

Making the Most of Your Assets

Bryan Sower

Dow Corning Corporation

Bryan.Sower@DowCorning.Com

DOW CORNING

Discussion Topics

- Dow Corning at a Glance
- What is TEEP/OEE
- Updates From Last Year's Presentation
- Utilization of PI-TEEP with Six Sigma Projects
- Condition Monitoring Request with PM-RLINK
- Summary

Dow Corning Profile

- 2002 Sales: 2.6 Billion
- Employees: 7000 globally
- Manufacture of Silicon based chemicals
- Significant softwares
 - OSI Soft PI tools including RLink
 - SAP 4.6B – single instance globally
 - Sample Manager LIMS
 - Web based Radio Frequency (RF) interface to PI and SAP
 - Various Control Systems (one of everything)

OSI Soft in Use at Dow Corning

- First PI system in 1992 – VMS based PI 1.X
- Interfaces – Sixteen, including Dow Corning written
- UDS/Edict (PI3.3)– 14 sites with 18 servers, 450,000 tags
- Client Licenses – 450, 200 shared, 250 named users
- PI Batch – 200 batch units
- Process Template SPC – 35 implementations
- Process Book & Excel Add-in – 700 clients
- RLINK Implementation – 38(22 PM + 16 PP/PI) at 4 sites

Total Effective Equipment Productivity (TEEP) Definition

- **TEEP is measuring how well we are using the total capacity of our assets.** It is recording, all planned and unplanned losses, which includes scheduled downtime for lack of product demand. TEEP is the sole indicator integrating all parameters that affect productivity of the equipment or process. It uncovers the “Hidden Factory” costs, not just maintenance deficiencies. It is expressed as Valuable time / Calendar Time, in percent.

Overall Equipment Effectiveness(OEE) Definition

- **OEE is a key measure focused on equipment and process reliability improvement.** It is a measure of how well we are capable of using our Production Equipment when we want them to operate (excludes planned down time). OEE is the product of three effective factors, Efficiency, Availability and Quality and can also be expressed as Valuable Operating Time / Available Time, in percent

Performance Measures : TEEP & OEE

Calendar Time (A)		
Available Time (B)		Planned Downtime
		Planning Rate ($PR = B/A$)
Operating Time (C)		Unplanned Downtime
		Availability Rate ($AR = C/B$)
Net Operating Time (D)	Speed Losses	Efficiency Rate ($ER = D/C$)
Valuable Operating Time (E)	Quality Losses	Quality Rate ($QR = E/D$)

Overall Equipment Effectiveness

$$OEE = AR \times ER \times QR$$

$$OEE = \text{Valuable Operating Time (E)} / \text{Available Time (B)}$$

Total Effective Equipment Productivity

$$TEEP = PR \times OEE = PR \times AR \times ER \times QR$$

$$TEEP = \text{Valuable Operating Time (E)} / \text{Calendar Time (A)}$$

PI-TEEP

- TEEP/OEE
 - Captures Loss Time, Failure Code, Reason, Root Causes and Comments
 - Additional Information Being Stored in PI for Description and Comments
 - High Level Reporting Available From SAP
 - Provided Analysis Capabilities for User
 - Parato Analysis
 - SPC Charts

The Numbers

	2002	2003
Sites Using PM-RLINK	2	3
Sites Using TEEP/OEE		
PI-TEEP	2	7
Excel-TEEP	+ 0	+ 2
Total	2	9
PI-TEEP Measuring Points		
Batch	47	65
<u>Continuous</u>	+ 30	+ 74
Total	77	139
Condition Monitoring Measuring Points		
Batch	0	6
<u>Continuous</u>	+ 3	+ 5
Total	3	11

Realized Savings and Cost Reductions

- Single Global Supply Chain

	2002 Planned	2002 Actual
Maintenance Expense Budget	\$37,200,000	\$37,691,000
10% Expense Reduction resulting from just PI-TEEP	\$1,300,000	>\$1,220,000

