Update on Foundation and Data Access

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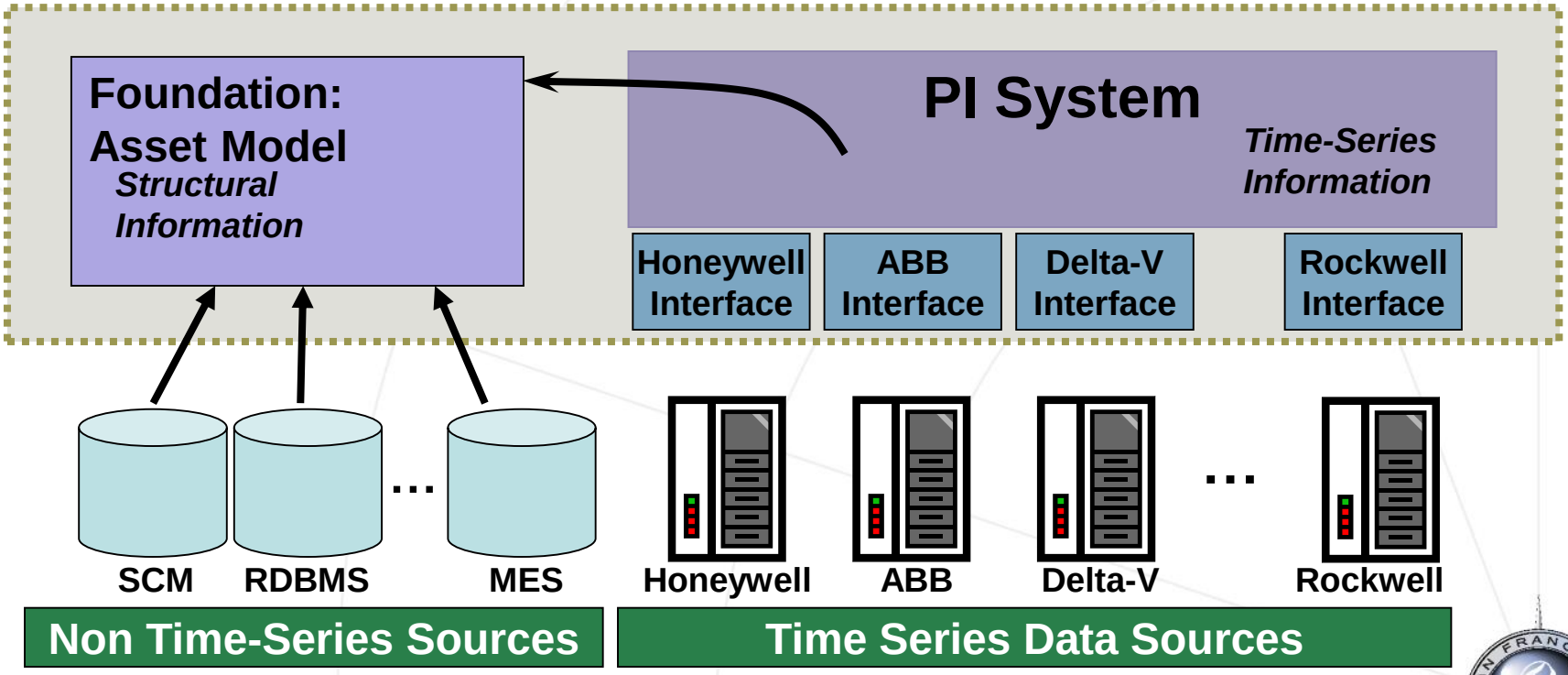
Richard Beeson

Outline

- What is Foundation
- Value of Foundation
- Functional Breakdown of Foundation
- Application Building Example
- Roadmap

What is Foundation?

- An application layer for PI
- The next version of Analysis Framework



Next Version of Analysis Framework

- Foundation is NOT a V1.0 product
- Analysis Framework has a very large value for PI users:
- Organization of your data—1000s of points
  - According to naming convention
  - In the way that you would like to use it in displays and applications
- Organizes relational and complex data with your PI data
- Your domain knowledge is reusable (centralized)
  - not in an Excel spreadsheet
- Replaces programming with configuration
- Protects your investments in your displays, reports, and applications

Where does this fit in RtPM:

- How We Got Here Today*
  - Pervasive connectivity
  - Quick roll-out
  - Do-it-yourself tools
  - Empowered, creative user base
  - Unwavering commitment to upgradeability

2005 UC Presentation “The Road Ahead”

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- How We Got Here Today*
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  - **Do-it-yourself tools**
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2005 UC Presentation "The Road Ahead"

Value of Foundation

- Helps you to derive more value from
  - Your PI systems
  - Your PI data

Value of Foundation

- Speed the development of displays and applications
  - Why Applications?
    - Each year, you present your valuable applications built on PI
    - We want to provide tools for this that make it easier
  - Why Displays?
    - This is how you use our technology to derive value
    - We want to provide tools accessible for all levels of users

What do we mean by applications?

Alarm Management
Analyzer Performance
Automated Generation Control
Automated Reports
Balanced Scorecards
Baseline Best Practices
Batch Quality Monitor
Certificate Of Analysis
Compliance Documentation
Condition Based Maintenance (CBM)
Continuous Emissions Monitor (CEM)
Control Loop Monitor
Corporate Data Warehouse
Customer Load Management
Data Reconciliation
Down-hole Systems In O&G Production
Downtime Monitoring
E-Commerce
Energy Management System
Environmental Compliance Monitor
General Ops Docn And Equipment Specs
Hazardous Waste Tracking
Hierarchical Process Data Views
Hydrogen Manufacturing And Distribution
Incident Investigations
Inventory Management
IT / Systems Monitoring
Key Performance Indicators (Kpi)
Lab Quality Data Integration
LNG Terminal Operating Assistance
LNG Terminal Operations Reports
Maintenance History Or Status
Maintenance Lockout Procedures
Manual Data Recording
Manufacturing Intelligence Data
Material Balance
Material Usage Tracking
Multi-Plant Equipment Performance Monitor
O&G Production Remote Monitoring
O&G Production Well Testing
Operating Envelope Data
Operations Data Warehouse
Operations Desktop
Operator Handover
Operator Training
Paper Machine Felt Monitoring
Paper Machine Grade Management
Paper Machine Lost Opportunity Module
Paper Machine Performance Monitor
Pipeline Equipment Remote Monitor
Pipeline Leak Detection Support
Pipeline Operations Planning
Pipeline Pigging Schedule For Paraffin Removal
Pipeline Solar Turbine Efficiency Remote Monitor
Plant Performance Overviews
Power Delivery Capability For Gas Turbines
Power Generation Fleet Outage Management
Power Generation Supplier Scheduling
Power Turbine Trip Monitor
Process Monitoring
Process Performance Analysis
Product Compliance Reporting
Product Development Trials
Product Pricing
Product Separation In Multi-Product Pipelines
Production Data Integration To ERP
Production Plan Versus Target Data
Production Plan Versus Actual Data
Pulp And Paper Mill Steam Energy Monitor
Pulp Mill Tracking
Quality Monitoring/Analysis
Reliability Centered Maintenance Support
Reservoir Control And Production Operations
Root-Cause Analysis
Shared Inventory Management Service
Shift Production Monitor
Six Sigma
SPC/SQC Production Quality Control
Steam Turbine Performance Analysis
Substation Load Monitoring
Substation Transformer Asset Management
Supply Chain Management
T&D Network System Load Forecasts
T&D Network System Load Planning
T&D Substation Equipment Monitoring
Tanker Fleet Current/Past Locations
Total Effective Equipment Productivity
Transmission Line Capacity Planning
Transmission Network Diagrams
Transmission Network Frequency Monitor
Troubleshooting Equipment Startups
Utilities Management
Virtual On-Line Analyzer In Refining
Waste Treatment Monitor
Weather Data Import

How Foundation accomplishes that

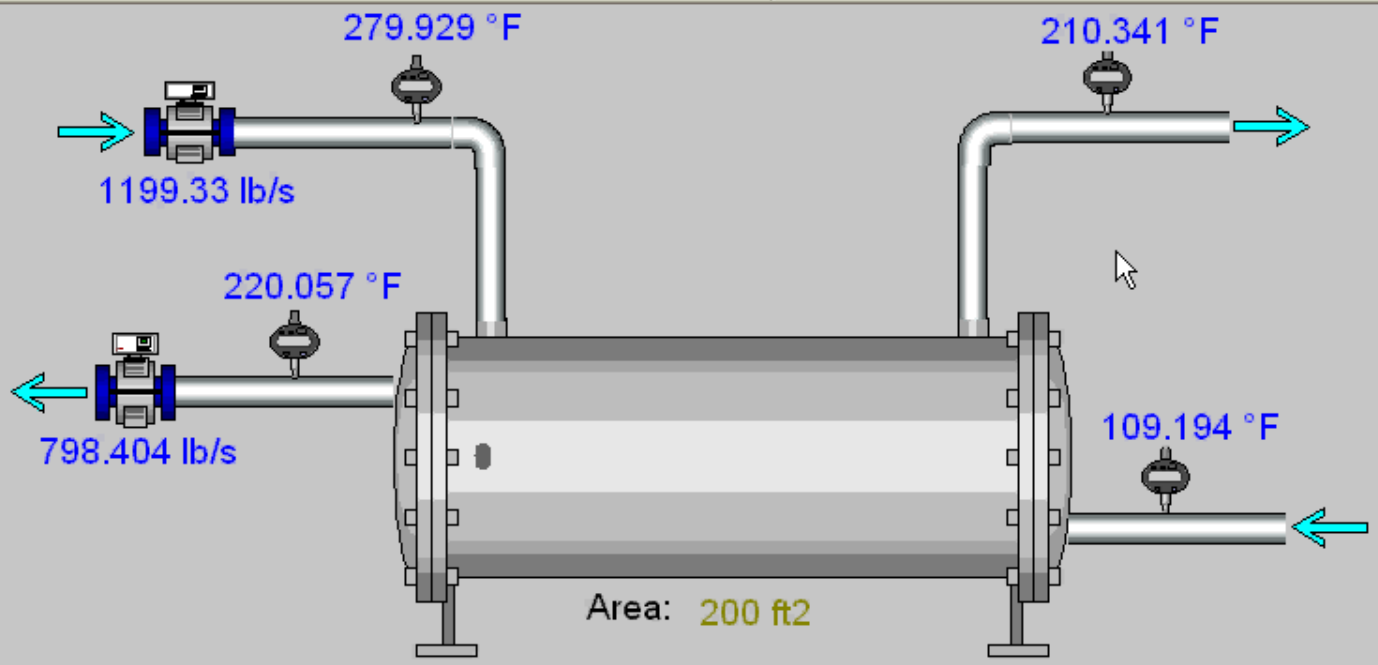
- OSIsoft is working on a set of projects that build on top of PI:
  - Foundation (next version of AF)
    - Process Objects, Data Directory
  - Data Access (next version of RtBLS)
    - Highly scalable access to PI and non-PI data
  - PIANO
    - Analysis, Notification

How Foundation accomplishes that

- Foundation, Data Access, PIANO
- Together, these create an environment on top of PI that:
  - Allows you to create
    - Displays
    - Applications
  - With configuration, and not programming
  - That use PI data and non-PI data
  - That solve useful business problems

PI ProcessBook - [HeatExchanger.PDI]

File Edit View Insert Tools Draw Arrange Window Help



Hot Side DeltaT: 59.8725 delta °F
Tube Side Heat Capacity: 0.87 BTU/Lb/Deg F
Tube Side Heat Duty: 77006.4 Btu/h

Cold Side DeltaT: 101.147 delta °F
Shell Side Heat Capacity: 1 BTU/Lb/Deg F
Shell Side Heat Duty: 83459.0 Btu/h

