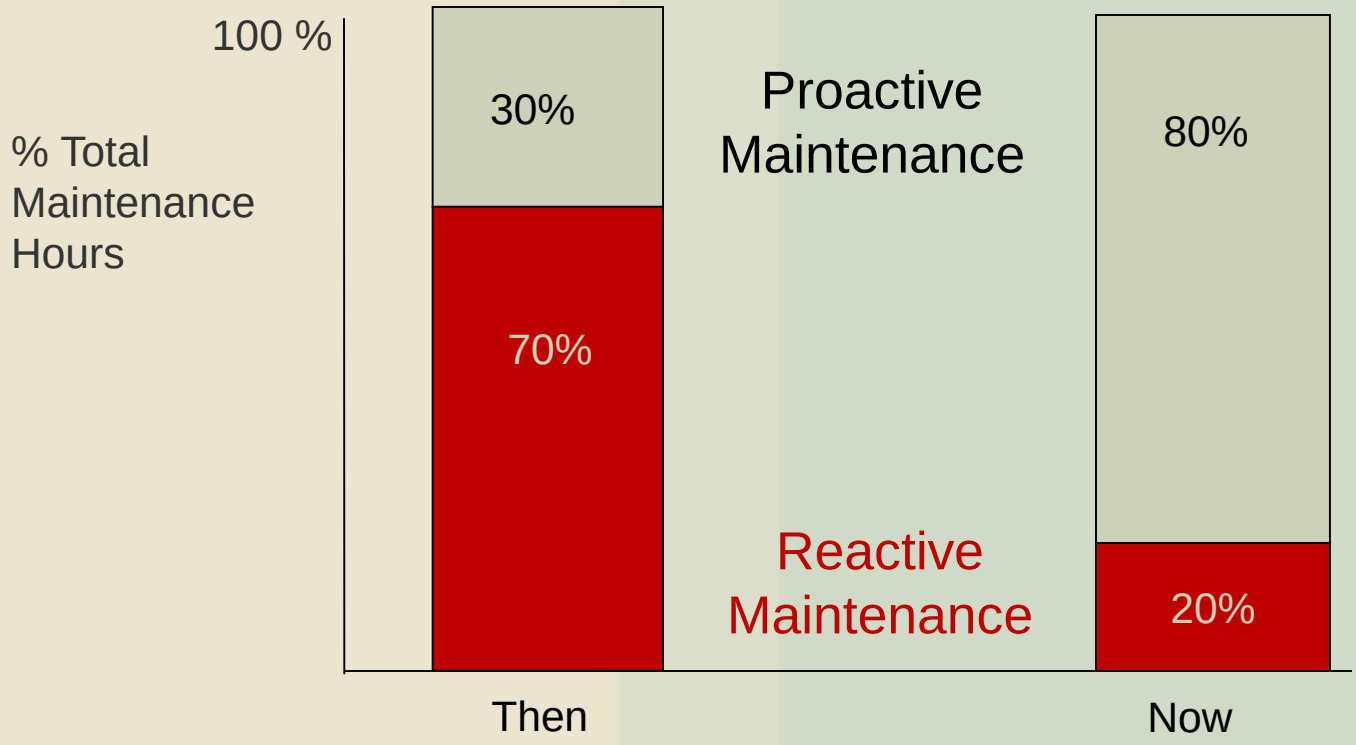
The Results



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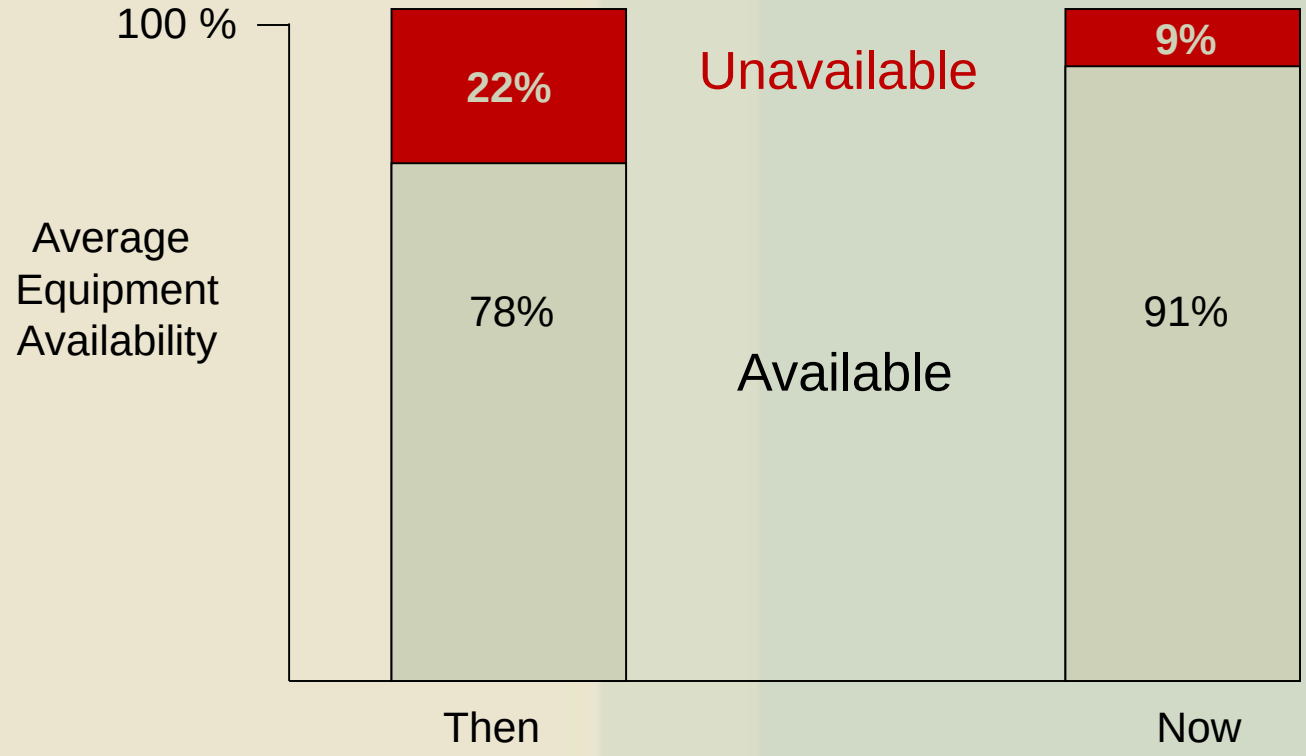
The Results



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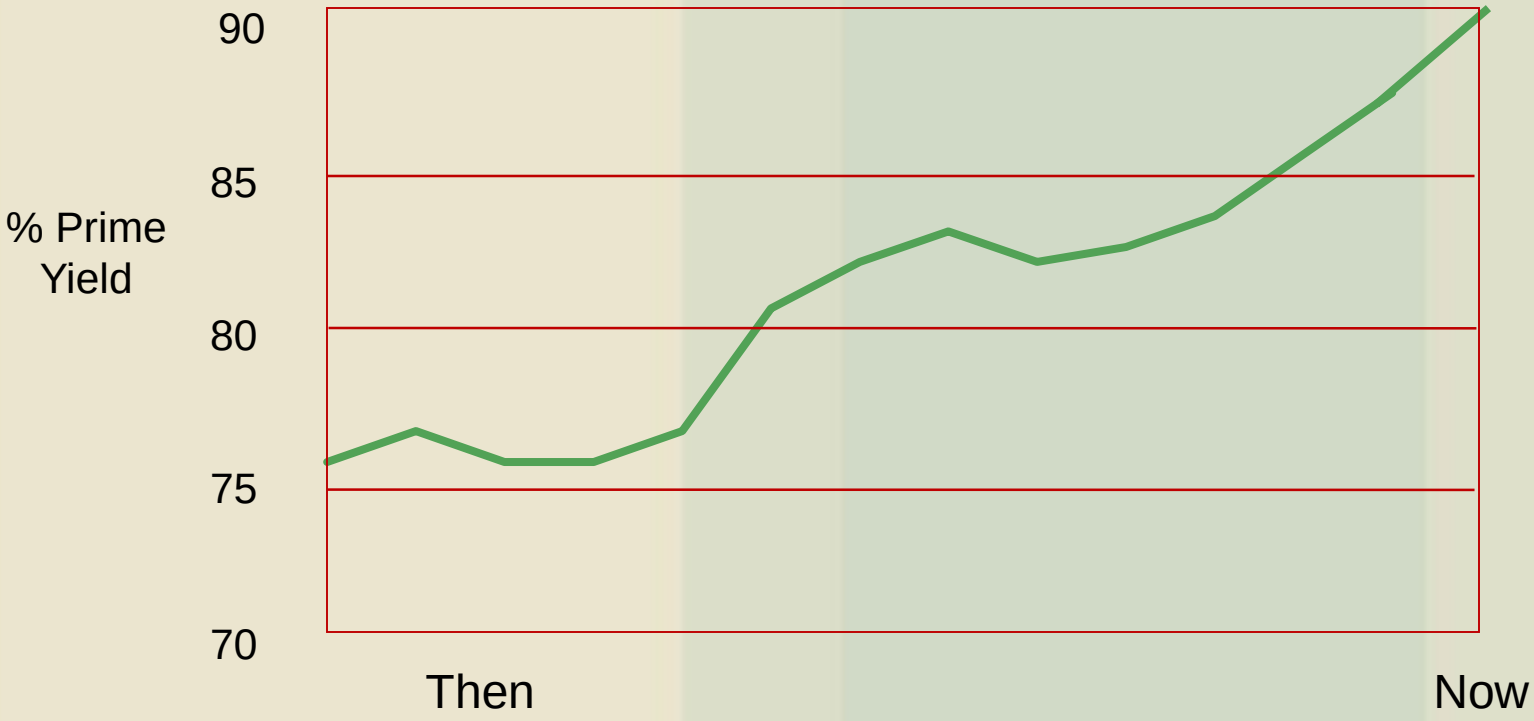
The Results