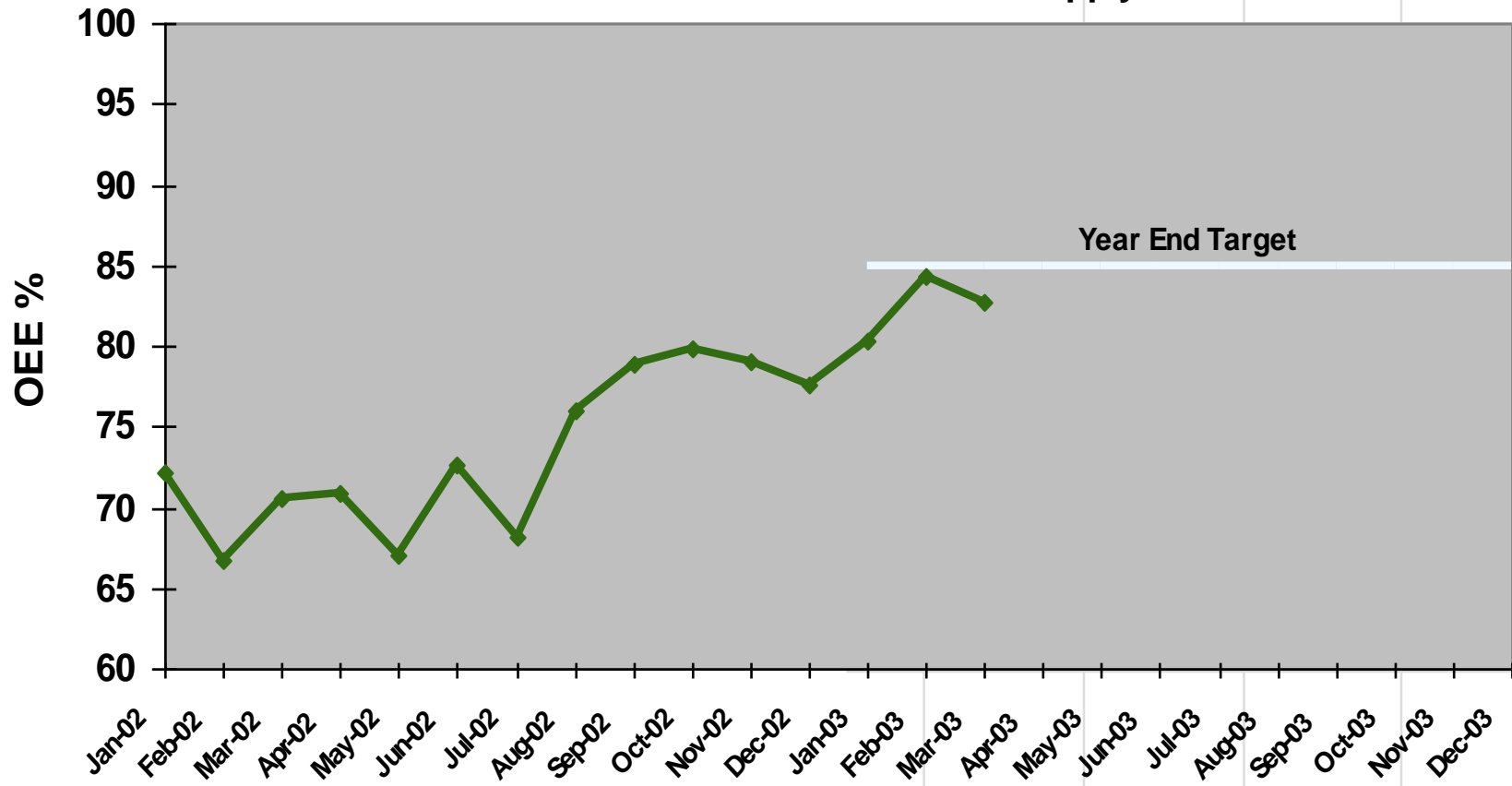
- Supply Chain Within a Large Plant

Asset Value = \$321,000,000	2002 Planned	2002 Actual
Maintenance Expense Budget	\$8,000,000	\$7,863,000
10% Expense Reduction resulting from just PI-TEEP	\$800,000	>\$726,000