LMDT: 78.7143 delta °F
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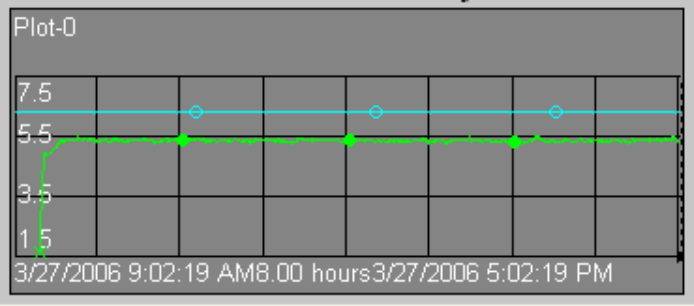
Calculated U: 5.30139 BTU/Hr/Ft2/DegF



Ready

Server Time

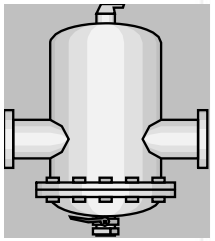
start AFExplorer PI ProcessBook - [He... 2000Server - Microso... 5:02 PM

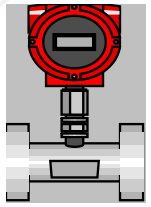
Functional Breakdown of Foundation

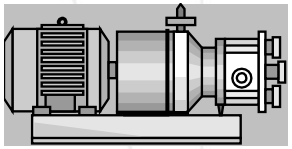
- Process Objects
- Models and Hierarchies of objects
- Data Directory
- Access to non-PI data
- Simple calculations

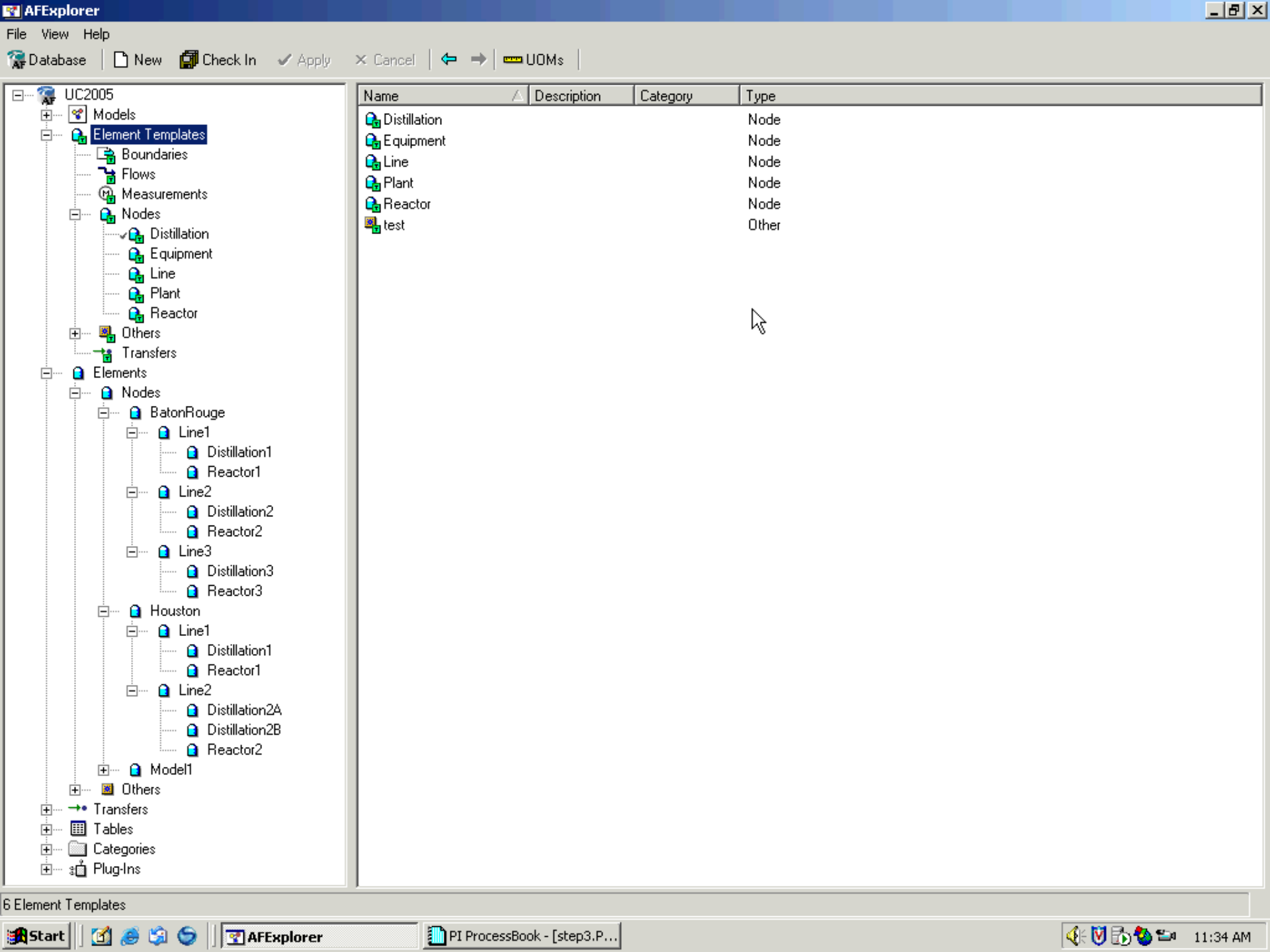
Functional Breakdown of Foundation

- Process Objects
  - These are the “data” equivalent of the ProcessBook symbol library
    - Reactors
    - Crystallizers
    - Valves
    - Mixers
    - etc.
  - You create these as “templates” and then can use them in:
    - Displays
    - Calculations








AFExplorer
File View Help
Database New Check In Apply Cancel UOMs
UC2005
Models
Element Templates
Boundaries
Flows
Measurements
Nodes
Distillation
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Line
Plant
Reactor
Others
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Line3
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Distillation2A
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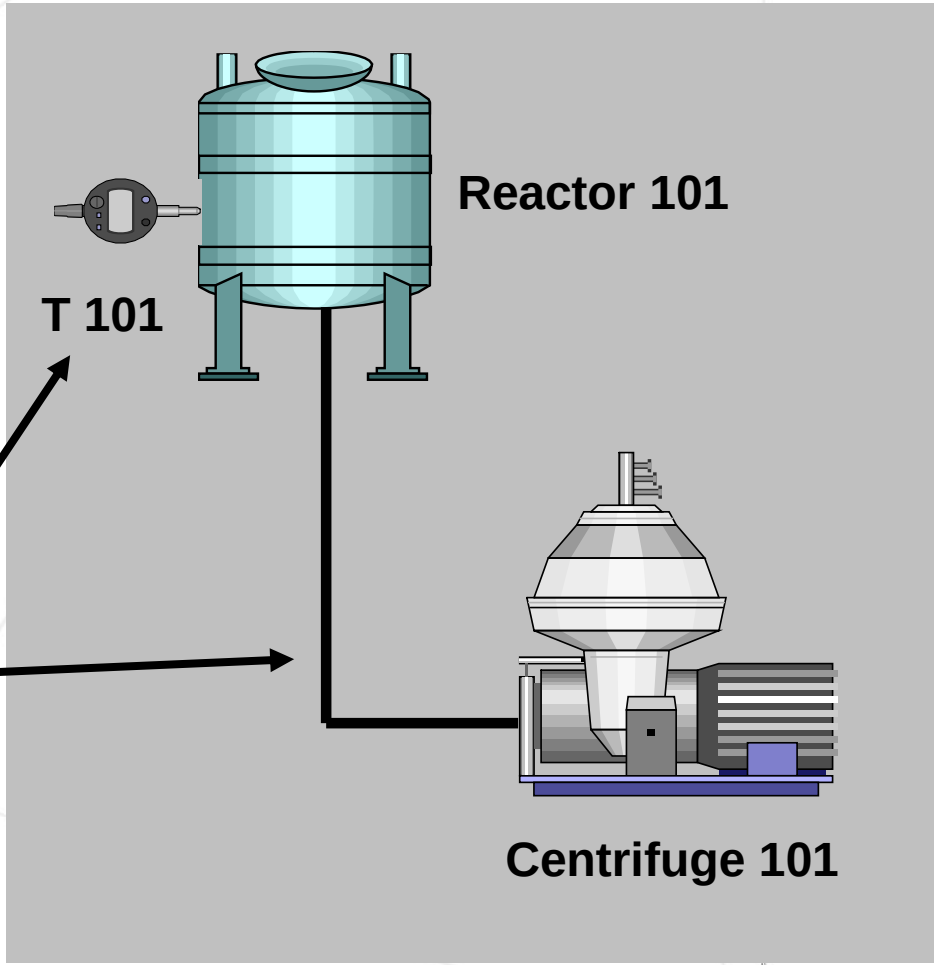
Reactor Node
test Other
6 Element Templates
Start
AFExplorer
PI ProcessBook - [step3.P...
11:34 AM

Process objects. Other features:

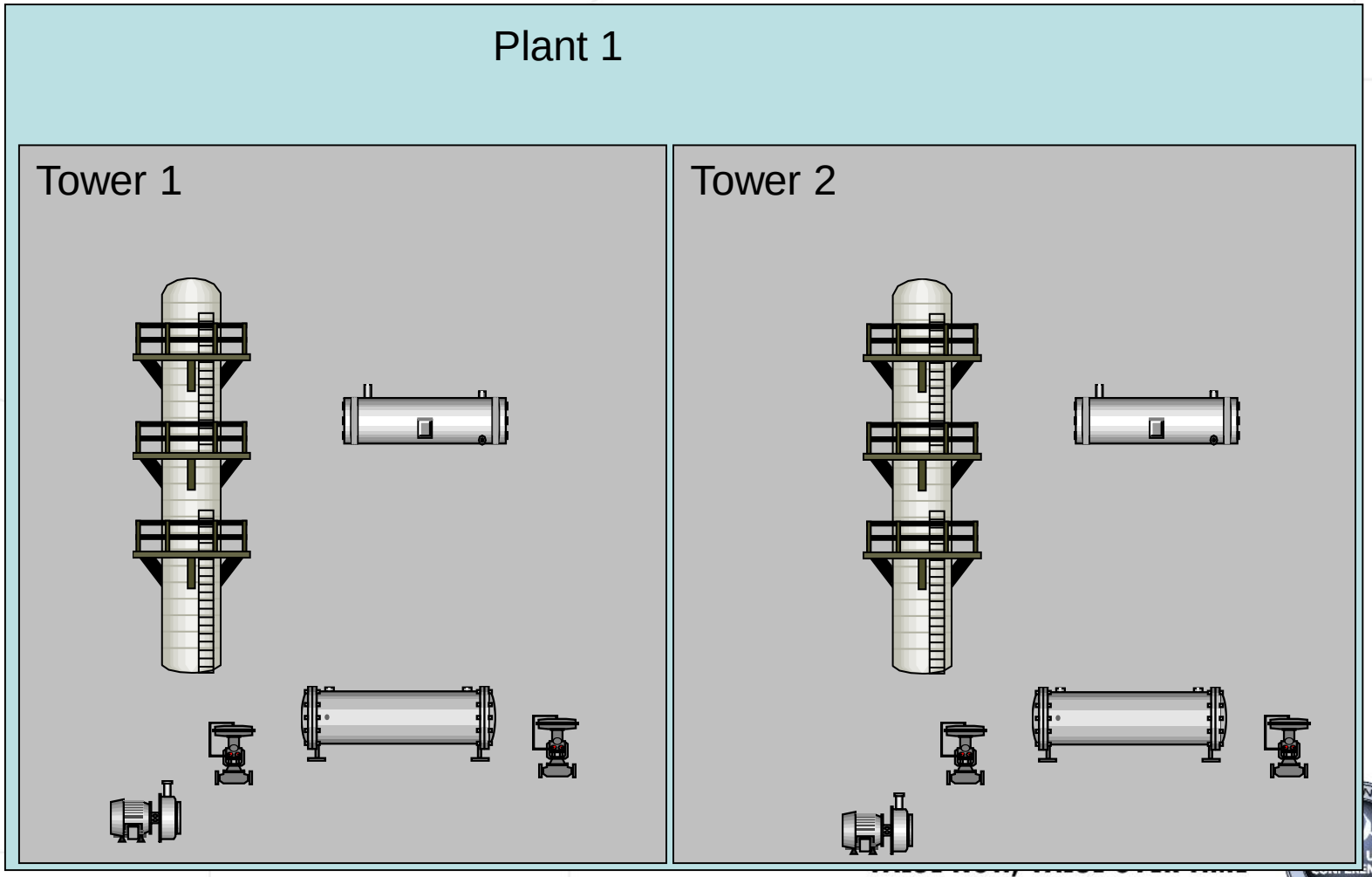
- Objects are created from templates
  - Templates can inherit from templates
    - Valves
      - 2-State Valve
      - 3-State Valve
- Attributes can be hierarchical
  - Temperature
    - Hi Limit
    - Lo Limit
- Attributes can create PI-tags automatically
- Objects track history
  - Useful where process connectivity changes
  - Useful for doing analysis on old data