Quality increased from 76% yield to 91%



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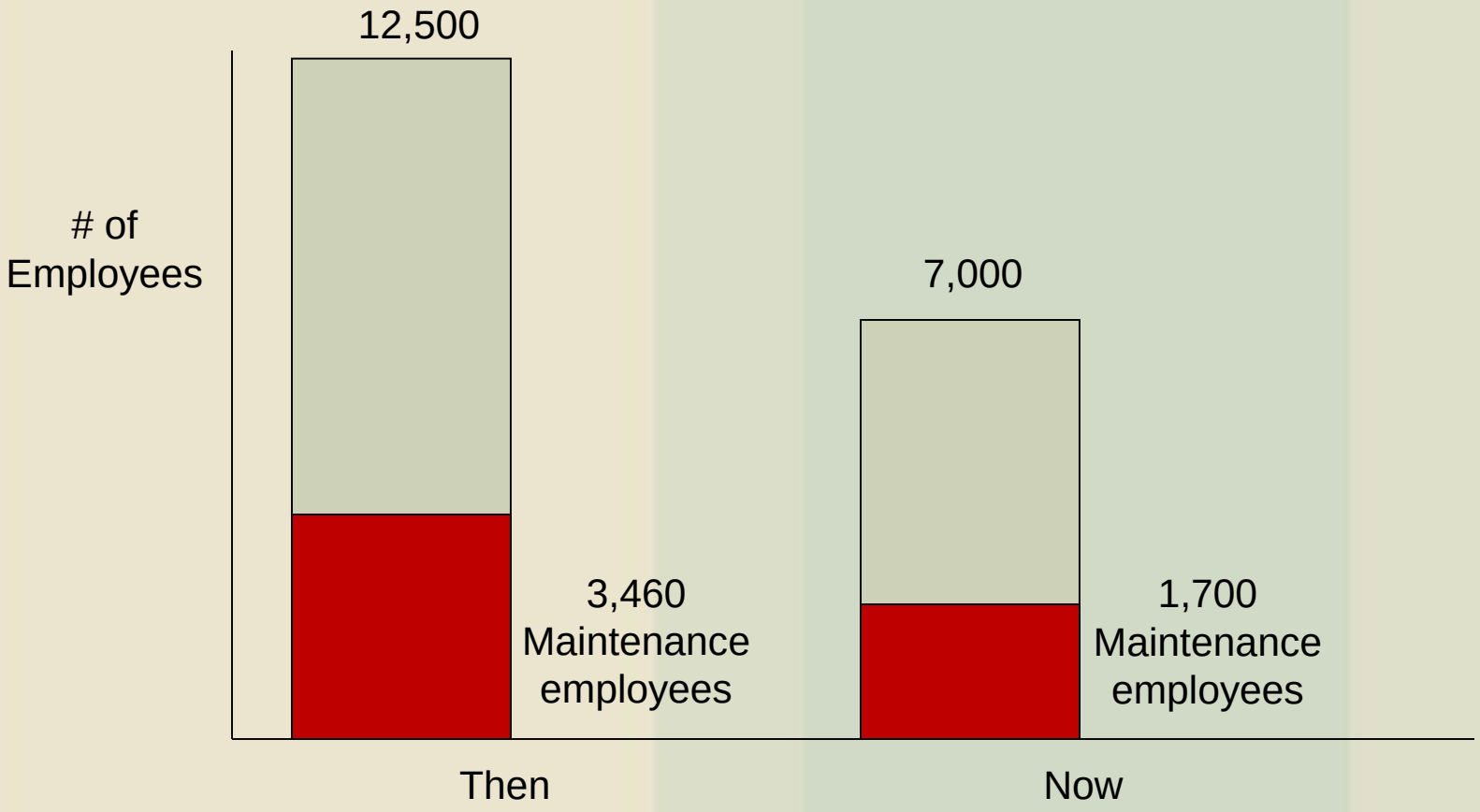
The Results

Reductions achieved through voluntary attrition



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The Payoff

- Winner of two prestigious maintenance awards:
  - Best use of Innovation and Technology in Maintenance
  - Best Maintenance for a Large Plant
- Most Profitable North American producer in their sector
- Ranked as #1 worldwide manufacturer in their industry by Dow Jones 2 years running
- North American benchmark for World Class maintenance practices and technologies

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Dofasco Maintenance Culture

- Historically Dofasco's maintenance department:
  - Repaired broken equipment
  - Or preferably, prevented equipment from breaking
- Majority of attention was to:
  - Improve trade repair skills
  - Optimize time based equipment overhauls
  - Better use of advanced planning & scheduling tools
- "Equipment Repair Culture" rather than an "Asset Management Culture"

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Asset Management Culture

- Higher market demands
  - Quality
  - Price
  - Delivery
- Increasingly stringent safety and environmental regulations
- Equipment becoming increasingly complex
- New research on modes of equipment failure
- New computer and diagnostic technology
- New failure paradigm

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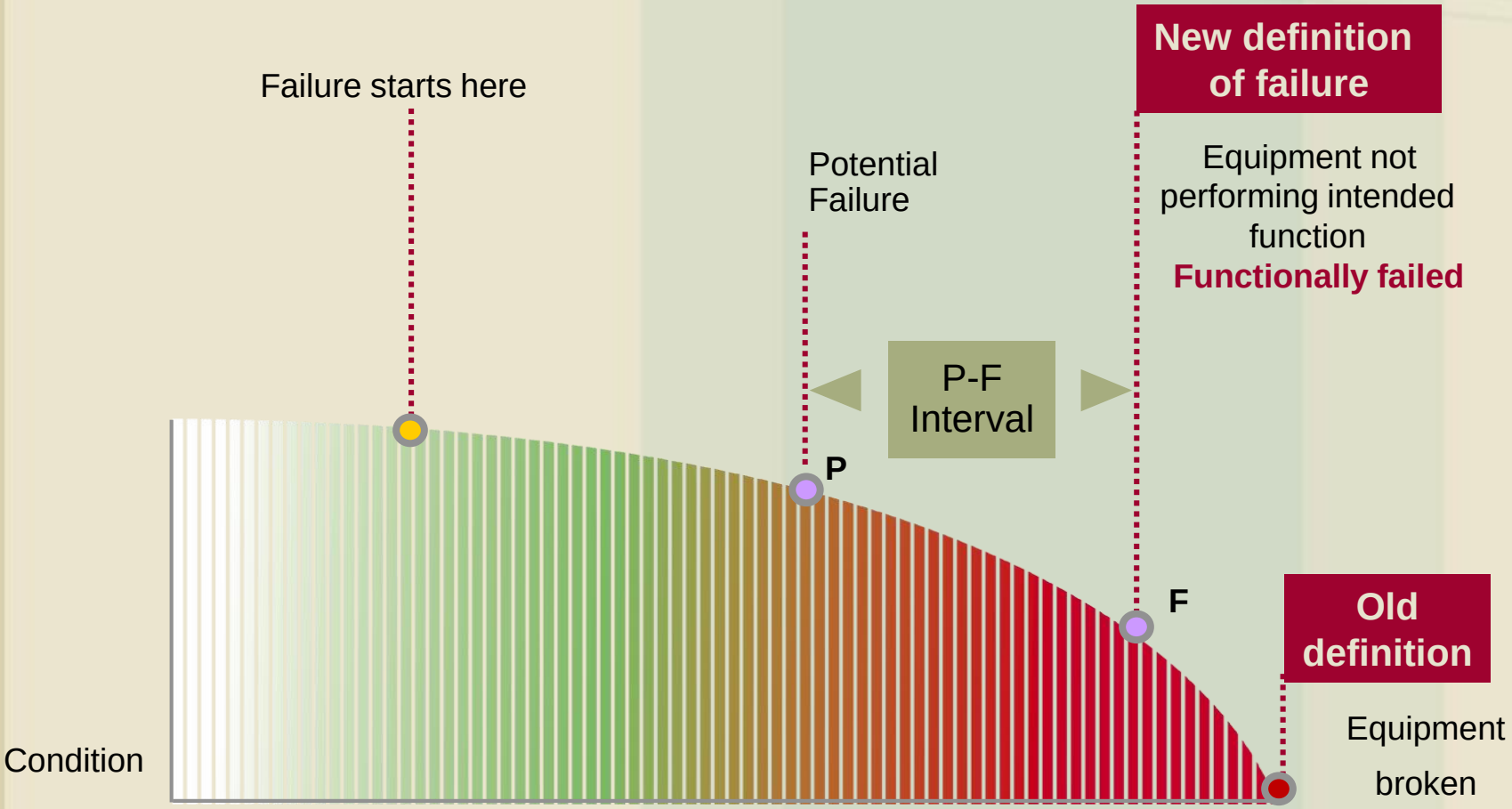
New Failure Paradigm



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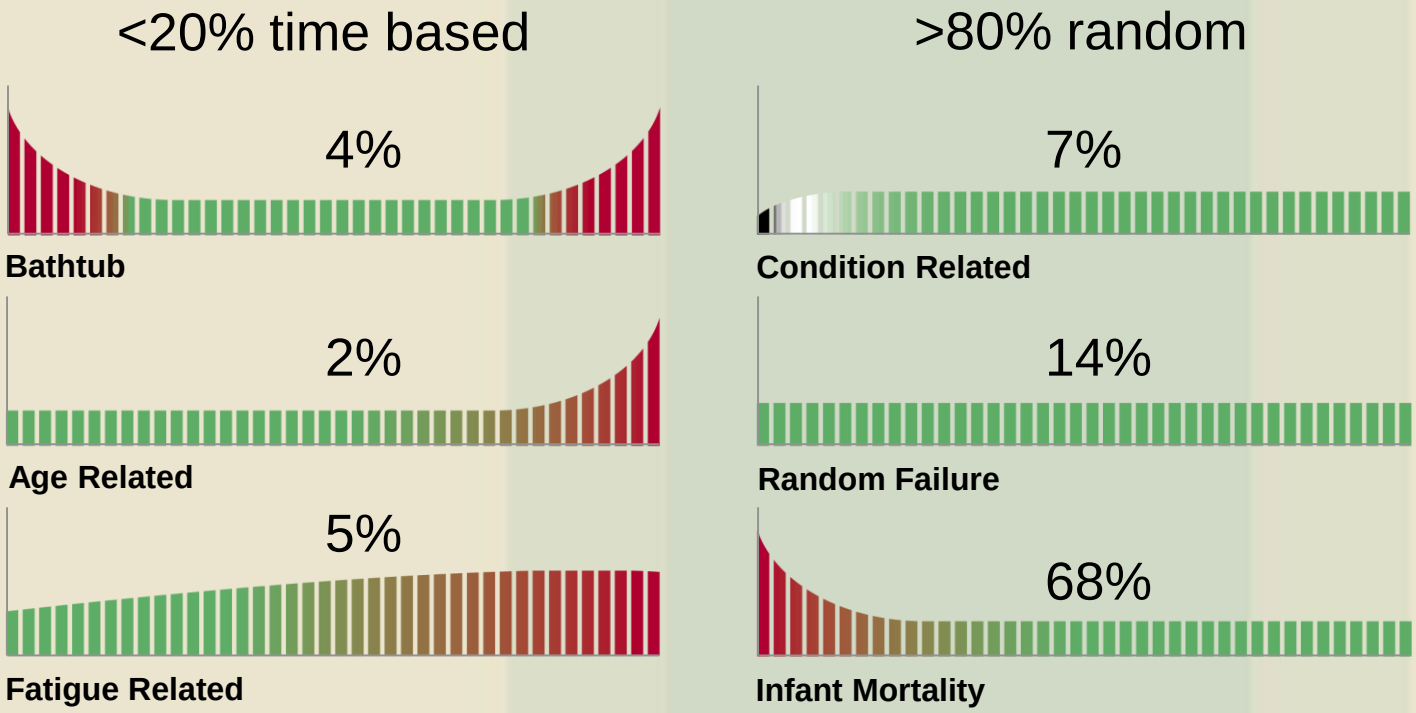
The Reality of Failure

- There are six failure patterns



The majority of failures are random, not time-based

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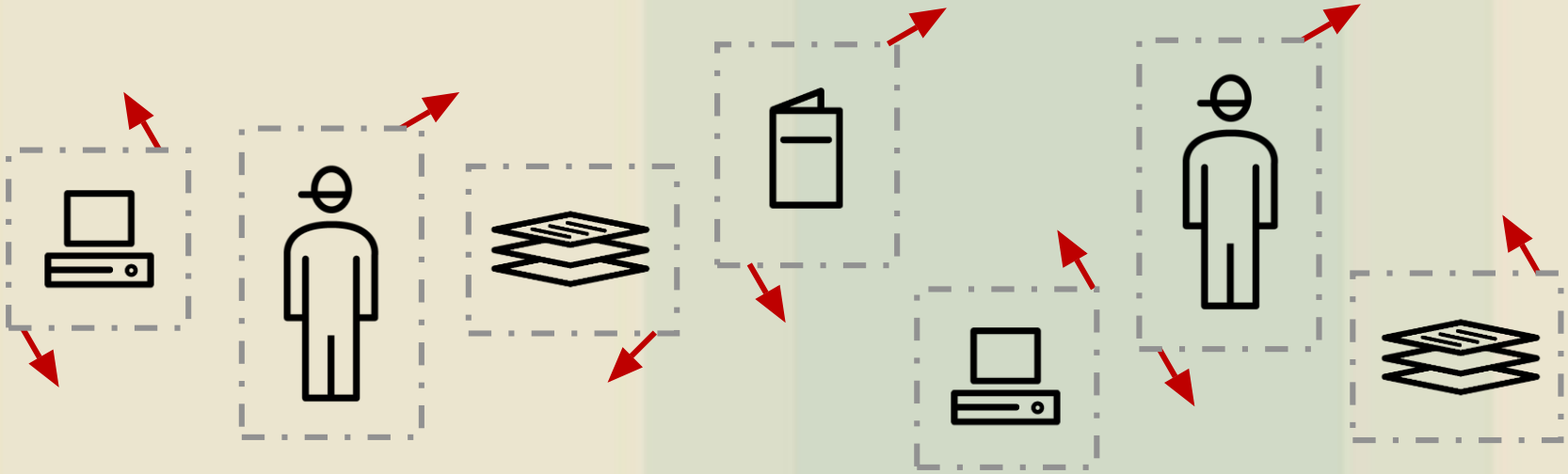
Typical Current Situation



Scattered knowledge

Inconsistent actions

What Maintenance Work?