Improvements in OEE

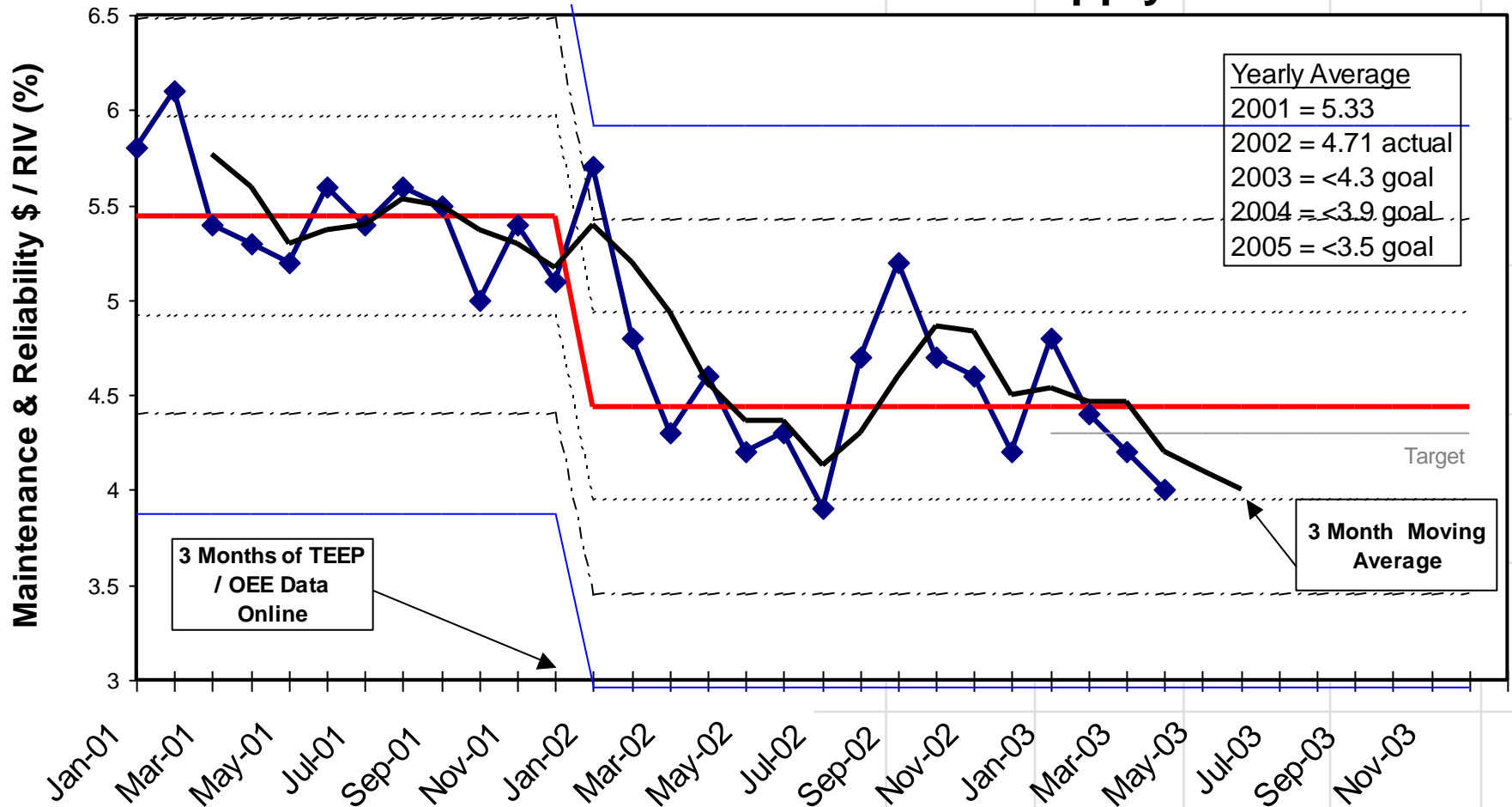
OVERALL EQUIPMENT EFFECTIVENESS(OEE)