Functional Breakdown of Foundation

- Models and Hierarchies
  - Process objects are often related to one another
  - For example Reactor 101
    - **Has a** Temperature Sensor T101
    - **Transfers to** Centrifuge 101

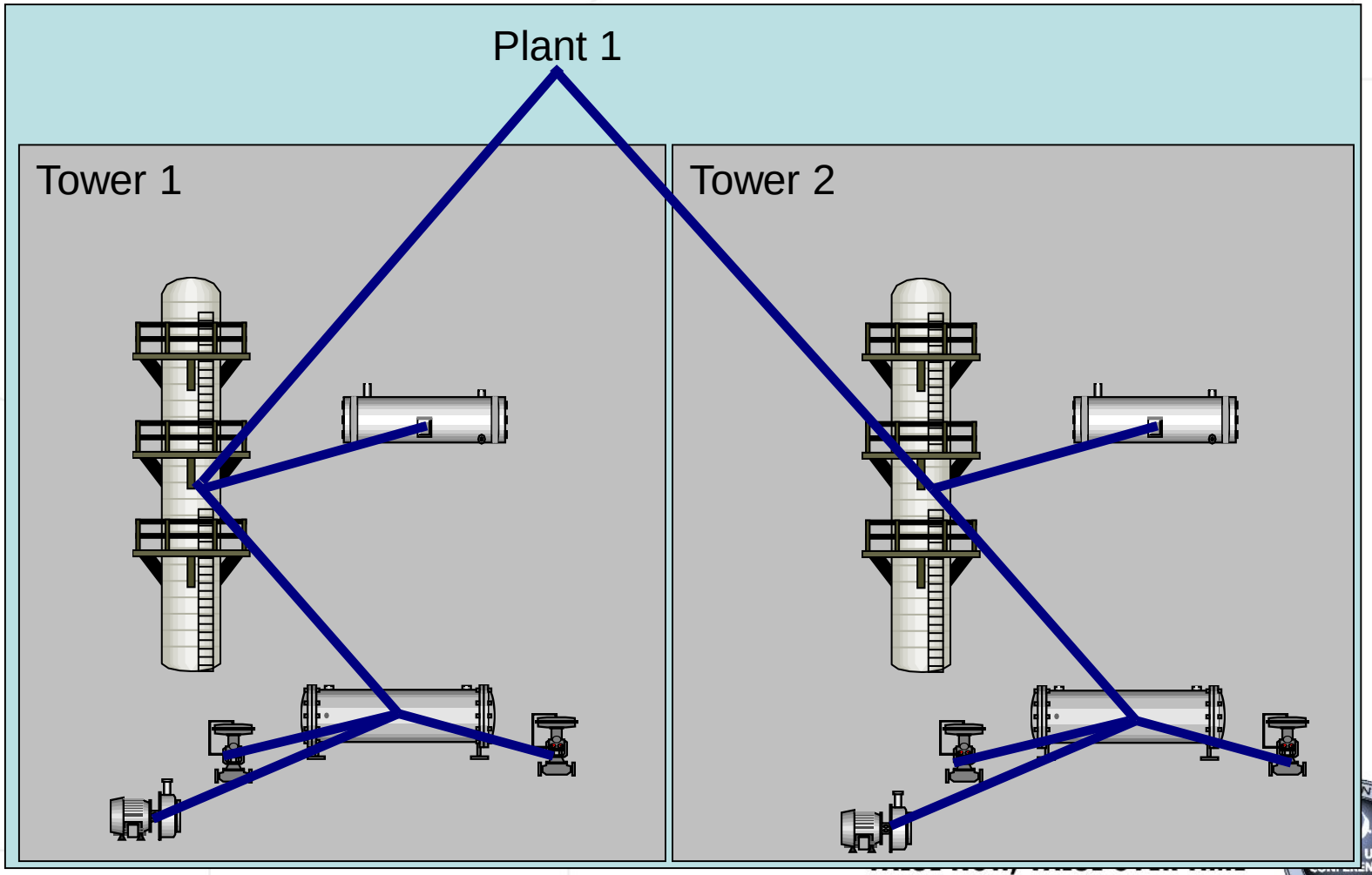


Models and Hierarchies



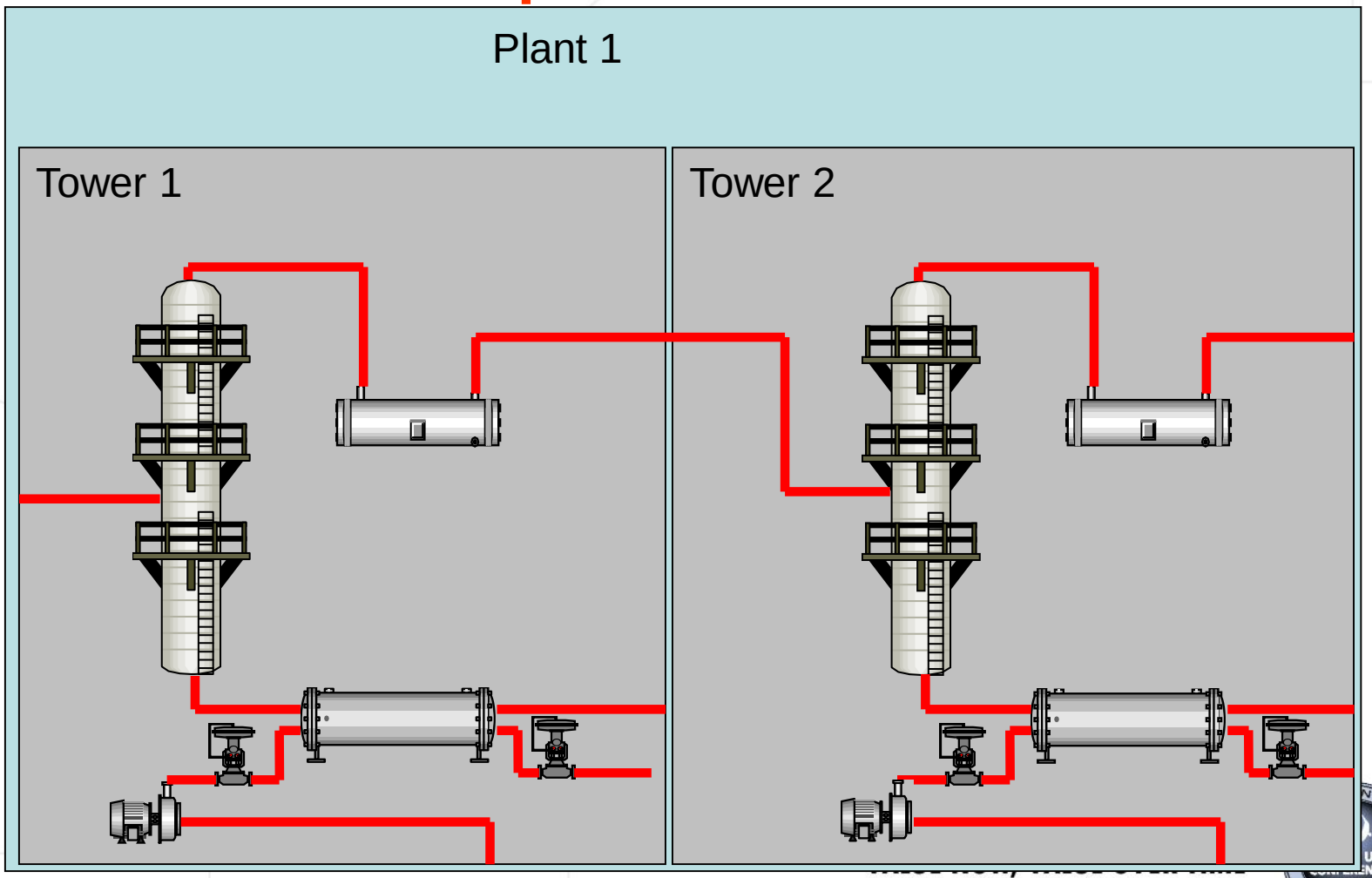
Models and Hierarchies

Hierarchical Relationships



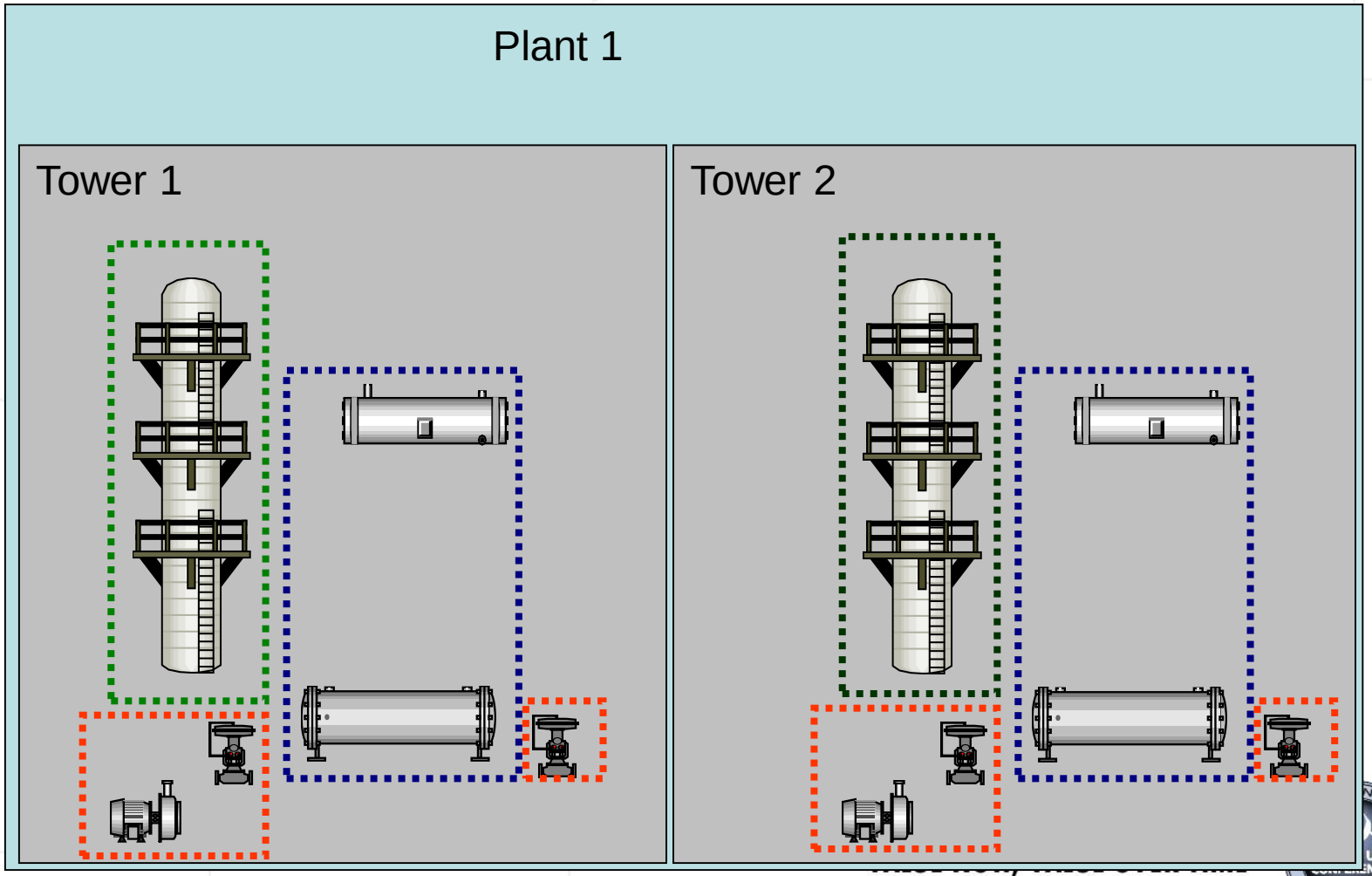
Models and Hierarchies

Flow Relationships



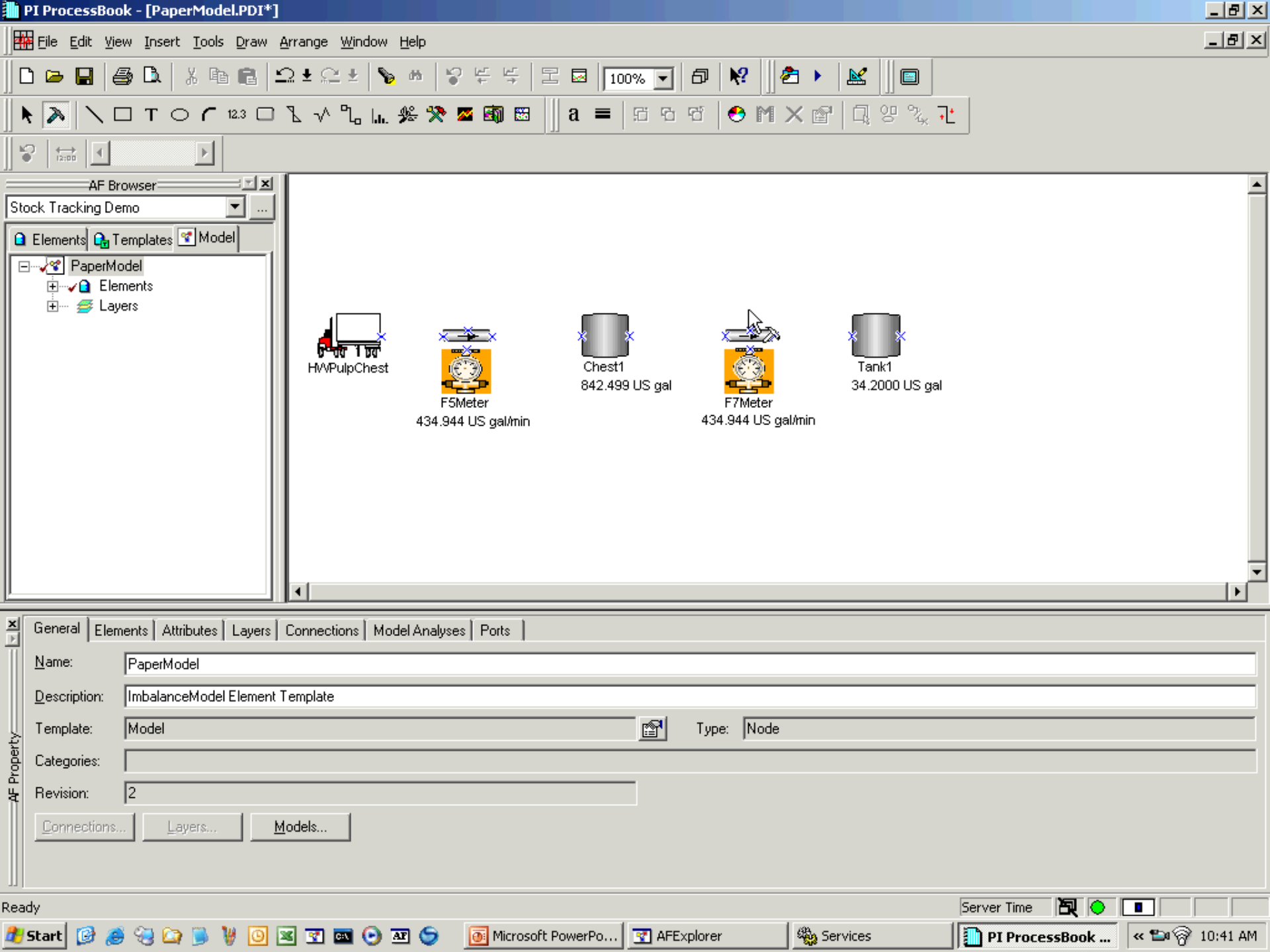
Models and Hierarchies - Roles

Role Relationships



Models and Hierarchies, Stock Tracking

- Goals:
  - Track route of stock through process
  - Track original source of material
  - Track several attributes of the stock:
    - Brightness
    - Dirt
    - Consistency
    - Etc.
  - Ability to create arbitrary marker events that flow through the process
  - Must be able to see attributes at any time in the past at any place in the process.


PI ProcessBook - [PaperModel.PDI*]
File Edit View Insert Tools Draw Arrange Window Help
100%
AF Browser
Stock Tracking Demo
Elements Templates Model
PaperModel
Elements
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HWPulpChest
F5Meter
434.944 US gal/min
Chest1
842.499 US gal
F7Meter
434.944 US gal/min
Tank1
34.2000 US gal
General Elements Attributes Layers Connections Model Analyses Ports