At What time?

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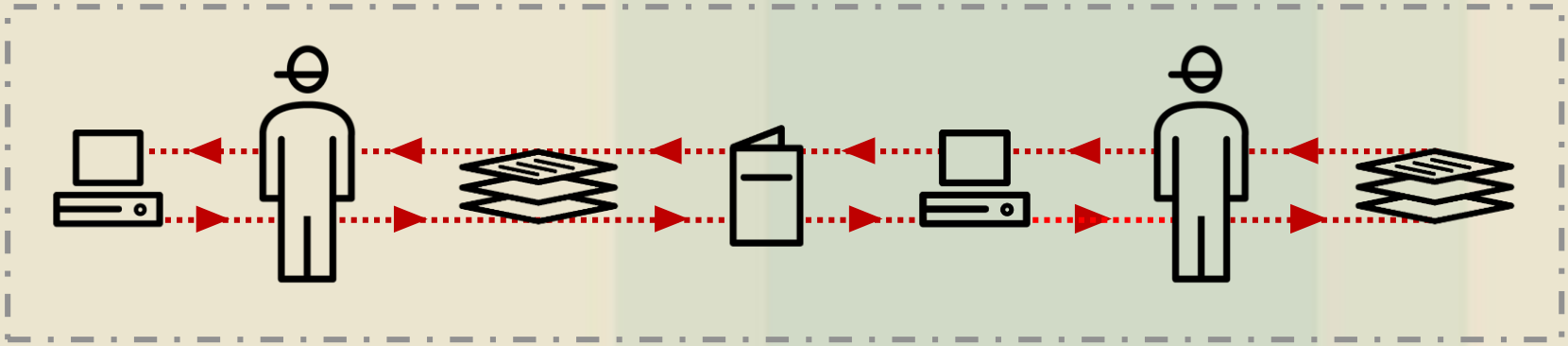
Preferred Situation



business process and practices

Consistent organized way to capture and use Knowledge & Information

actionable knowledge

Information System provides easy access to a Common Knowledge Repository

consistent action

The Right Work

at

The Right Time

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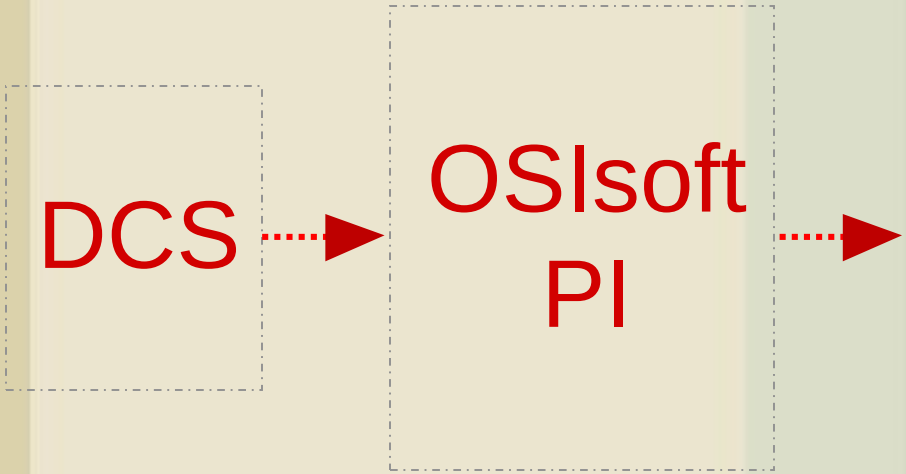
Integration with OSIsoft PI



CMMS

- Asset Management
- Work Order Management
- Planning & Scheduling
- MRO Materials
- Procurement
- Tasks and Jobs
- Personnel & Trades

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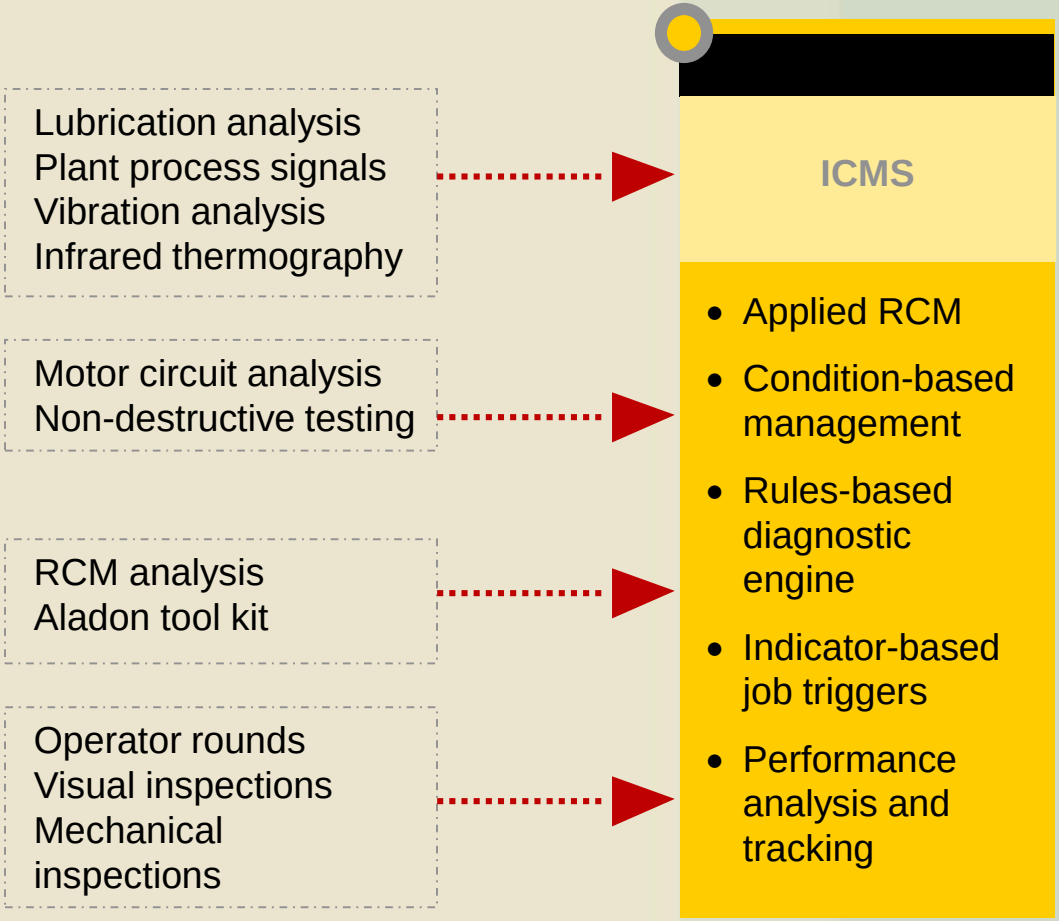
Integration with OSIsoft PI



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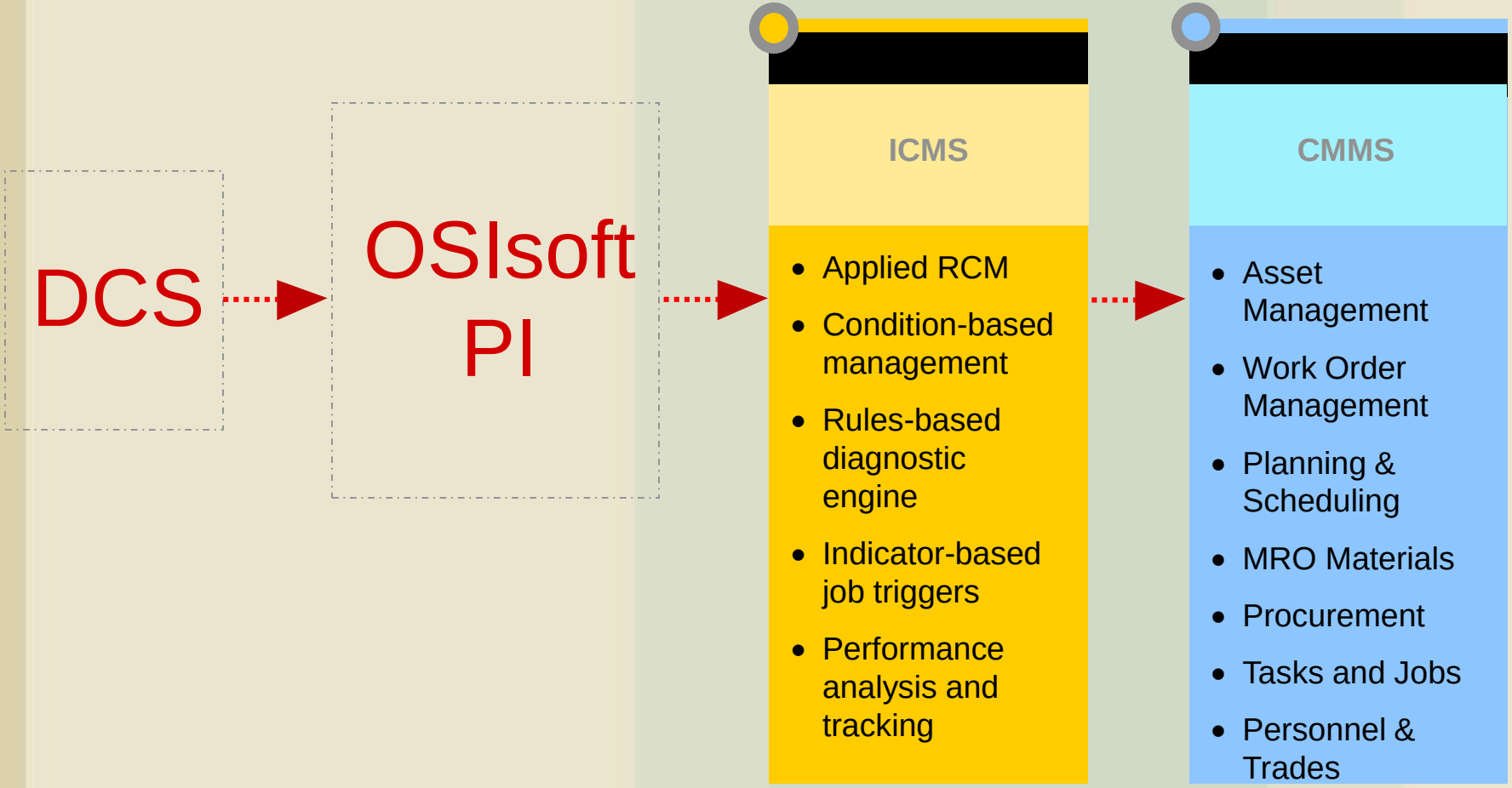
Integration with OSIsoft PI