Global Chemicals Business Supply Chain



Maintenance Cost Reduction

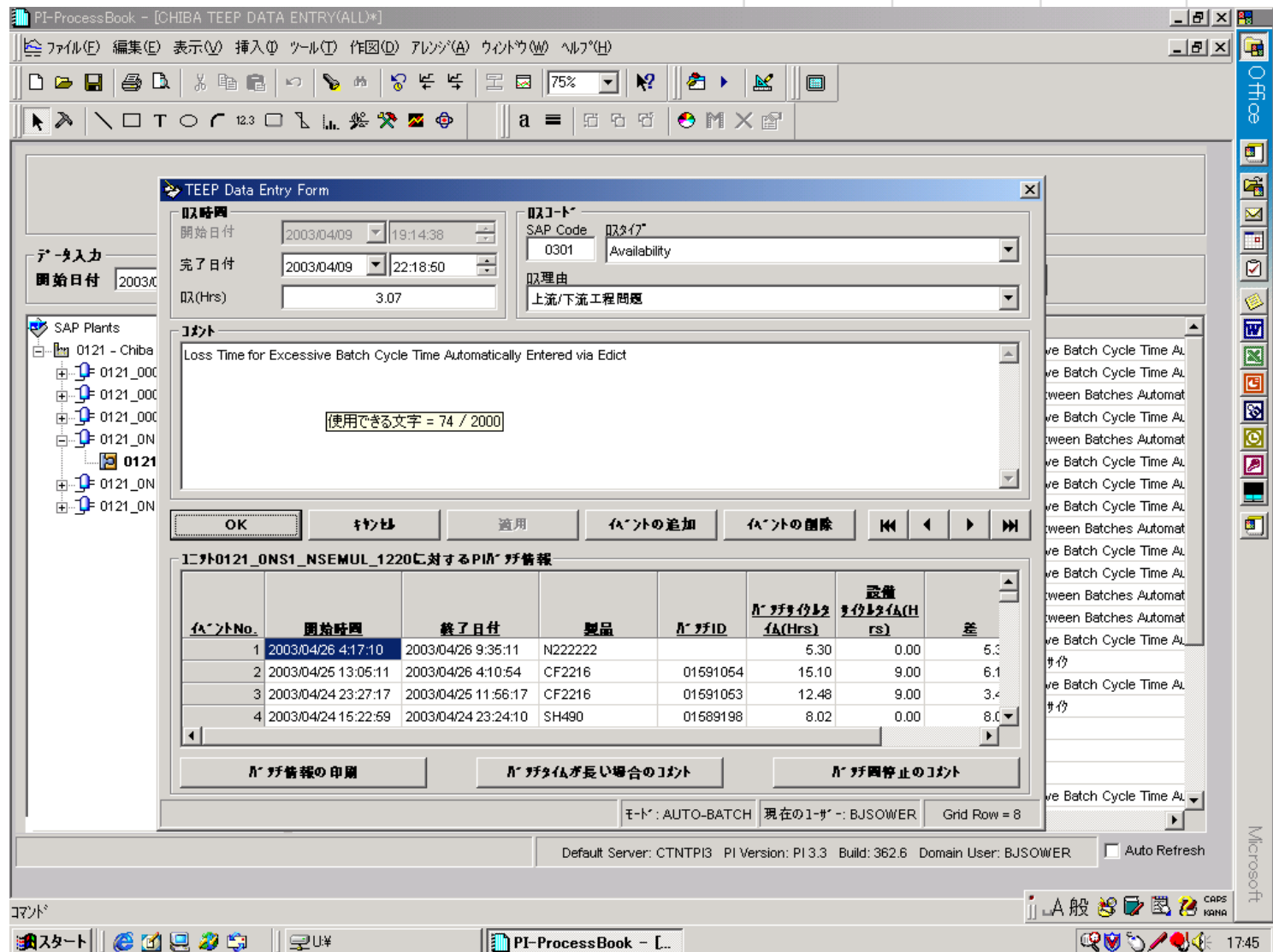
Maintenance Cost Index for Global Supply Chain



Enhancements - Internationalization

- Tremendous Learning Experience
- Conversion Issues
 - Language Translation
 - Date and Time Formats
 - Decimal Separators
 - Unicode
 - Double Byte Character Set
 - Database Configuration
- Support for English, Japanese, French and German

Enhancements - Internationalization



Enhancements – Root Cause Investigation(RCI)

The screenshot displays a software window titled "Root Cause Data Entry for". It contains several input fields and a hierarchical selection tree for root causes.

Header Fields:

- Process: A10
- Functional Location: 0054-5205
- RCI Leader: BJSOWER
- Investigation Date: 28-Apr-2003

Root Cause Section:

- Primary Difficulty: Equipment
- Problem Category: Installation/Corrective/Preventative Maintenance Problem
- Major Root Cause: Human Factors
- Near Root Cause: Work Environment
- Root Cause: Excessive Noise

Other Possible Roots:

- None
- None
- None

Comments(80 characters):

Buttons: OK, Cancel, Apply, and navigation buttons (back, forward, etc.).

Status Bar: Mode: CONTINUOUS, Current Login: BJSOWER, Grid Row = 14

Enhancements – User Interaction

- Look and Feel
- Navigation
- Pop-up Menus
- Copy Functions
- Labeling
- Graphics

Enhancements – User Interaction

PI - ProcessBook - [CARROLLTON TEEP DATA ENTRY.PDI*]