Name: PaperModel
Description: ImbalanceModel Element Template
Template: Model
Type: Node
Categories:
Revision: 2
Connections... Layers... Models...
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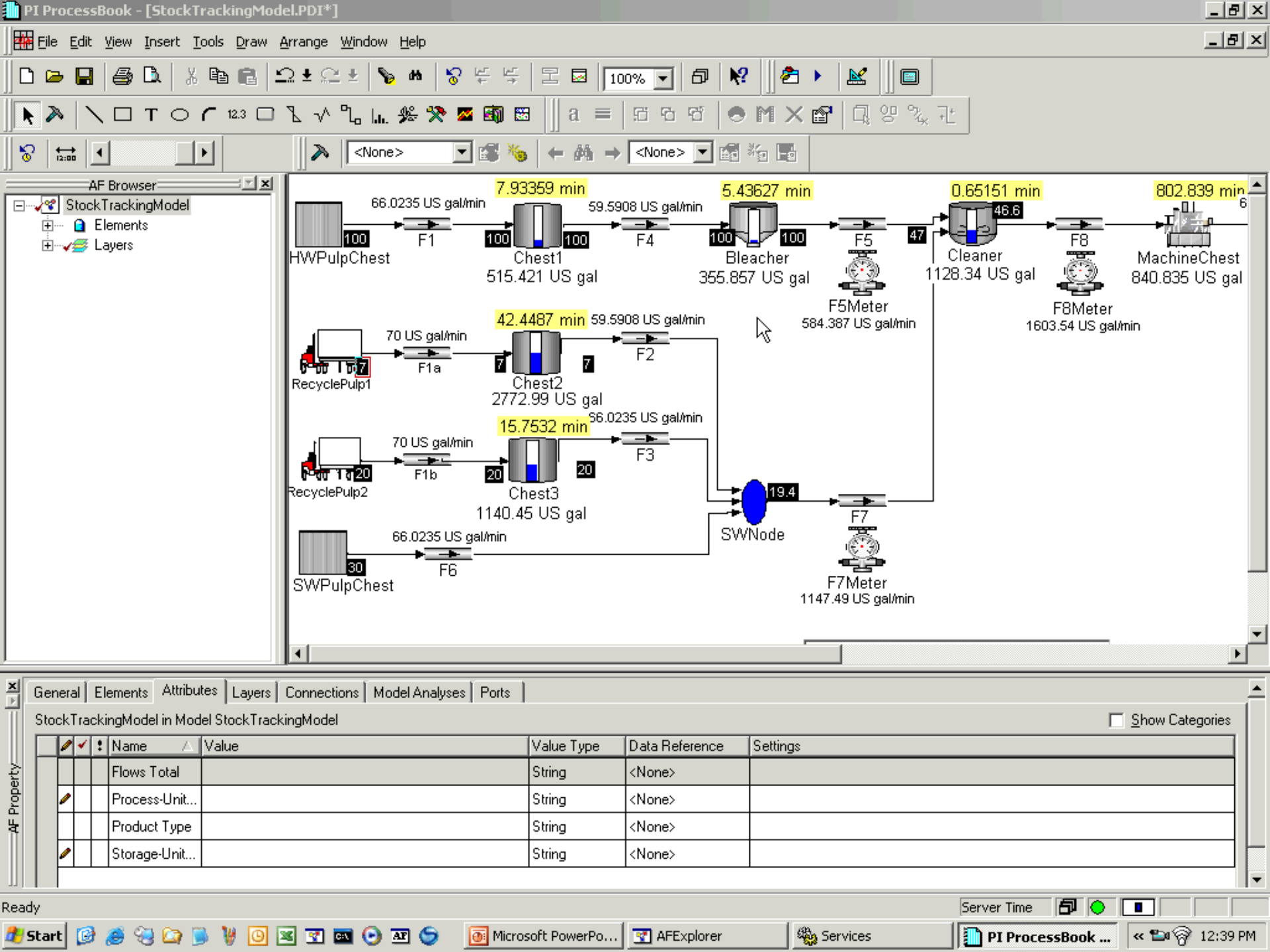
10:41 AM


PI ProcessBook - [StockTrackingModel.PDI*]
File Edit View Insert Tools Draw Arrange Window Help
AF Browser
StockTrackingModel
Elements
Layers
66.0235 US gal/min
7.93359 min
59.5908 US gal/min
5.43627 min
0.65151 min
802.839 min
HWPulpChest
F1
Chest1
515.421 US gal
F4
Bleacher
355.857 US gal
F5
F5Meter
584.387 US gal/min
Cleaner
1128.34 US gal
F8
F8Meter
1603.54 US gal/min
MachineChest
840.835 US gal
70 US gal/min
42.4487 min
59.5908 US gal/min
F1a
RecyclePulp1
Chest2
2772.99 US gal
F2
15.7532 min
56.0235 US gal/min
70 US gal/min
F1b
RecyclePulp2
Chest3
1140.45 US gal
F3
SWNode
F7
F7Meter
1147.49 US gal/min
66.0235 US gal/min
F6
SWPulpChest
General Elements Attributes Layers Connections Model Analyses Ports
StockTrackingModel in Model StockTrackingModel
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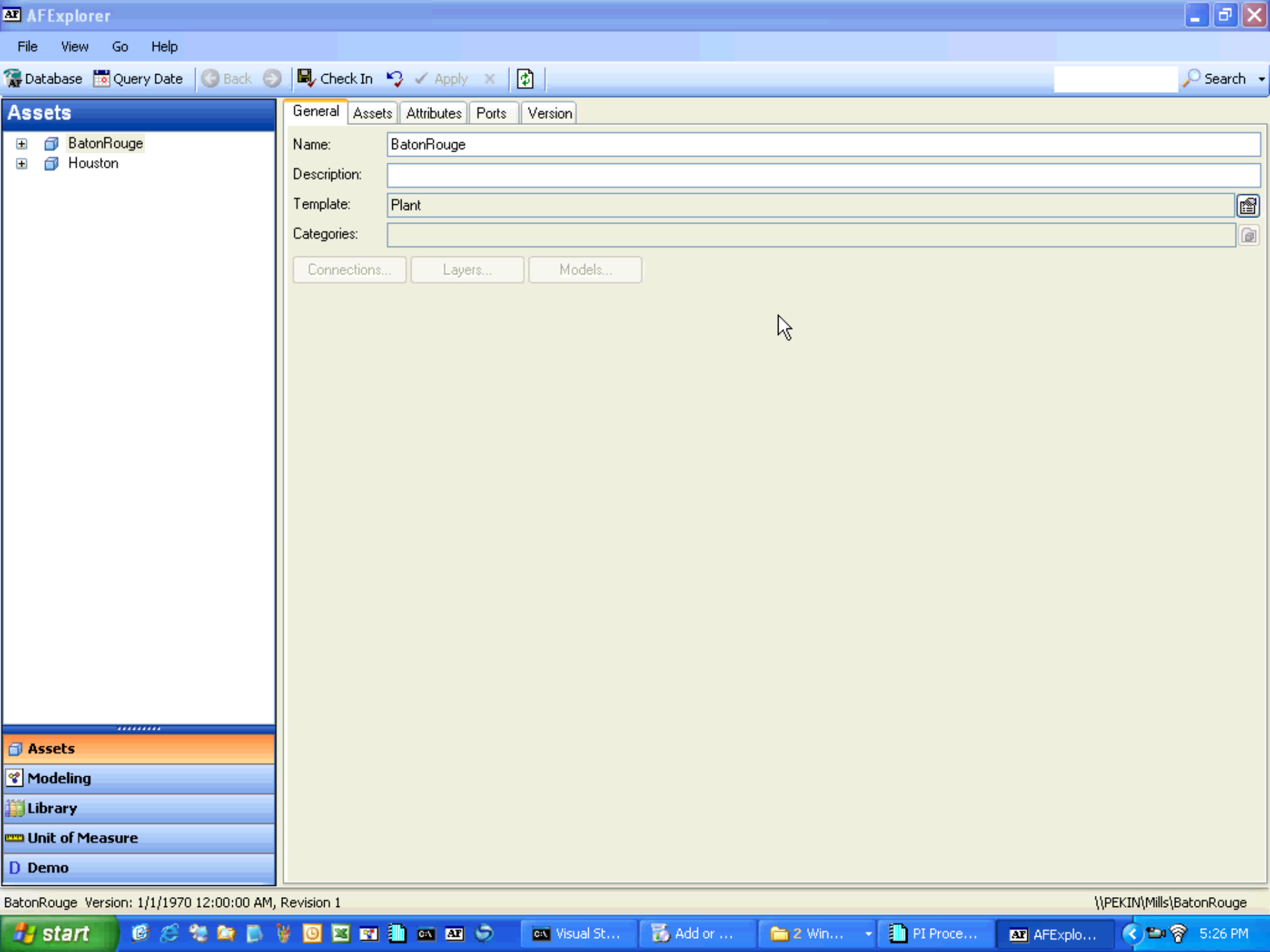
Name Value Value Type Data Reference Settings
Flows Total String <None>
Process-Unit... String <None>
Product Type String <None>
Storage-Unit... String <None>
AF Property
Ready
Server Time
Start
Microsoft PowerPo...
AFExplorer
Services
PI ProcessBook ...
12:39 PM