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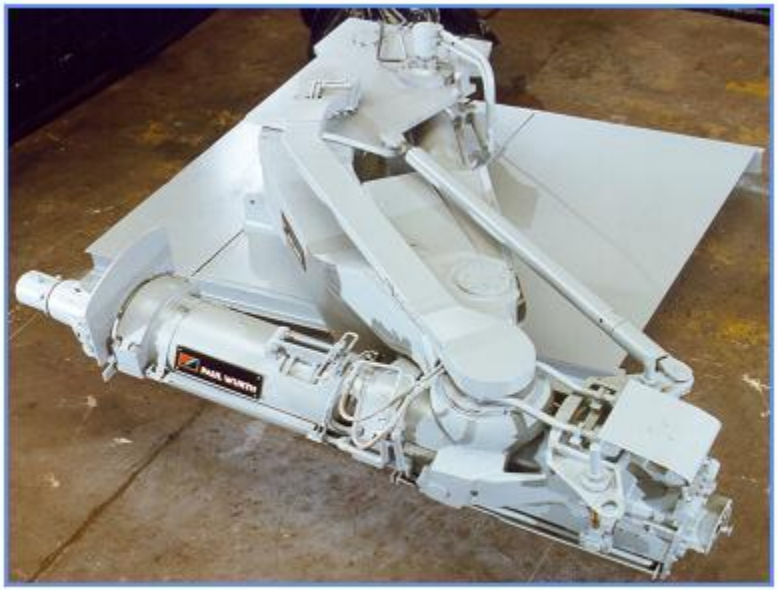
Case Study:

Using PI Data Collector to Improve Equipment Reliability



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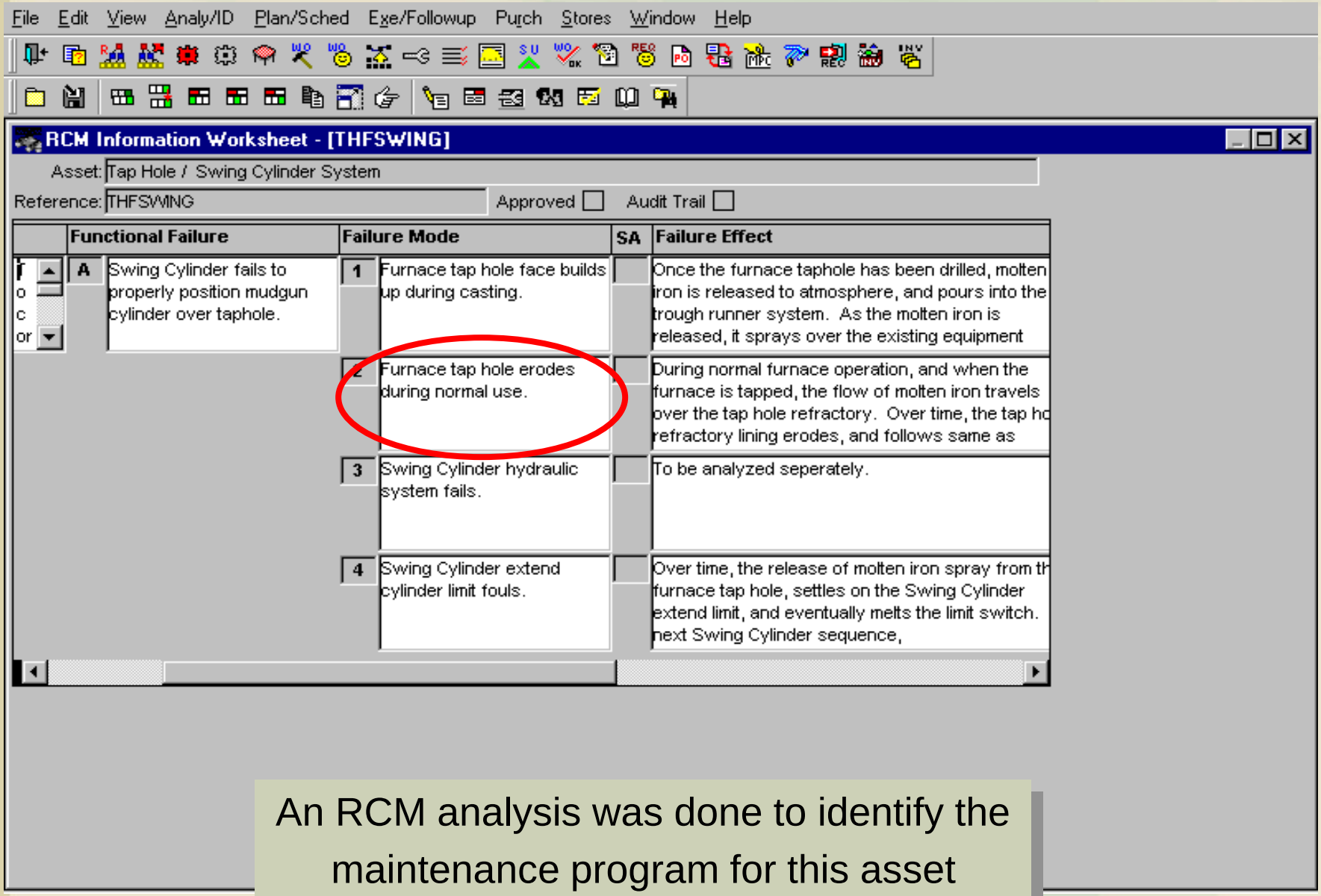

An RCM analysis was done to identify the maintenance program for this asset

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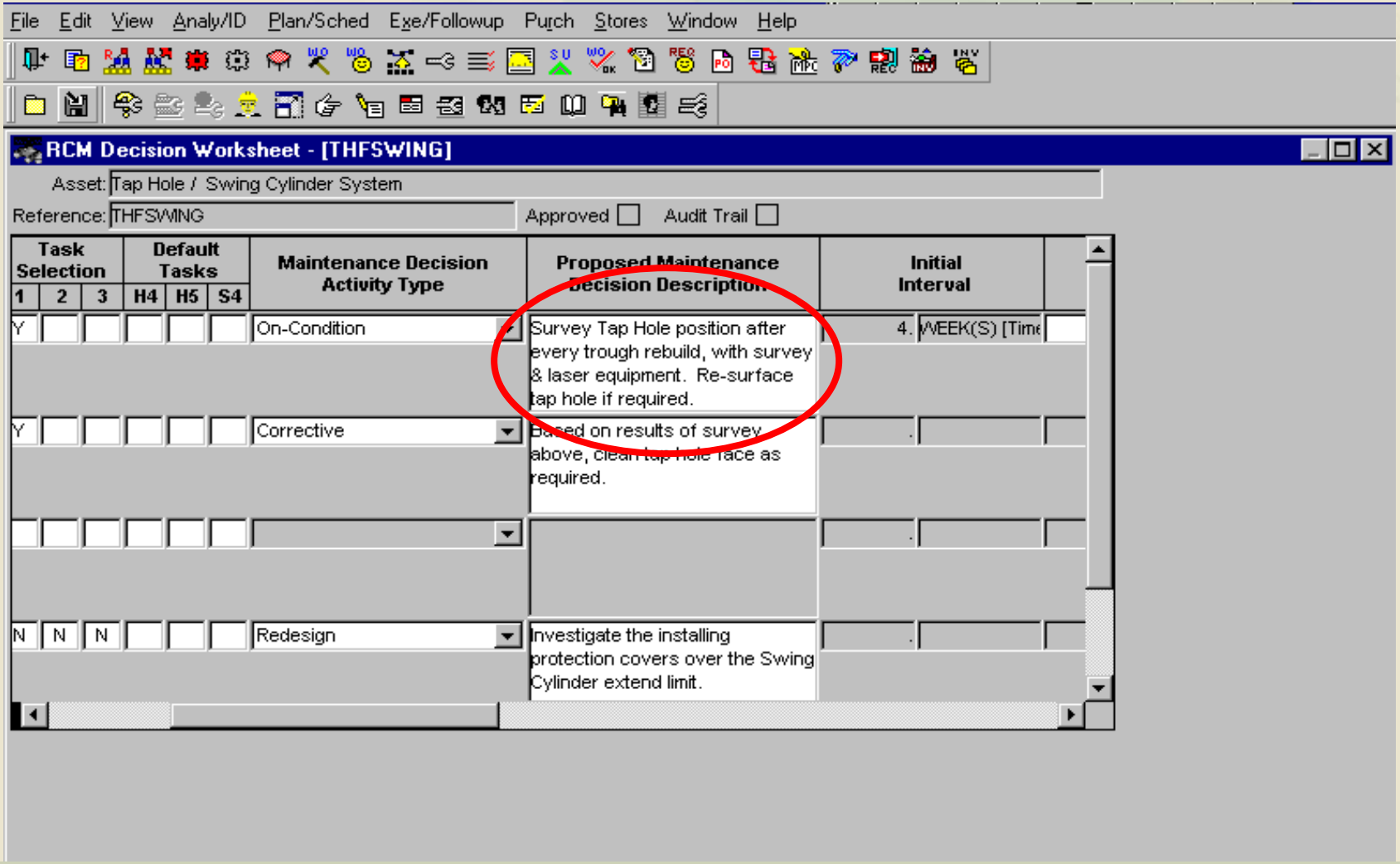

One of the Maintenance activities identified was an On-Condition task to determine tap hole face condition with survey equipment.

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Before PI Implementation

- Tap hole position was collected after every trough rebuild
- Performed manually with surveying and laser equipment
- Based on the results, the Tap hole face was re-surfaced

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PI Implementation Requirements

- Installed Linear Voltage Differential Transducer (LVDT) into the end of the Swing Cylinder
- Calibrated the LVDT to Tap Hole Face based on a cylinder stroke of 1370mm
- Maintenance and Operations determined the effective stroke ranges of the cylinder required by the process

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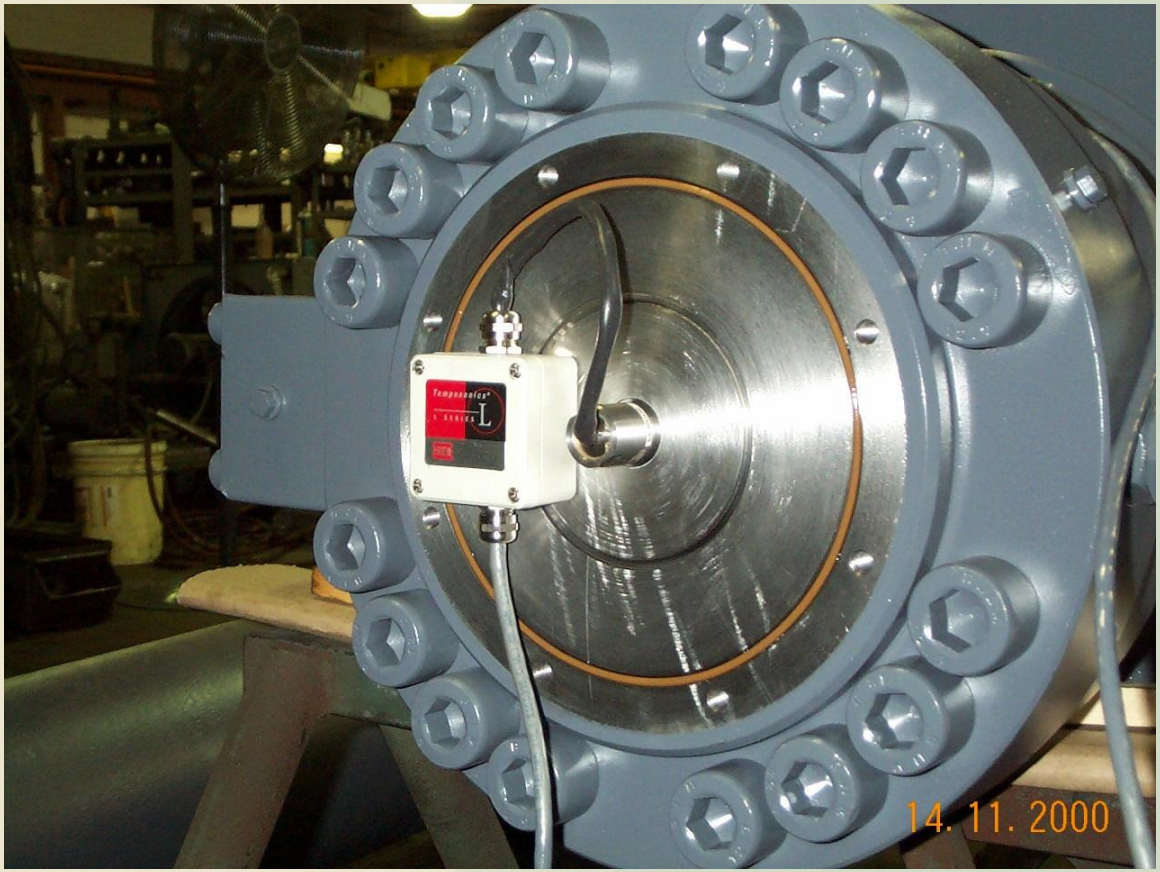
Swing Cylinder with LVDT