File Edit View Insert Tools Draw Arrange Window Help

75%

TEEP Data Entry

Data Entry

Start Date: 26-Mar-2003 End Date: 28-Apr-2003

No.	SAP	PI	Edit	Time Stamp	Loss Time(Hrs)	Failure Type	Failure Reason	Event Comments	SAP Catalog Code
1				28-Mar-2003 12:00:00 AM	2.96	Availability	Full PAC Tanks	Loss Time Due to Lov	0301
2				29-Mar-2003 12:00:00 AM	3.90	Availability	Full PAC Tanks	Loss Time Due to Lov	0301
3				31-Mar-2003 12:00:00 AM	3.81	Availability	Full PAC Tanks	Loss Time Due to Lov	0301
4			<input checked="" type="checkbox"/>	02-Apr-2003 12:00:00 AM	4.59	Availability	Full PAC Tanks	Loss Time Due to Lov	0301
5			<input checked="" type="checkbox"/>	03-Apr-2003 12:00:00 AM	10.99	Availability	Full PAC Tanks	Loss Time Due to Lov	0301
6			<input checked="" type="checkbox"/>	04-Apr-2003 12:00:00 AM	12.55	Availability	Full PAC Tanks	Loss Time Due to Lov	0301
7			<input checked="" type="checkbox"/>	05-Apr-2003 12:00:00 AM	6.79	Availability	Full PAC Tanks	Loss Time Due to Lov	0301
8			<input checked="" type="checkbox"/>	06-Apr-2003 12:00:00 AM			Full PAC Tanks	Loss Time Due to Lov	0301
9			<input checked="" type="checkbox"/>	07-Apr-2003 12:00:00 AM			Full PAC Tanks	Loss Time Due to Lov	0301
10			<input checked="" type="checkbox"/>	09-Apr-2003 12:00:00 AM			Full PAC Tanks	Loss Time Due to Lov	0301
11			<input checked="" type="checkbox"/>	10-Apr-2003 12:00:00 AM			Full PAC Tanks	Loss Time Due to Lov	0301
12			<input checked="" type="checkbox"/>	21-Apr-2003 12:00:00 AM				Loss Time Due to Lov	
13			<input checked="" type="checkbox"/>	22-Apr-2003 12:00:00 AM				Loss Time Due to Lov	
14			<input checked="" type="checkbox"/>	23-Apr-2003 12:00:00 AM				Loss Time Due to Lov	
15			<input checked="" type="checkbox"/>	24-Apr-2003 12:00:00 AM	3.87	Other		Loss Time Due to Lov	
16			<input checked="" type="checkbox"/>	26-Apr-2003 12:00:00 AM	3.16	Other		Loss Time Due to Lov	
17			<input checked="" type="checkbox"/>	27-Apr-2003 12:00:00 AM	14.68	Other		Loss Time Due to Lov	

0054 - DCC Carrollton

- 0054_3201_DrumOff
- 0054_3201_F04
- 0054_3201_F15
- 0054_3201_F15B
- 0054_3201_F16
- 0054_3201_F17
- A01
- A02
- A10
- 0054-5205
- B01
- B03
- B10
- B20
- Blocks
- Boiler House
- C02
- C03
- C10
- D01
- D10
- DPR
- F01
- F01A
- F02

Default Server: CTNTP13 PI Version: PI 3.3 Build: 362.6 Domain User: BJSQWER ☐ Auto Refresh

Ready

Enhancements – User Interaction

PI - ProcessBook - [CARROLLTON TEEP DATA ENTRY.PDI*]