Models and Hierarchies, other features

- Hierarchies
  - Multiple Hierarchies
    - Pump that is part of a ‘pumps’ collection and a reactor
  - Named relationships
    - Tells why one object is related to another
      - E.g. Supplier - Vendor
- Models
  - Ability for an object to be in multiple models:
    - Model of an area vs. Model of a Plant
  - Multiple layers in a model:
    - Steam flow vs. product flow

Functional Breakdown of Foundation

- The Data Directory is:
  - The organization of PI data into
    - Process objects
  - The organization of process objects into
    - A hierarchy
    - A model
- This allows PI data and other data to be:
  - Browsed
  - Easily searched


AFExplorer
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AFExplo...
5:26 PM

Data Directory, other features

- Ability to use in RtWebParts
  - Search
  - Browsing
- Use in other client applications
  - OLEDB
  - Excel Add-In

Functional Breakdown of Foundation

- Simple calculations
  - Similar to Performance Equations
    - But assigned to an object template
  - Easy to configure, no programming
  - Apply to process object attributes
  - For example:
    - Engineering calculations
    - Max, Min, etc.

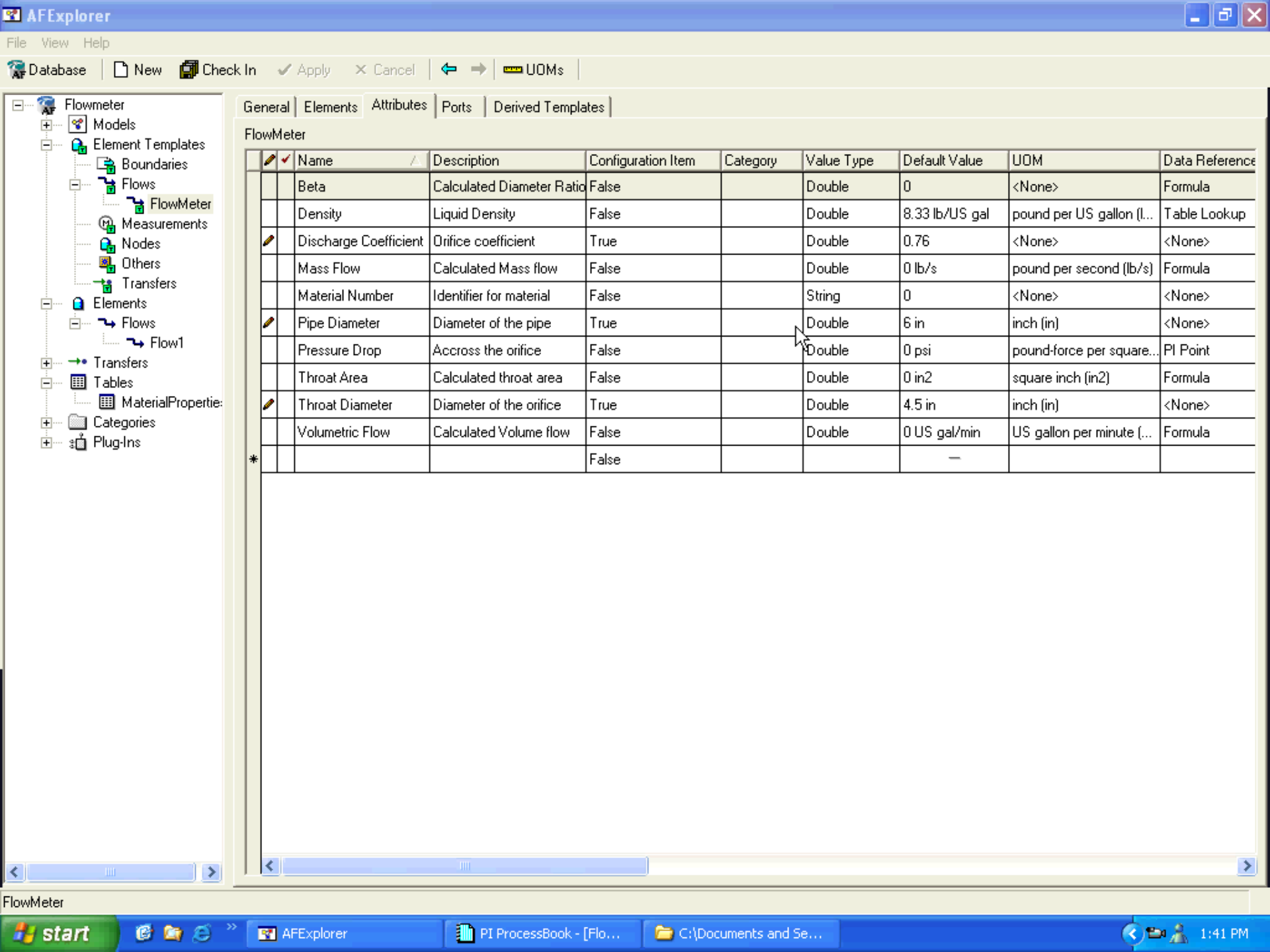

Planning_20...
WP_AF Integration_...
Foundation Reference.chm
Houston_Fo...
UC 2005 ProcessPoint
App Server work in ...
Smart Signal.doc
PI Server Install
Shortcut to My Computer
ch1_6.pdf
3.1.2.2
App Server Logic
Shortcut to RAY HALL (D)
ch2_5.pdf
snagit.exe
Oledb Provider
PIANO User Manual.doc
HEAT_EXCH...
Pinky.wmv
New Text Document.txt
Smart Search
Shortcut to 2.0.0.1455
Unit-of-Mea... Classes.xml
UC 2006
Template
1.2.2.1264 Release 1.2.2
3.0.14.3
IT MOnitor
SnagIt 8
1.0.1.966
New Microsoft Excel Work...
SQL
test.avi
Trip To Yardley
FlowMeter.xml
Recycle Bin
start
AFExplorer
PI ProcessBook - [Flo...
1:21 PM

Simple Calculations, other features

- Makes use of attributes
  - Therefore can access:
    - PI Data
    - Non PI Data
    - Fixed values
- Accessible in ProcessBook
  - Can add to a trend
  - Can display current value

Functional Breakdown of Foundation

- Access to non-PI data
  - There are several ways to accomplish this:
    - Com Connectors
    - ProcessBook data sets
    - RtBLS data sets
    - AF Data references
  - The approach that we are standardizing upon:
    - “Data Access” layer to access the data
    - AF Data references to expose in an object model


AFExplorer
File View Help
Database New Check In Apply Cancel UOMs
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Flow1
Transfers
Tables
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Categories
Plug-Ins
General Elements Attributes Ports Derived Templates
FlowMeter
Name Description Configuration Item Category Value Type Default Value UOM Data Reference
Beta Calculated Diameter Ratio False Double 0 <None> Formula
Density Liquid Density False Double 8.33 lb/US gal pound per US gallon (l... Table Lookup
Discharge Coefficient Orifice coefficient True Double 0.76 <None> <None>
Mass Flow Calculated Mass flow False Double 0 lb/s pound per second (lb/s) Formula
Material Number Identifier for material False String 0 <None> <None>
Pipe Diameter Diameter of the pipe True Double 6 in inch (in) <None>
Pressure Drop Accross the orifice False Double 0 psi pound-force per square... PI Point
Throat Area Calculated throat area False Double 0 in2 square inch (in2) Formula
Throat Diameter Diameter of the orifice True Double 4.5 in inch (in) <None>
Volumetric Flow Calculated Volume flow False Double 0 US gal/min US gallon per minute (... Formula
False
FlowMeter
start
AFExplorer
PI ProcessBook - [Flo...
C:\Documents and Se...
1:41 PM