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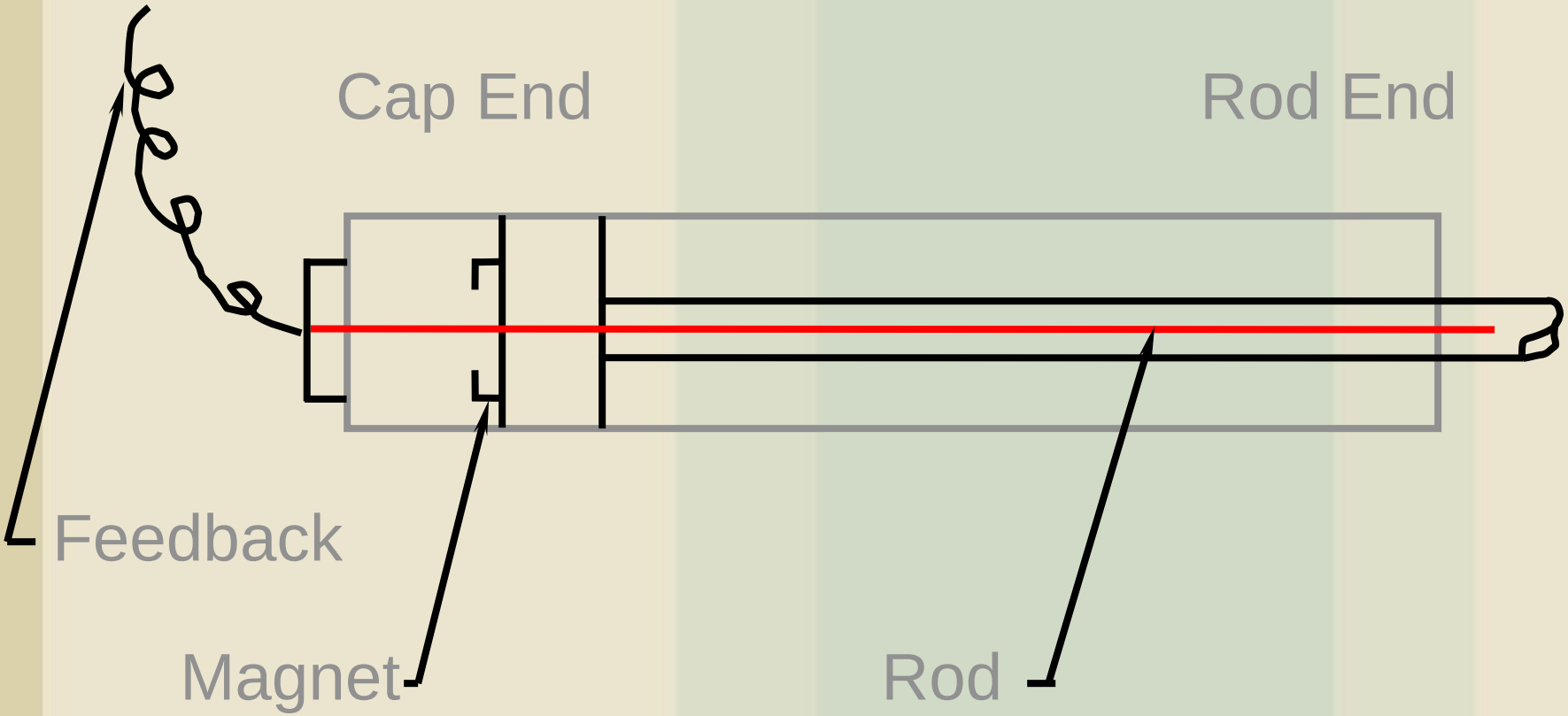
Cylinder Schematic



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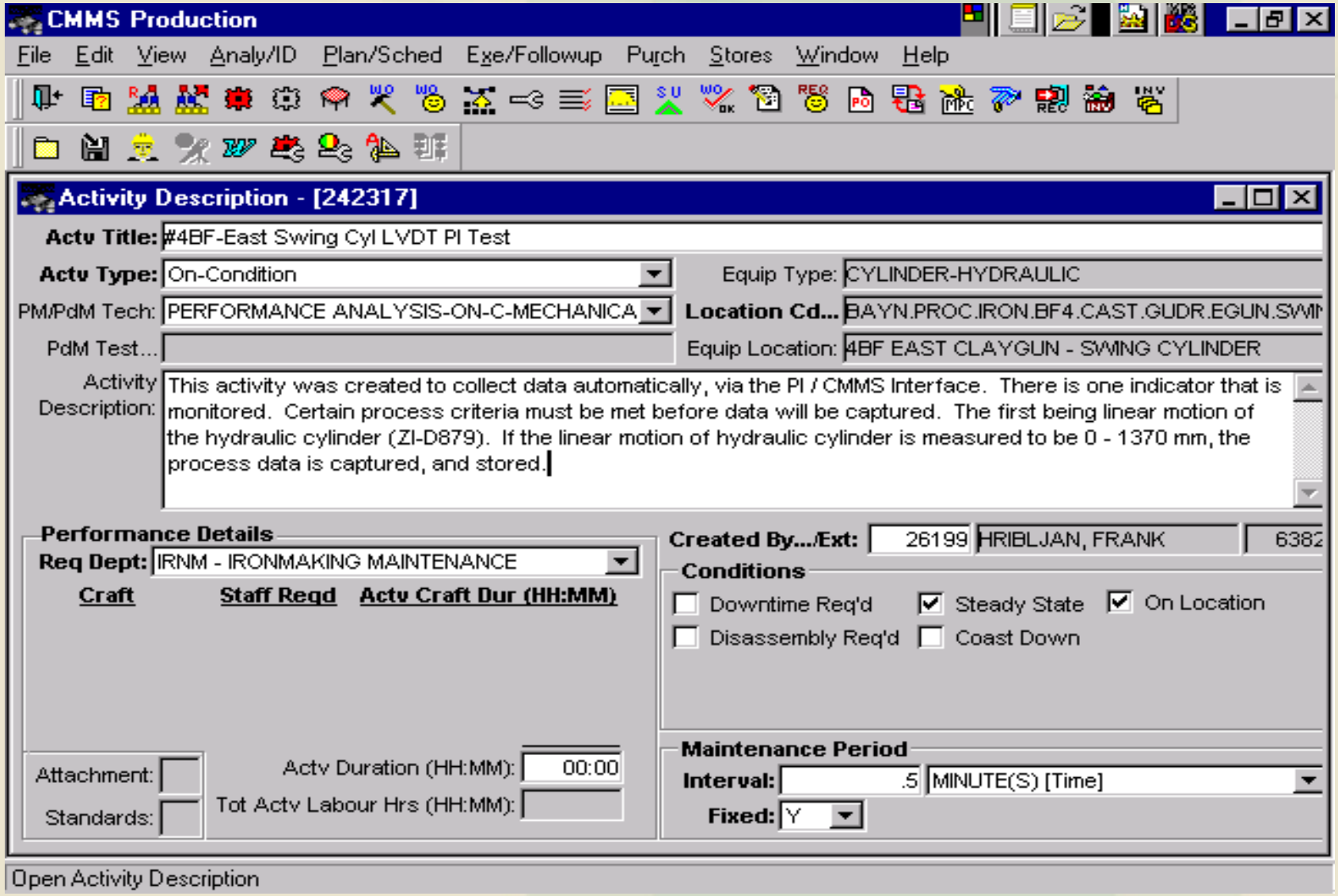

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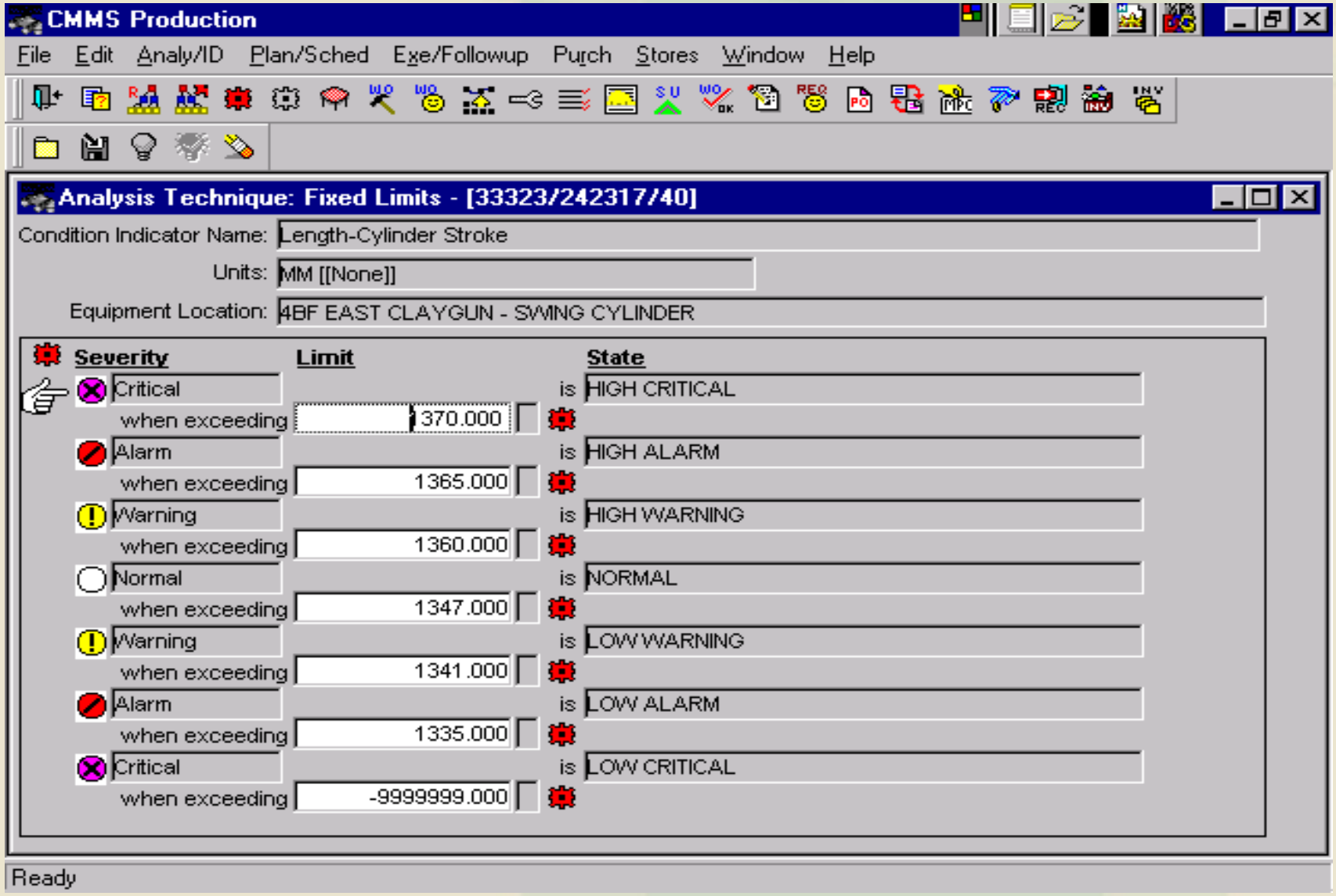