File Edit View Insert Tools Draw Arrange Window Help

TEEP Data Entry

Data Entry

Start Date: 26-Mar-2003 End Date: 29-Apr-2003

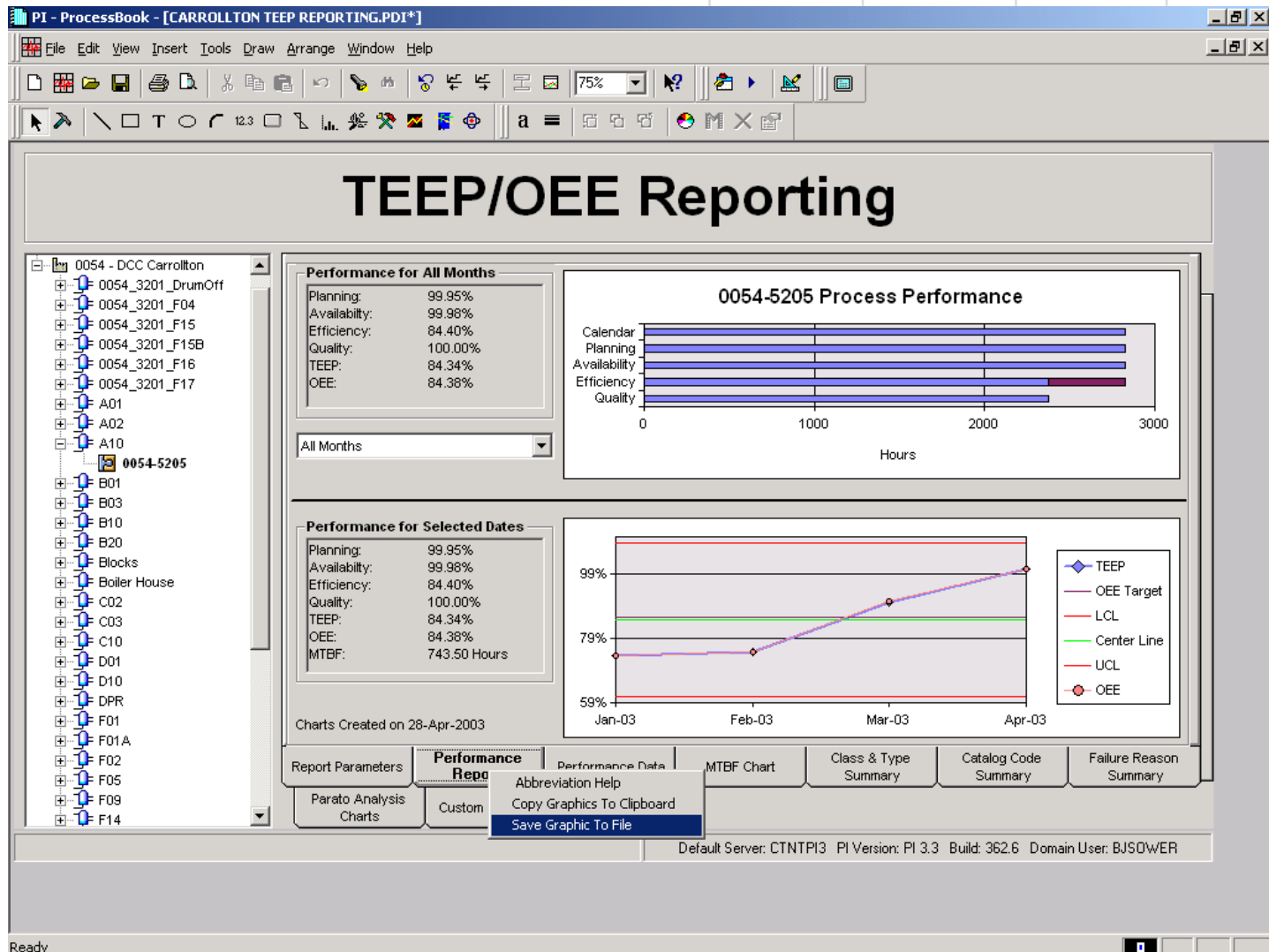
No.	SAP	PI	Edit	Time Stamp	Loss Time(Hrs)	Failure Type	Failure Reason	Event Comments	SA
1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	28-Mar-2003 12:00:00 AM	2.96	Availability	Full PAC Tanks	Loss Time Due to Lov	
2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	29-Mar-2003 12:00:00 AM	3.90	Availability	Full PAC Tanks	Loss Time Due to Lov	
3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	31-Mar-2003 12:00:00 AM	3.81	Availability	Full PAC Tanks	Loss Time Due to Lov	
4	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	02-Apr-2003 12:00:00 AM	4.59	Availability	Full PAC Tanks	Loss Time Due to Lov	
5	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	03-Apr-2003 12:00:00 AM	10.99	Availability	Full PAC Tanks	Loss Time Due to Lov	
6	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	04-Apr-2003 12:00:00 AM	12.55	Availability	Full PAC Tanks	Loss Time Due to Lov	
7	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	05-Apr-2003 12:00:00 AM	6.79	Availability	Full PAC Tanks	Loss Time Due to Lov	
8	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	06-Apr-2003 12:00:00 AM	10.65	Availability	Full PAC Tanks	Loss Time Due to Lov	
9	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	07-Apr-2003 12:00:00 AM	7.04	Availability	Full PAC Tanks	Loss Time Due to Lov	
10	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	09-Apr-2003 12:00:00 AM	3.97	Availability	Full PAC Tanks	Loss Time Due to Lov	
11	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	10-Apr-2003 12:00:00 AM	1.24	Availability	Full PAC Tanks	Loss Time Due to Lov	
12	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	21-Apr-2003 12:00:00 AM	1.13	Availability	Full PAC Tanks	Loss Time Due to Lov	
13	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	22-Apr-2003 12:00:00 AM	3.17	Availability	Full PAC Tanks	Loss Time Due to Lov	
14	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	23-Apr-2003 12:00:00 AM	0.86	Availability	Full PAC Tanks	Loss Time Due to Lov	
15	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	24-Apr-2003 12:00:00 AM	3.87	Availability	Full PAC Tanks	Loss Time Due to Lov	
16	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	26-Apr-2003 12:00:00 AM	3.16	Availability	Full PAC Tanks	Loss Time Due to Lov	
17	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	27-Apr-2003 12:00:00 AM	14.68	Availability	Problem with Downstream Equipment	Low Boiler Train dov	
18	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	28-Apr-2003 12:00:00 AM	15.26	Availability	Problem with Downstream Equipment	Low Boiler Train dov	