Data from Other Systems

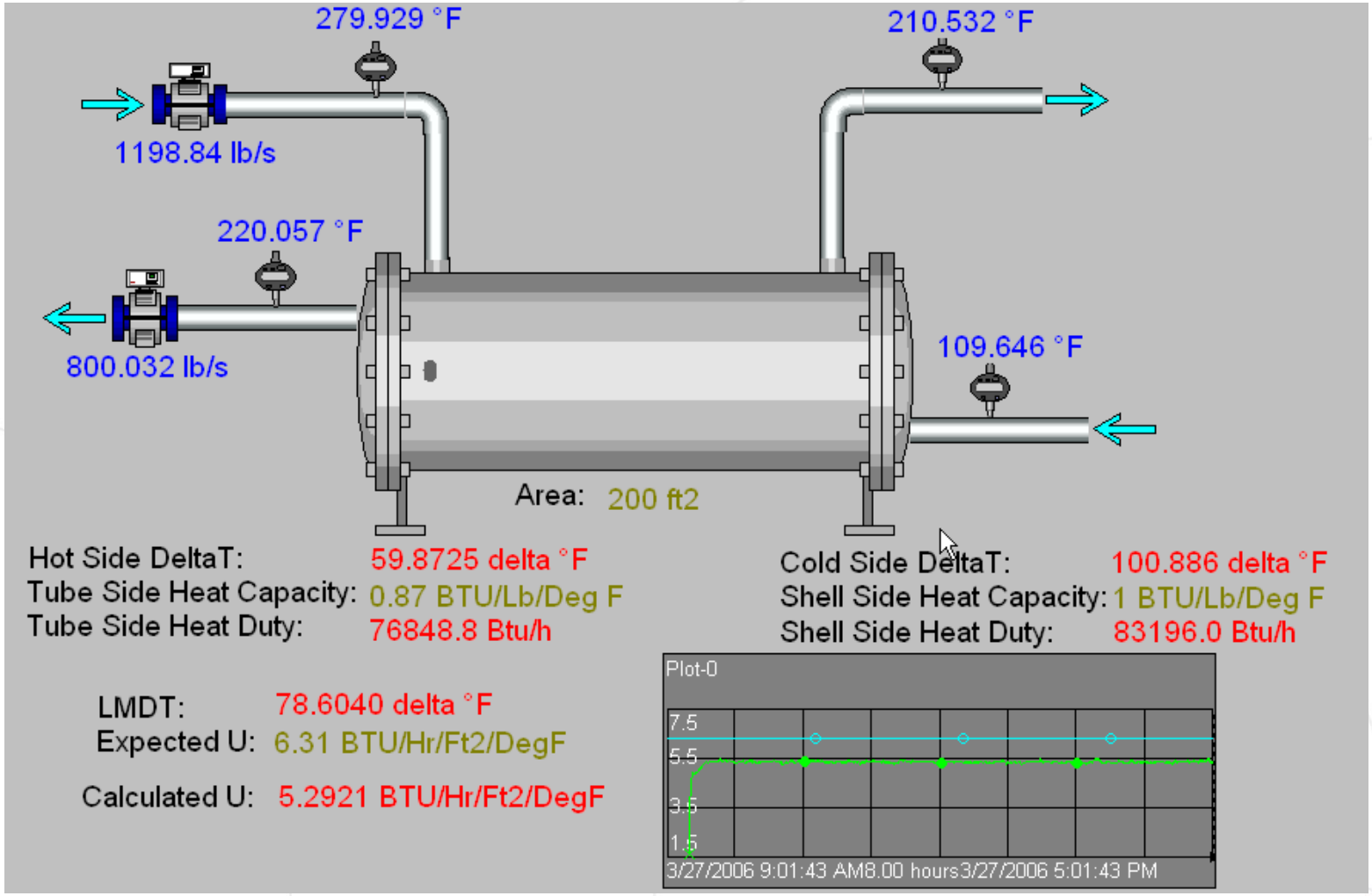
- Other examples of non time-series data

System	Example Asset
ERP – HR	Personnel, Organizations, Personnel Capabilities
ERP – Inventory	Materials, Suppliers, Inventory Items
Asset Management	Maintenance request, Technicians, Contracts, Companies, Equipment, Parts, Faults
MES	Dispensed Material, Equipment, Procedures, Work in Progress, Electronic Work Instructions
LIMS	Sample, Test, Analytical Procedures, Technician, Test Results, COA
ProcessPoint	Material Classes, Products, Bill of materials, Specifications, Materials
Document Management	Standard Operating Procedures, Material Safety Data Sheets
Planning	Production Plan, Equipment, Production Schedule, Dispatch List, Routes
Inventory Management	Warehouse, Material Lot, Supplier, Container, Personnel, Transfer Equipment, Material Energy requirements
Supply Chain	Forecast, Demand Plan, Manufacturing Models, Schedule, Order
Other	Bill of Lading, Batches (e.g. from PI Batch)

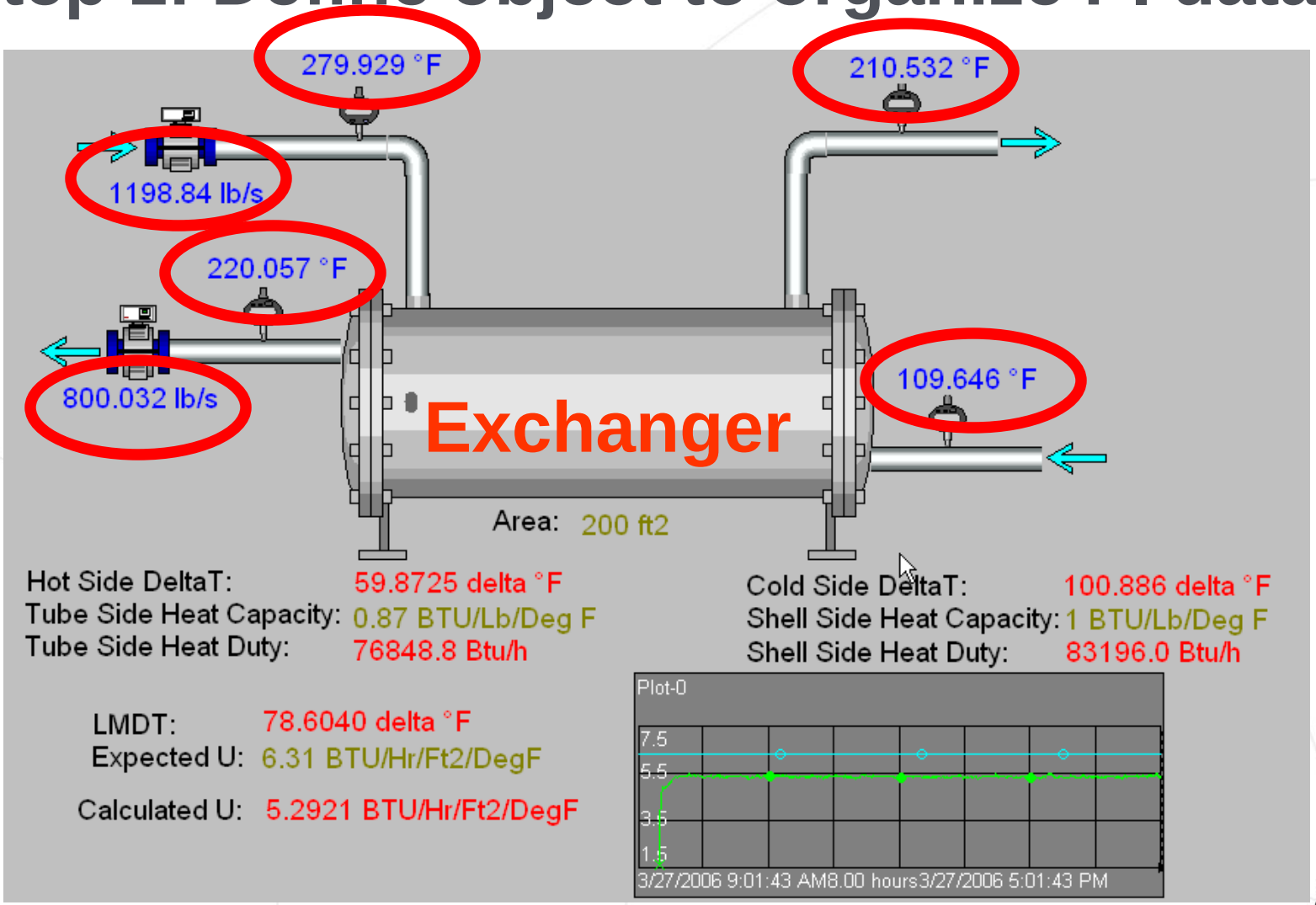
Data References, other features

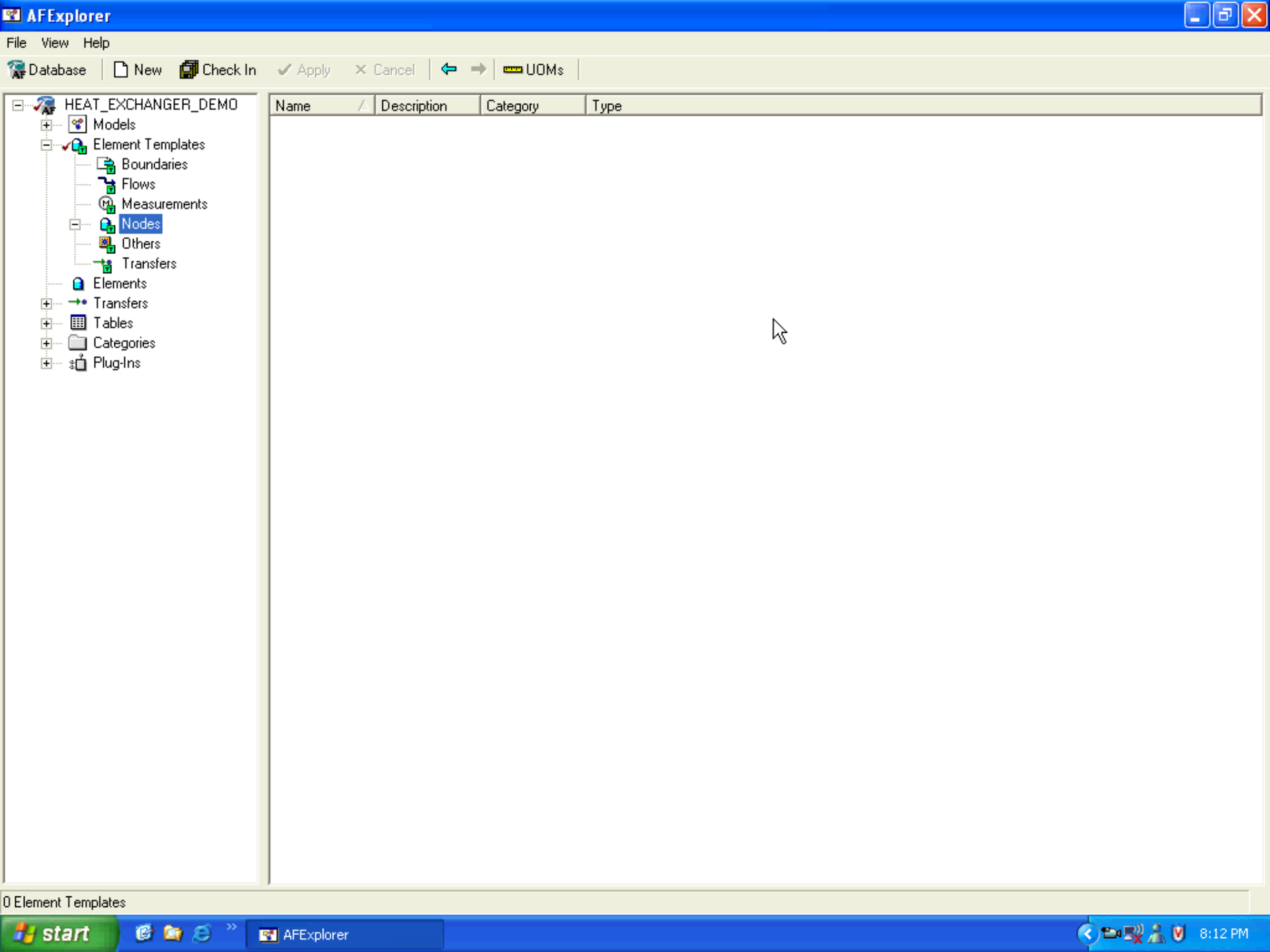
- Can be created by:
  - OSIsoft
  - 3rd party
- Used on the template
  - No need to configure each one

Application Building Demonstration



Step 1: Define object to organize PI data




AFExplorer
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Models
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start
AFExplorer
8:12 PM

PI ProcessBook - [HeatExchanger1B.PDI]