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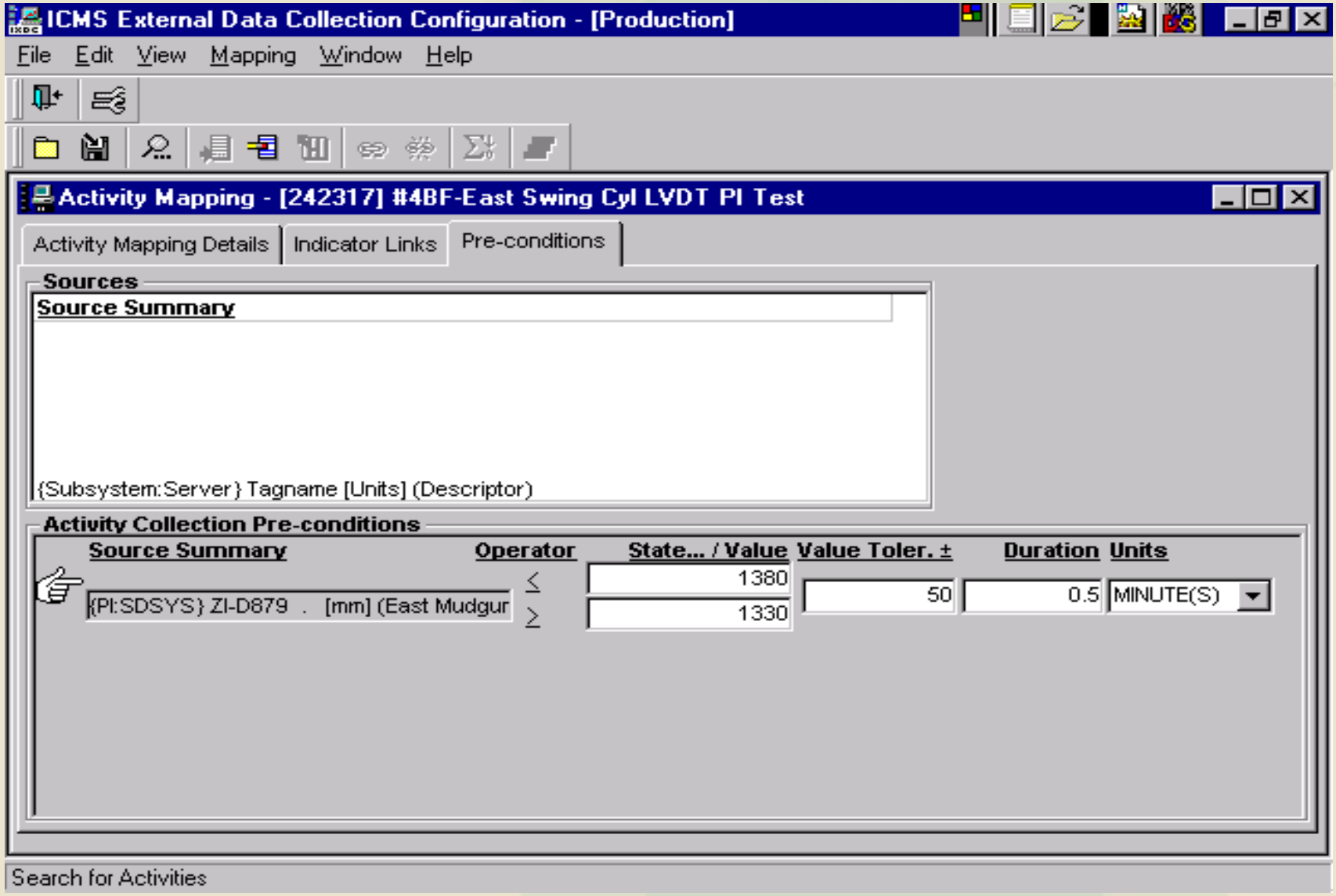

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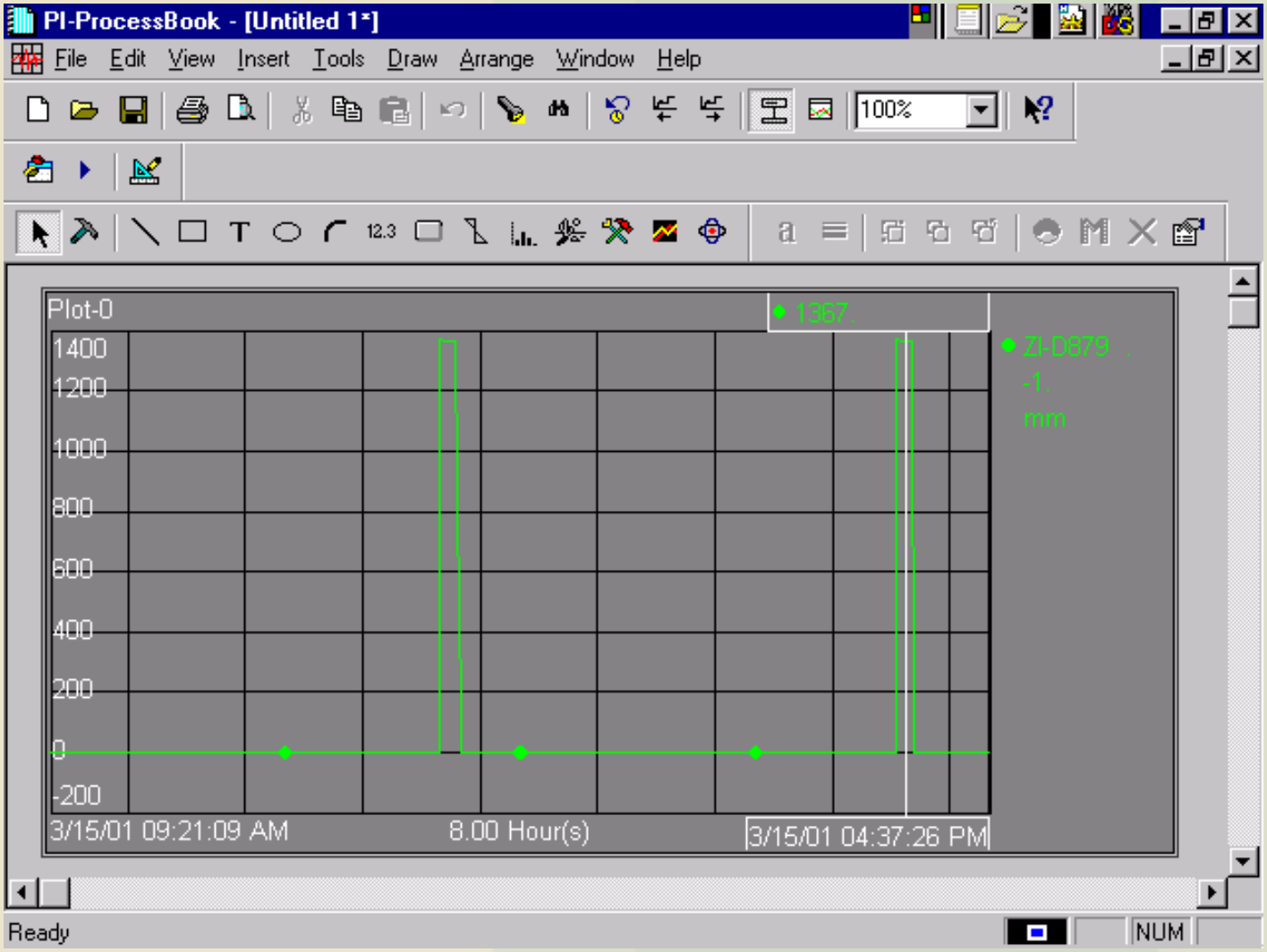
After PI Implementation



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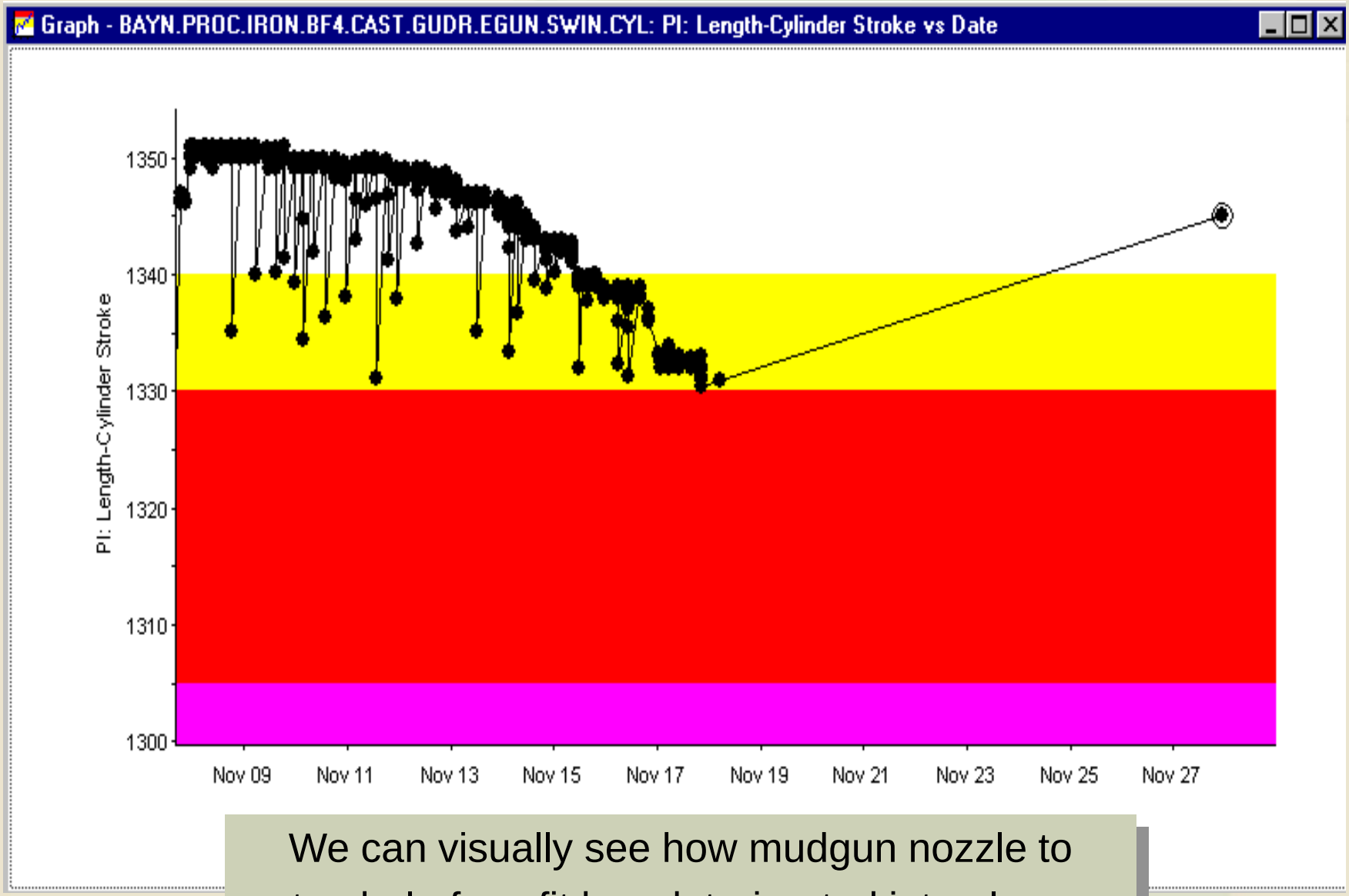