RCI Data Entry
Propagate Up
Propagate Down
Print Grid

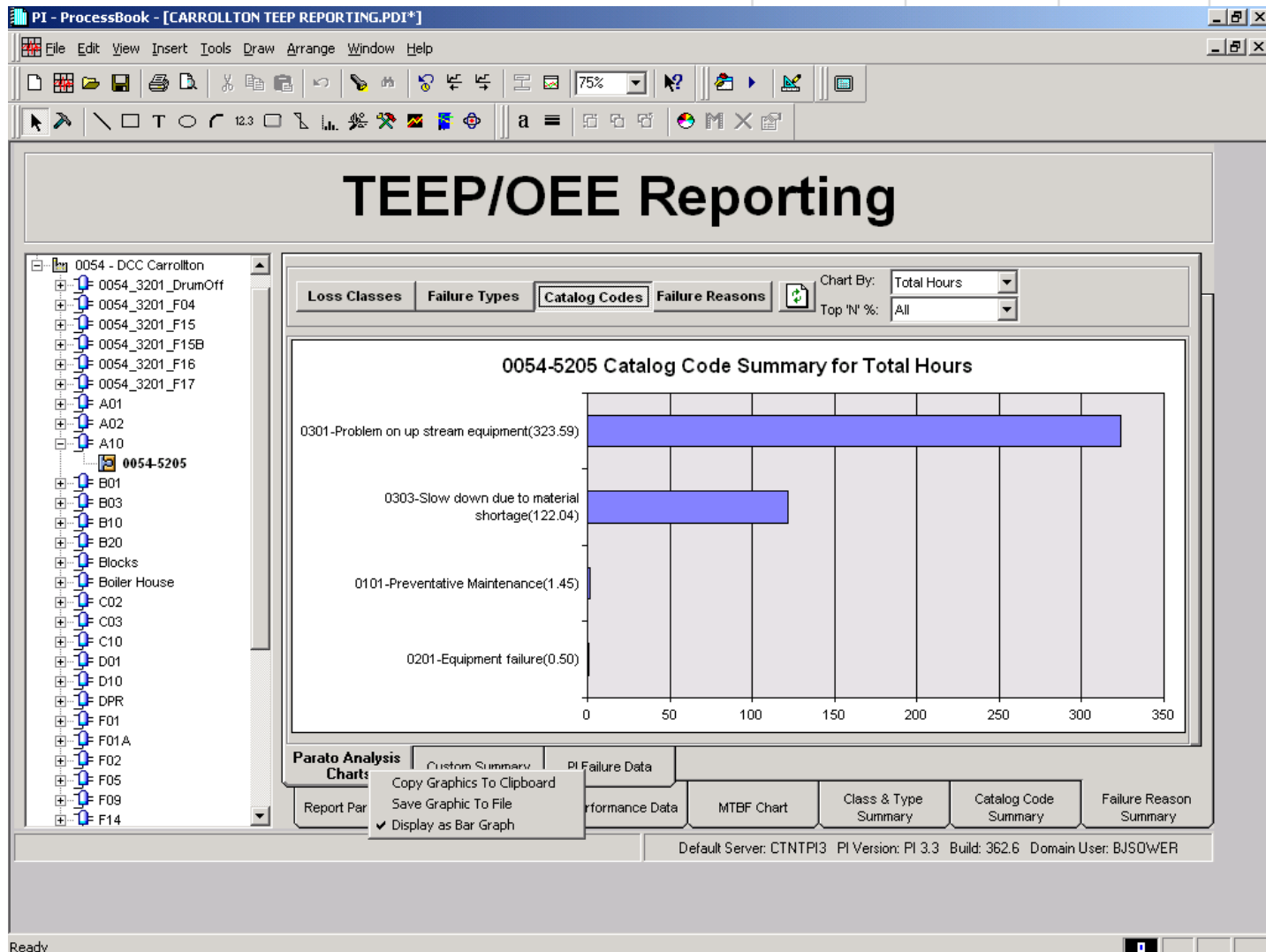
Default Server: CTNTP13 PI Version: PI 3.3 Build: 362.6 Domain User: BJSQWER ☐ Auto Refresh

Ready

Enhancements - Graphics



Enhancements - Graphics



Enhancements – Data Processing

- Boiling up Data From Individual Processes Into Common Groupings of a Particular Process Block and Then to a Site Level
- Tools to Allow the User to Quickly Collect the Required Data and Then Analyze It With Tools That Are Comfortable and Familiar.