We can visually see how mudgun nozzle to tap hole face fit has deteriorated into alarm

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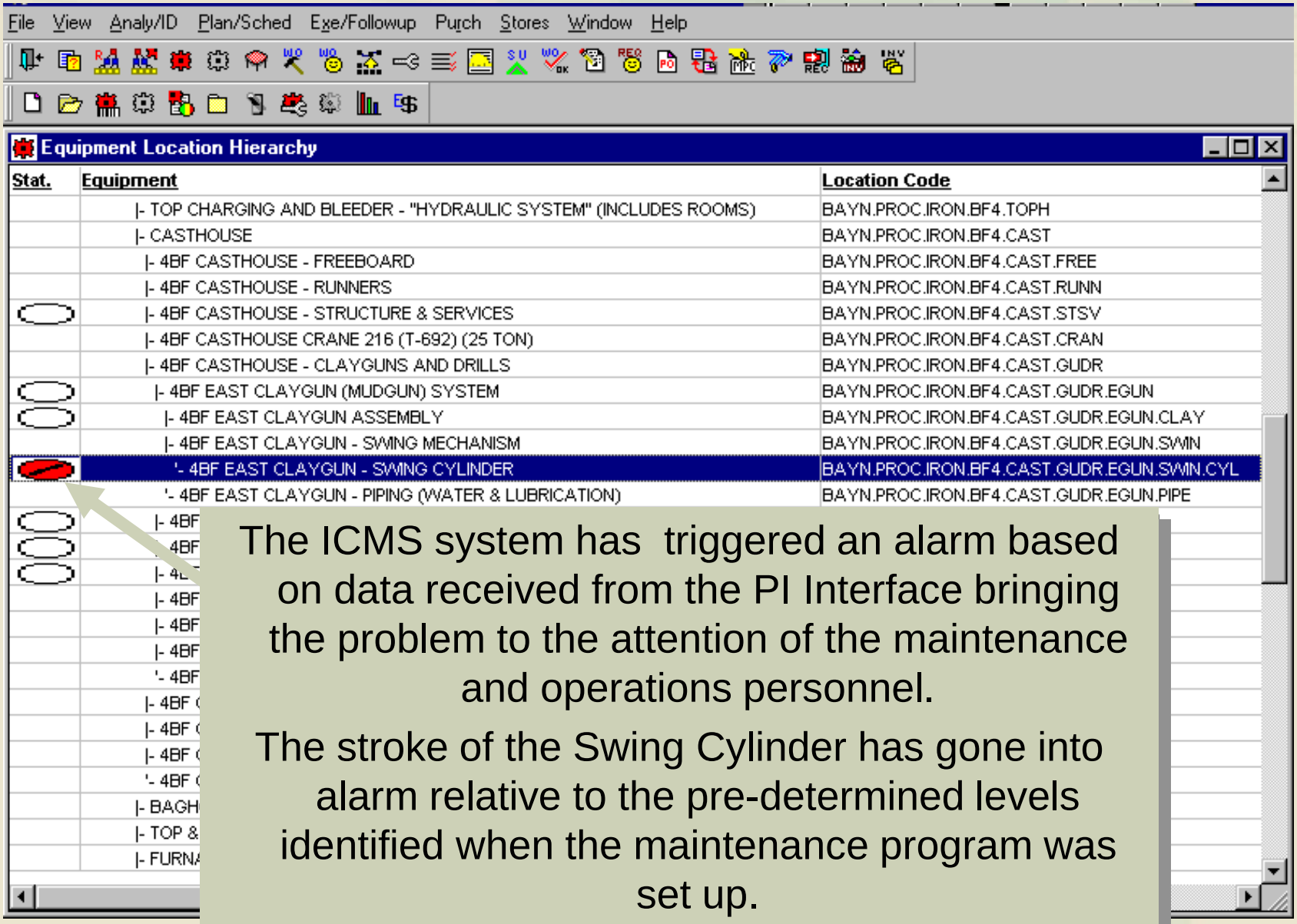

The ICMS system has triggered an alarm based on data received from the PI Interface bringing the problem to the attention of the maintenance and operations personnel.

The stroke of the Swing Cylinder has gone into alarm relative to the pre-determined levels identified when the maintenance program was set up.

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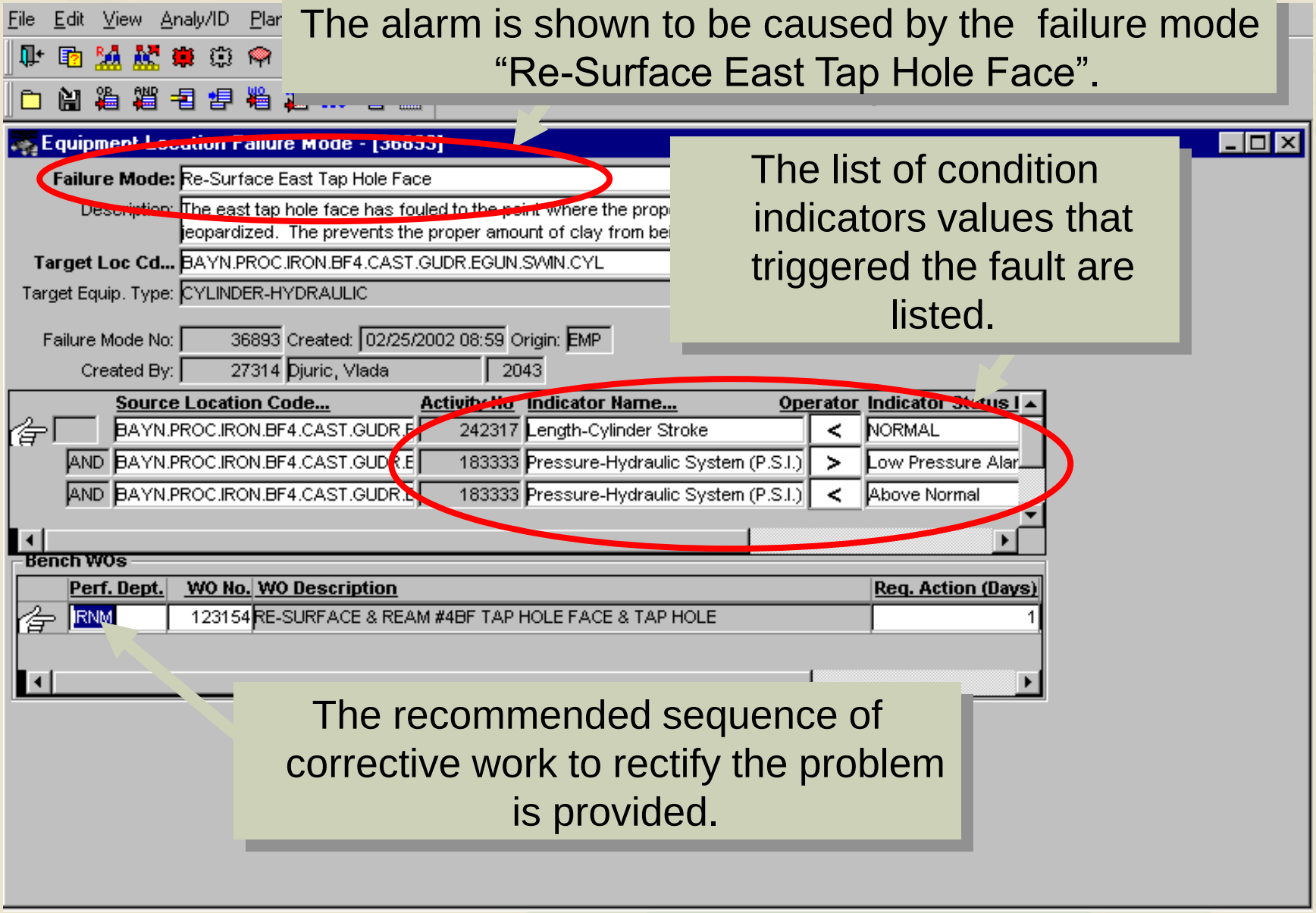
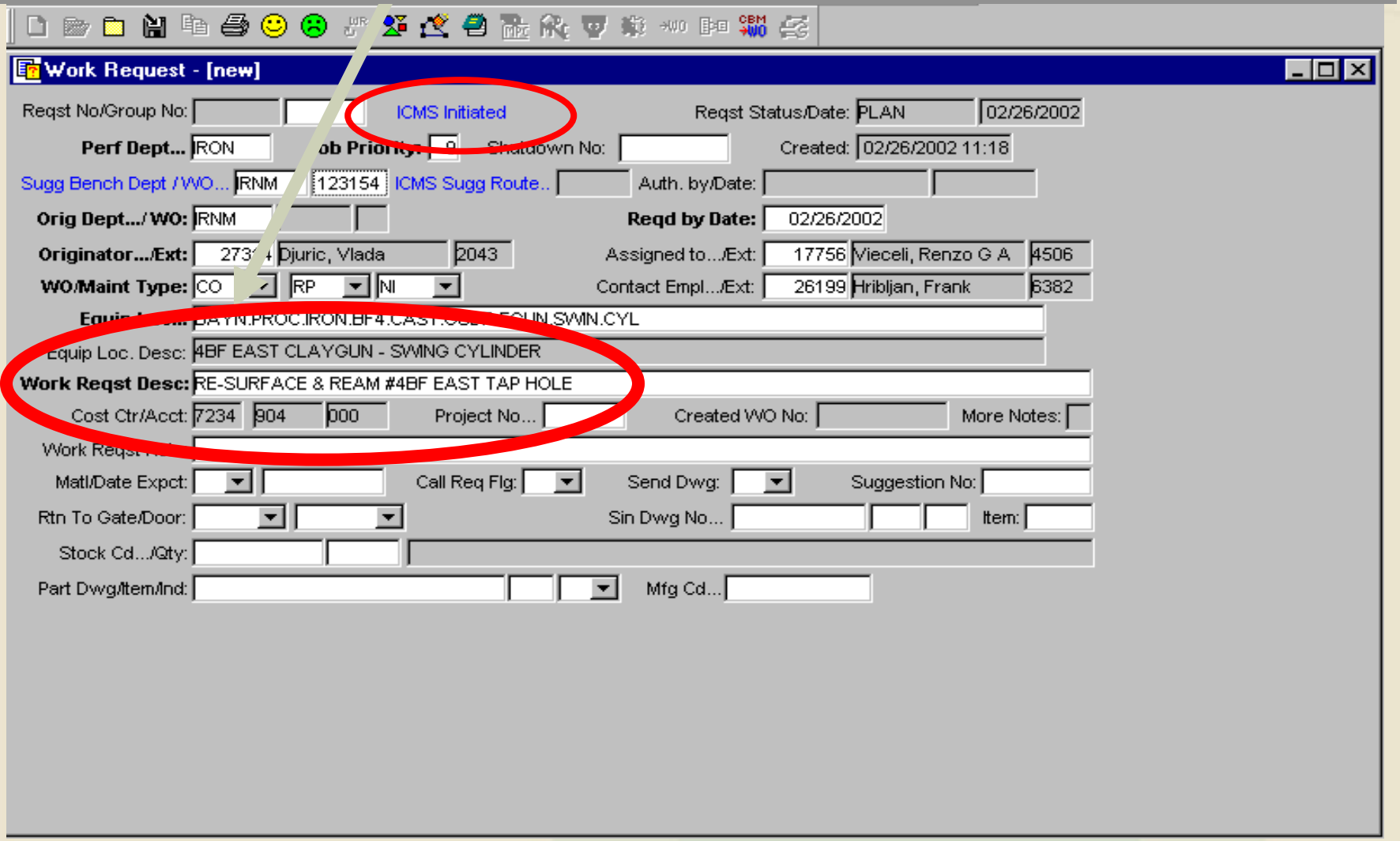
The alarm is shown to be caused by the failure mode "Re-Surface East Tap Hole Face".



The list of condition indicators values that triggered the fault are listed.

The recommended sequence of corrective work to rectify the problem is provided.

An Automated Work Request was generated by the EXP to re-surface and ream the furnace tap hole. After the supervisor/planner approved the Automated Work Request, the company's CMMS planned, scheduled and generated the Work Order necessary to have the work completed.



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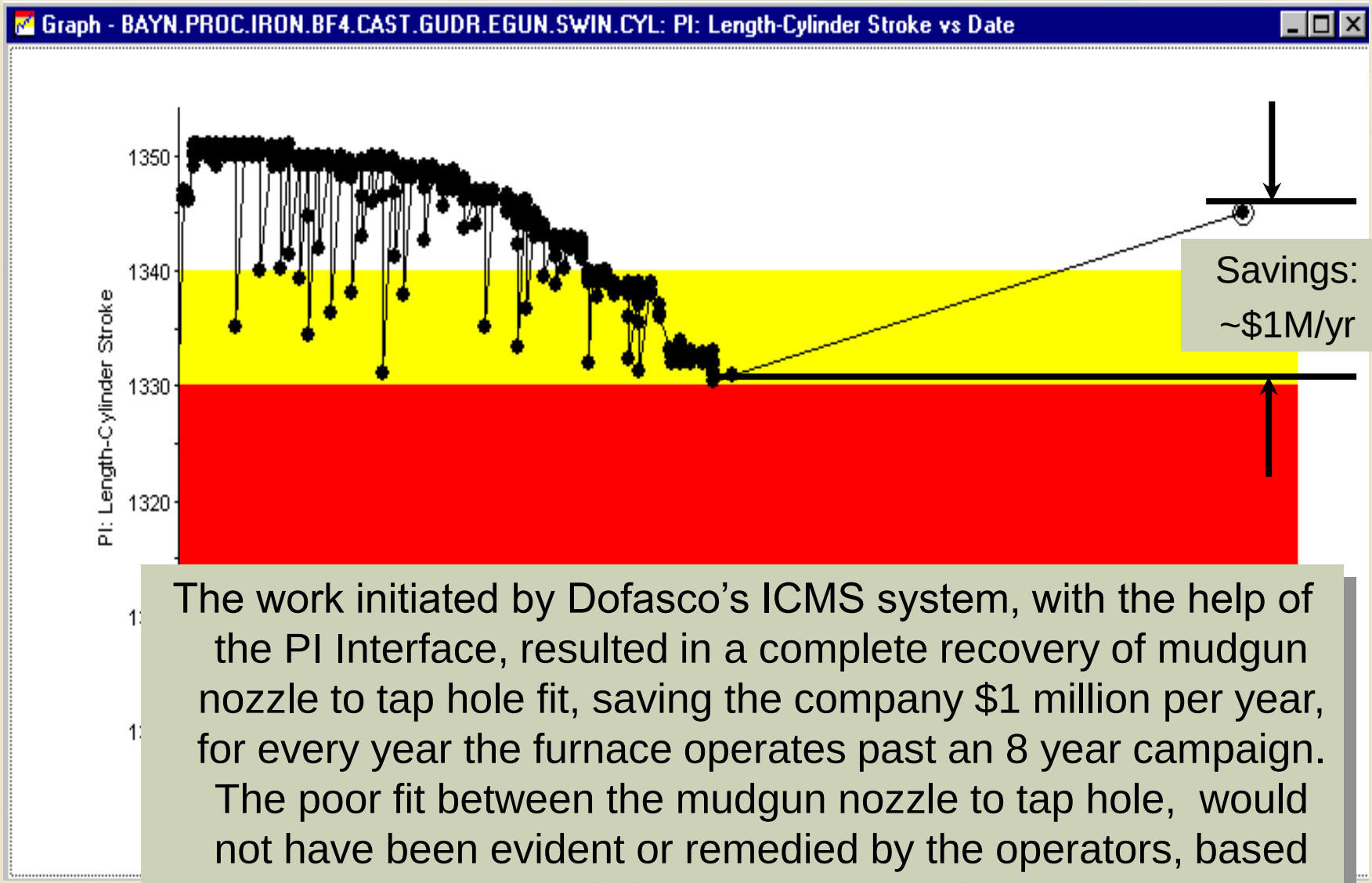

The work initiated by Dofasco's ICMS system, with the help of the PI Interface, resulted in a complete recovery of mudgun nozzle to tap hole fit, saving the company $1 million per year, for every year the furnace operates past an 8 year campaign. The poor fit between the mudgun nozzle to tap hole, would not have been evident or remedied by the operators, based on existing control room data.

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Benefits of PI Integration

- Collecting important equipment indicator information automatically and more often
- Early warning of impending failure
- Scheduling the right work at the right time
- Significantly increased time between furnace re-linings

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Benefits of PI Integration

- Savings
  - Furnace #4
    - Extending campaign from 8 years to 15 years
    - Save $1 million per year after 8 years = projected $7 million
  - Furnace #3
    - Extending campaign from 8 years to 20 years
    - Save $1 million per year after 8 years = projected $12 million
  - Total Projected Savings
    - $19 million (just for this one example)

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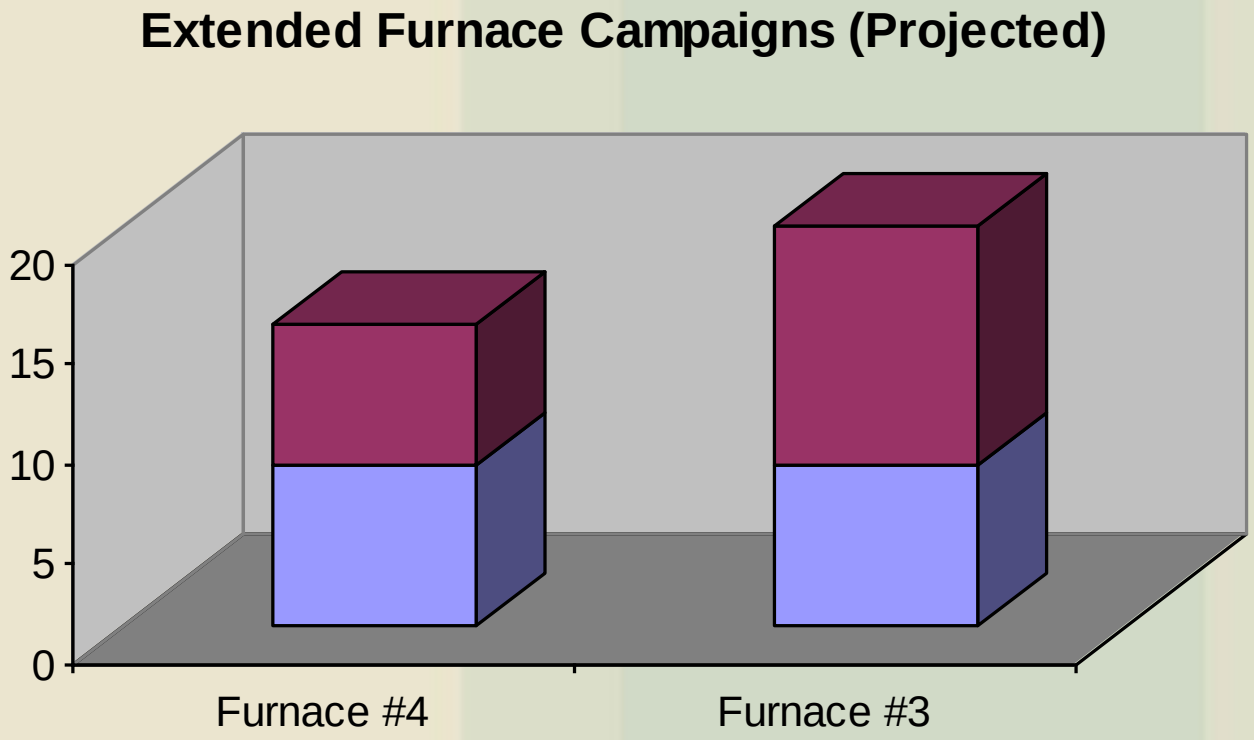
Benefits of PI Integration



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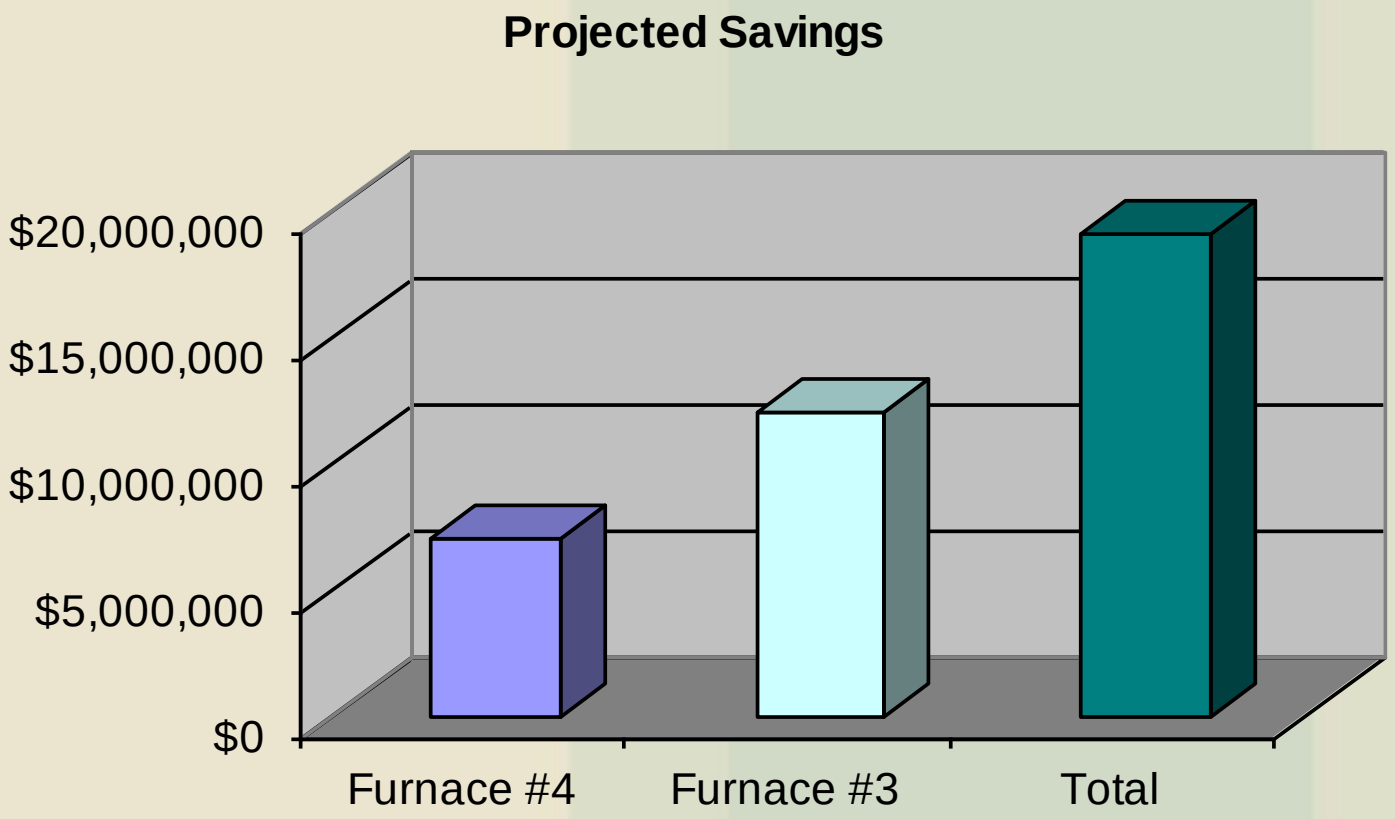
Benefits of PI Integration



Questions?

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