Enhancements – Data Processing

Microsoft Excel - PI-TEEP Loss Time Summary.xls

File Edit View Insert Format Tools Data Window PI PI-SMT Help

Arial 10 B I U \$ % , .00 +.00

Q422 Equipment

Time To Query PI Data Was 287 seconds

Start Date 1-Jan-03 Current Year Get PI Data Refresh Pivot Tables

End Date 31-Dec-03 Previous Year

PI-TEEP Information					ion(RCI) Attributes				
SAP Plan	Bldg/Area	Process	Functional Location	Time Stamp	RCI Leader	Primary Difficul	Problem Catego	Major Root Caus	Hear Ro
0054	AR01	B01	0054-3212-03	3-Jan-03 12:00:00 AM					
0054	AR01	B01	0054-3212-03	4-Jan-03 12:00:00 AM					
0054	AR01	B01	0054-3212-03	5-Jan-03 12:00:00 AM					
0054	AR01	B01	0054-3212-03	6-Jan-03 12:00:00 AM	NEMOORE	Equipment	Equipment Design Prot	Design Input/Output	Design In
0054	AR01	B01	0054-3212-03	7-Jan-03 12:00:00 AM					
0054	AR01	B01	0054-3212-03	8-Jan-03 12:00:00 AM					
0054	AR01	B01	0054-3212-03	9-Jan-03 12:00:00 AM					

PI-TEEP Failure Data Unplanned DownTime Summary LossType Summary Fail Type Summary Fail Reason Summary SAP Code Summary

Ready Calculate CAPS

Six Sigma

- PI-TEEP Fits Very Well With the Six Sigma Improvement Process Methodology
- Inherently We Know We Have Downtime on Equipment
- PI-TEEP Identifies How Much and When
- Prior to PI-TEEP We Had Inconsistent Processes for Collecting the Data. Usually Done in Spreadsheet. Required Many Hours a Month to Collect, Process and Analyze
- PI-TEEP Provides a Standardized Workflow for Collecting the Data and Assigning Reasons for the Losses and a Root Cause for Those Reasons.

Improvement Process

- 1 - **D**efine Opportunity
- 2 - **M**easure Performance
- 3 - **A**nalyze Opportunity
- 4 - **I**mprove Performance
- 5 - **C**ontrol Performance



Six Sigma

- These Failure Reasons Can Then Be Categorized and Viewed in a Pareto Chart to Determine Where the Most Failures Are Occurring
- The Results of a Root Cause Analysis Identify Common or Latent Roots
- These Common or Latent Roots Are Then the Source of Six Sigma Projects
- PI-TEEP Can Greatly Reduce the Time It Takes to Complete the First 3 Steps of the Six Sigma Improvement Process for a Project

Improvement Process

- 1 - **D**efine Opportunity
- 2 - **M**easure Performance
- 3 - **A**nalyze Opportunity
- 4 - **I**mprove Performance
- 5 - **C**ontrol Performance



Six Sigma

- Provides an Easy Solution to Last Step of the Improvement Process by Easily Monitoring TEEP and/or OEE
- Currently at One Facility There Are 9 Projects Underway As a Result of Opportunities Identified From PI-TEEP.
- These Projects Range From \$250,000 Expected Growth / Loss Margin Reduction to Over \$2,000,000

Improvement Process

- 1 - **Define** Opportunity
- 2 - **Measure** Performance
- 3 - **Analyze** Opportunity
- 4 - **Improve** Performance
- 5 - **Control** Performance



Condition Monitoring

- Unexpected Requests
 - Notifications Based on Completion of a Specific Product Batch for PM of a Pump
 - Notifications Based on Discrepancies Between Redundant Process Instruments
- New Techniques
 - Notifications Based on Combined Logic of SPC and Rate of Change Over a Specified Time Frame
- Primary Focus For Event Based Monitoring Is Just Generating the Notification

Summary

- Tremendous Benefits From PM-RLINK
- ROI Very Short With Minimal Effort and Resources
- For Condition Monitoring the Key Is Understanding Your Process and Having The Instrumentation Necessary to Monitor the Critical Failure Points
- Critical Success Factor for PI-TEEP and Condition Monitoring Is an Calculation Engine.
- The Use of TEEP / OEE and Six Sigma With Data Collected in Pi Will Help Companies Squeeze Every Last Penny Out of the Assets.
- Maintenance Avoidance Through Condition Monitoring With PM-RLINK Can Save Thousands, If Not Millions of Dollars.

Thank You