File Edit View Insert Tools Draw Arrange Window Help

100%

AF Browser

HEAT_EXCHANGER

Elements Templates

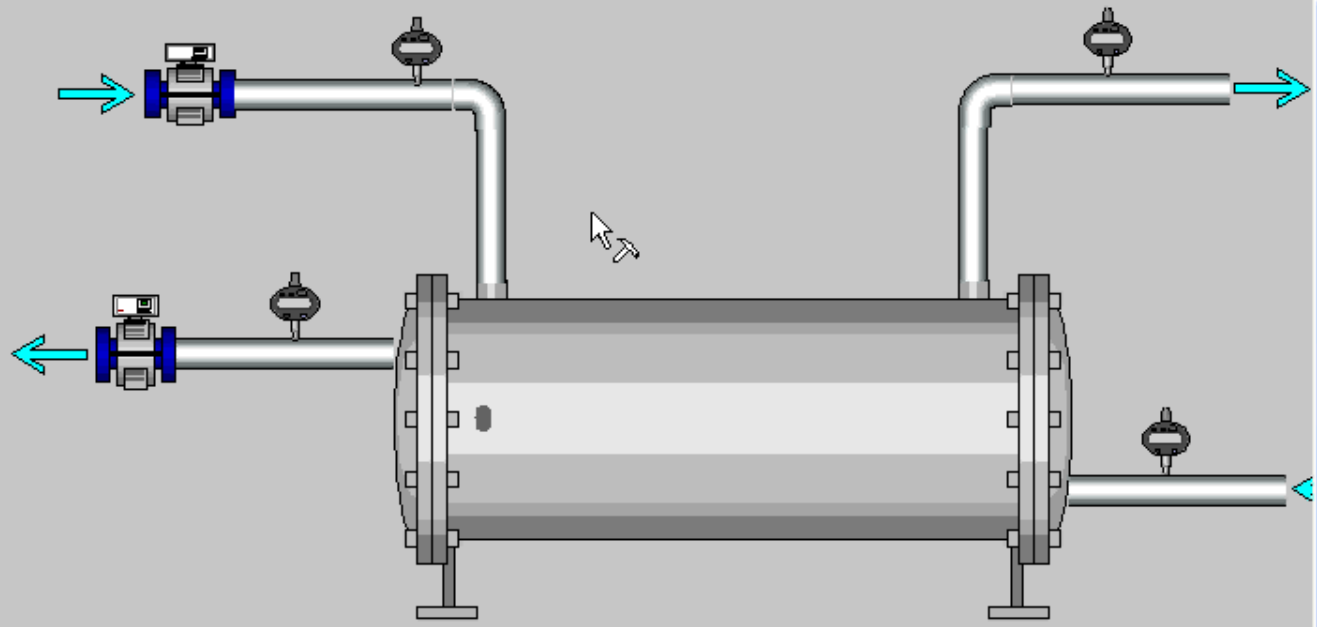
- Elements
  - Exchanger2
  - Exchanger3
  - Exchanger4

AF Property

General Elements Attributes Ports

Exchanger3

Name	Value
Area	200 ft2
Cold Side Temperature D...	100.0068054
Fouling Factor	2.75992758
Hot Side Temperature Di...	59.7237243
LMTD	78.1423575
Shell Mass Flow	1198.861572
Shell Side Heat Capacity	1 BTU/Lb/D
Shell Side Heat Duty	83988.8728
Shell Side Inlet Temperat...	280.0715026
Shell Side Material	WX12000
Shell Side Outlet Temper...	210.0143127
Shell Temperature Differ...	70.05718994
Tube Mass Flow	801.8128051
Tube Side Heat Capacity	0.87 BTU/Lb
Tube Side Heat Duty	76970.85073

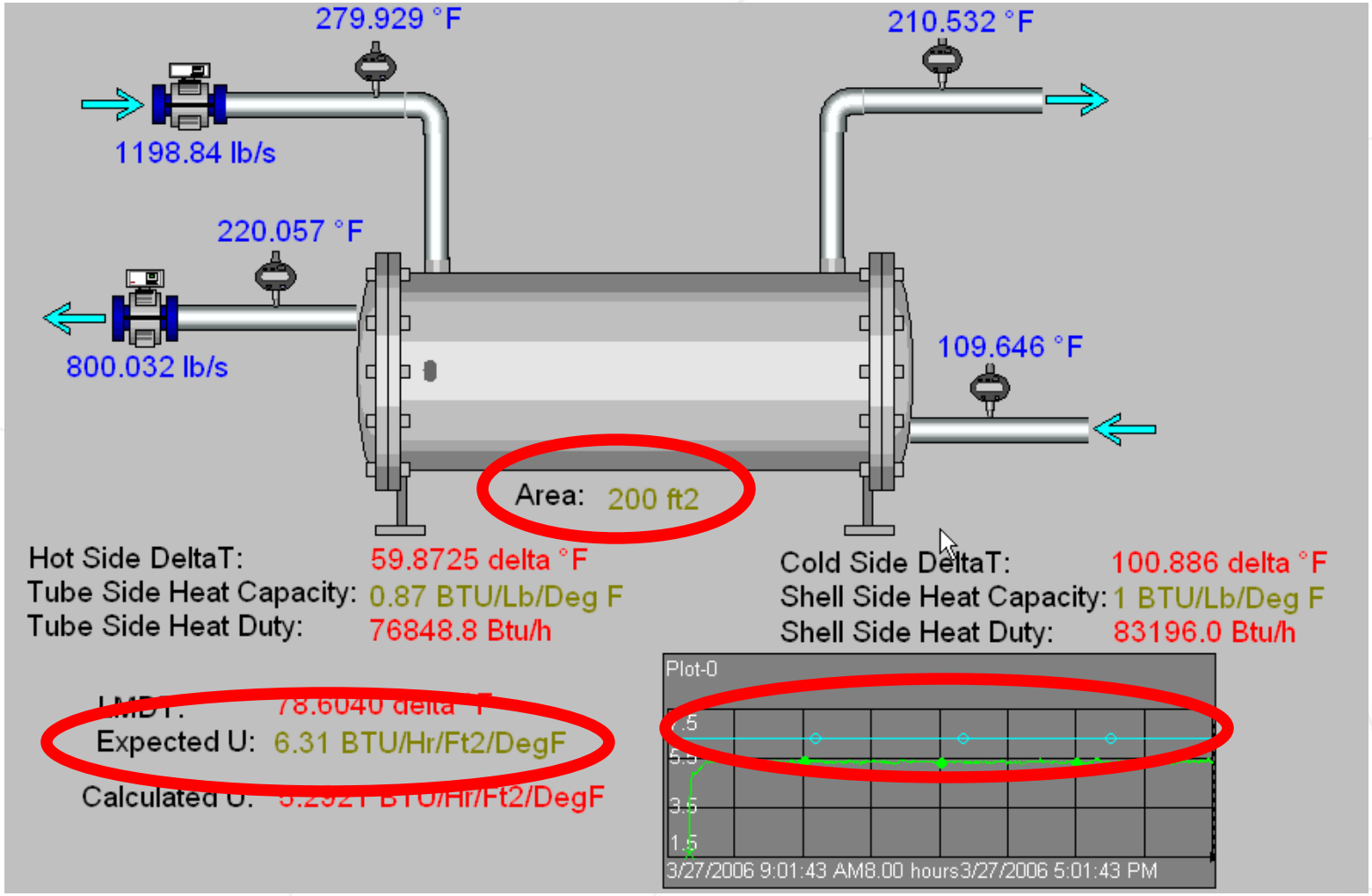


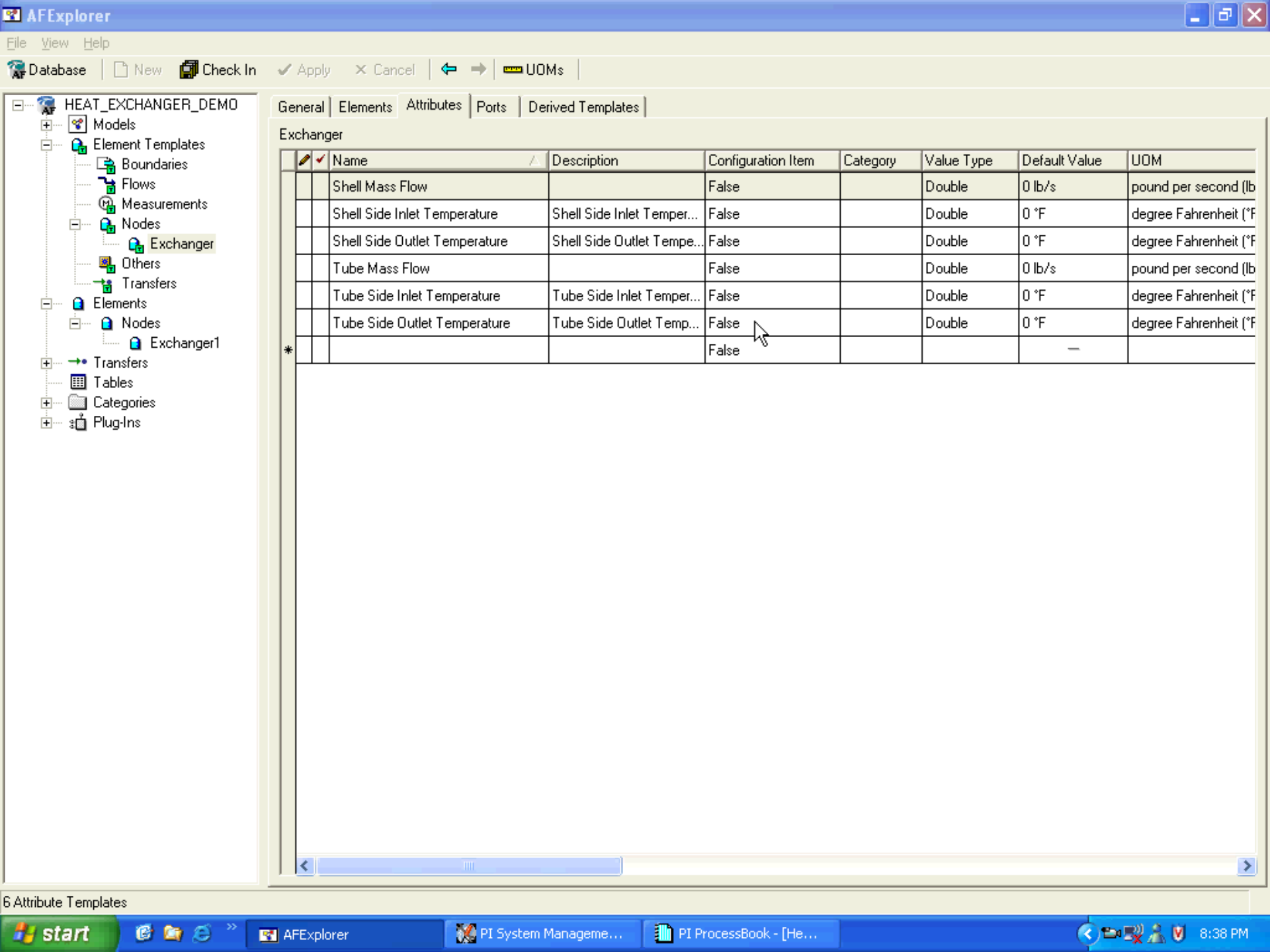
Ready

Server Time

start AFExplorer PI ProcessBook - [He... 2000Server - Microso... 5:37 PM

Step 2: Add configured data

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Plug-Ins
General Elements Attributes Ports Derived Templates
Exchanger
Name Description Configuration Item Category Value Type Default Value UOM
Shell Mass Flow False Double 0 lb/s pound per second (lb
Shell Side Inlet Temperature Shell Side Inlet Temper... False Double 0 °F degree Fahrenheit (°F
Shell Side Outlet Temperature Shell Side Outlet Tempe... False Double 0 °F degree Fahrenheit (°F
Tube Mass Flow False Double 0 lb/s pound per second (lb
Tube Side Inlet Temperature Tube Side Inlet Temper... False Double 0 °F degree Fahrenheit (°F
Tube Side Outlet Temperature Tube Side Outlet Temp... False Double 0 °F degree Fahrenheit (°F
False
6 Attribute Templates
start
AFExplorer
PI System Manageme...
PI ProcessBook - [He...
8:38 PM

PI ProcessBook - [HeatExchanger2B.PDI]

File Edit View Insert Tools Draw Arrange Window Help

AF Browser

HEAT_EXCHANGER

Elements | Templates

- Elements
  - Exchanger2
  - Exchanger3
  - Exchanger4
  - FlowMeter1

AF Property

General | Elements | Attributes | Ports

Exchanger3

Name	Value
Shell Temperature Differ...	69.9
Tube Mass Flow	801.2
Tube Side Heat Capacity	0.87 I
Tube Side Heat Duty	7676
Tube Side Inlet Tempera...	110.0
Tube Side Material	HC15
Tube Side Outlet Temper...	220.1
Tube Temperature Differ...	110.1
UC	5.378
UE	6.31 I

279.762 °F

209.771 °F

1197.67 lb/s

220.184 °F

801.272 lb/s

110.059 °F

Area:

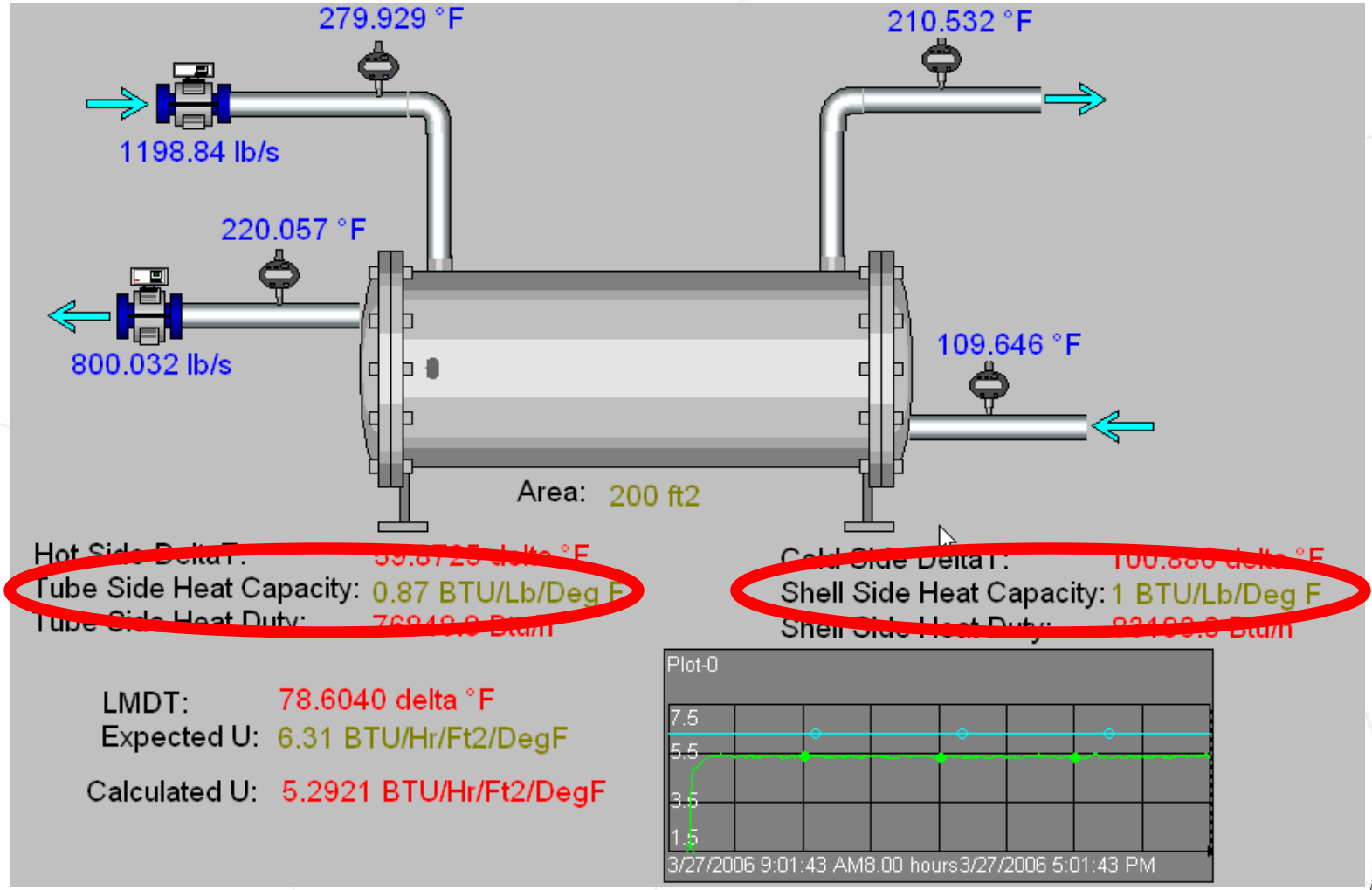
Expected U:

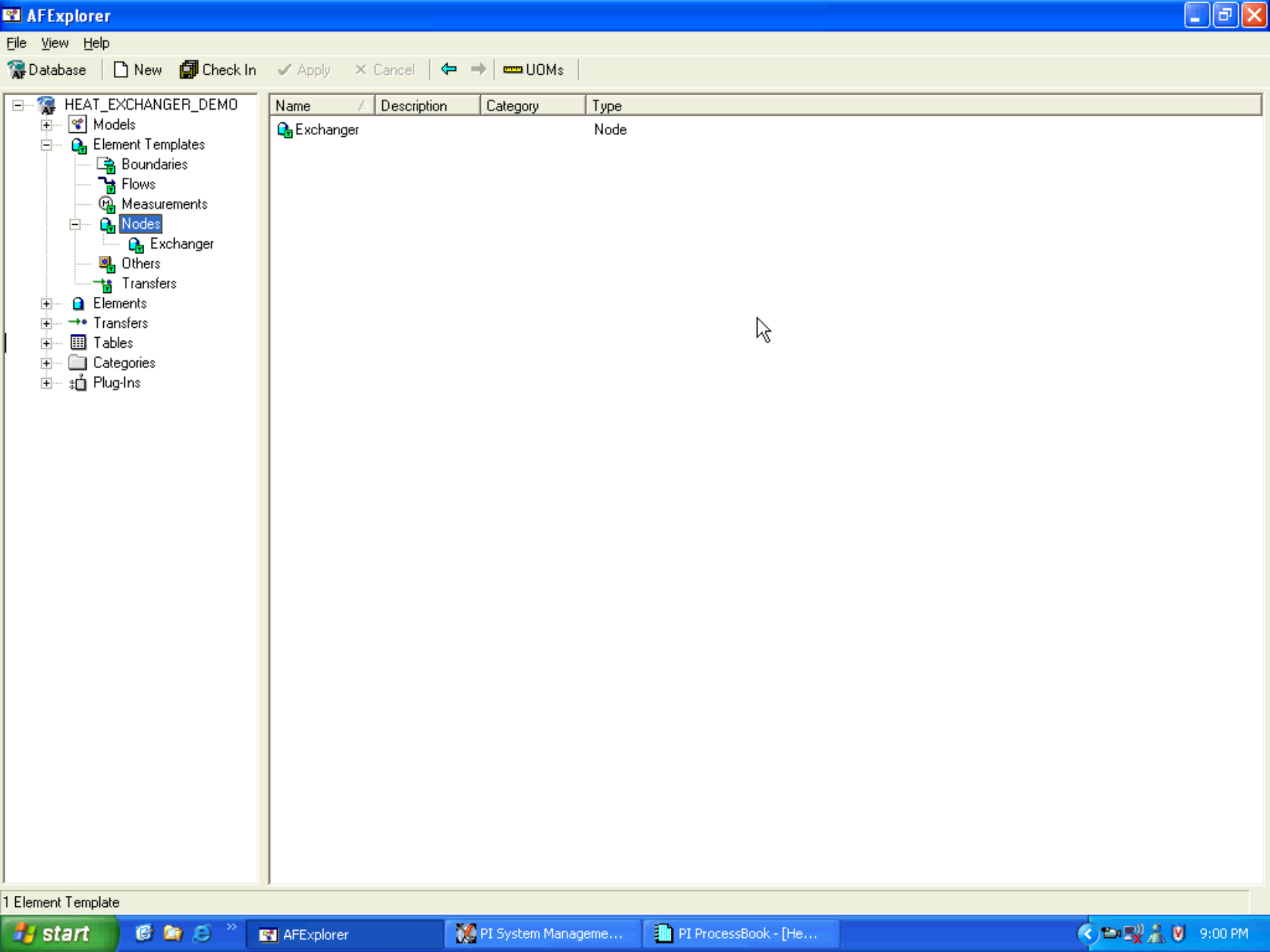
Ready

Server Time

start | AFExplorer | PI ProcessBook - [He... | 2000Server - Microso... | 5:40 PM

Step 3: Add non-PI data




AFExplorer
File View Help
Database New Check In Apply Cancel UOMs
HEAT_EXCHANGER_DEMO
Models
Element Templates
Boundaries
Flows
Measurements
Nodes
Exchanger
Others
Transfers
Elements
Transfers
Tables
Categories
Plug-Ins
Name Description Category Type
Exchanger Node
1 Element Template
start
AFExplorer
PI System Manageme...
PI ProcessBook - [He...
9:00 PM

PI ProcessBook - [HeatExchanger3B.PDI]

File Edit View Insert Tools Draw Arrange Window Help

AF Browser

HEAT_EXCHANGER

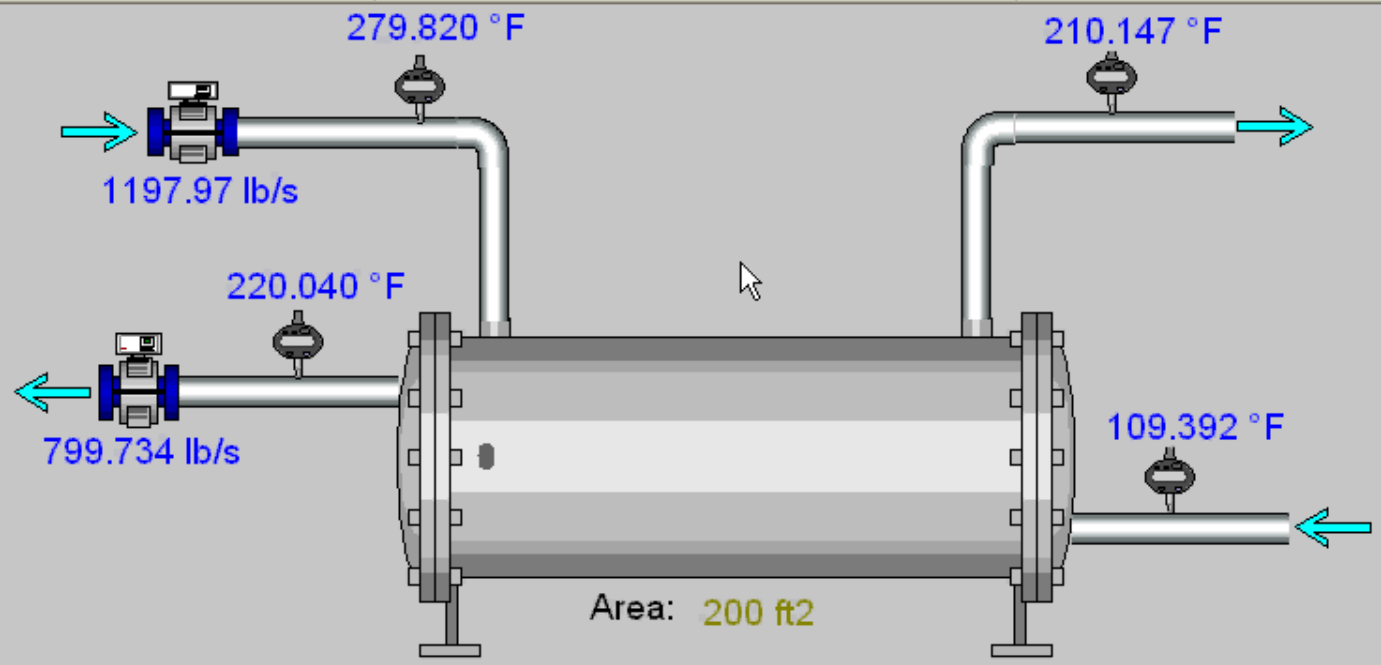
Elements Templates

AF Property

General Elements Attributes Ports

Exchanger3

Name
Area
Cold Side Temperature D...
Fouling Factor
Hot Side Temperature Di...
LMTD
Shell Mass Flow
Shell Side Heat Capacity
Shell Side Heat Duty
Shell Side Inlet Temperat...
Shell Side Material
Shell Side Outlet Temper...
Shell Temperature Differ...
Tube Mass Flow
Tube Side Heat Capacity
Tube Side Heat Duty
Tube Side Inlet Tempera...
Tube Side Material
Tube Side Outlet Temper...



Tube Side Heat Capacity:

Shell Side Heat Capacity:

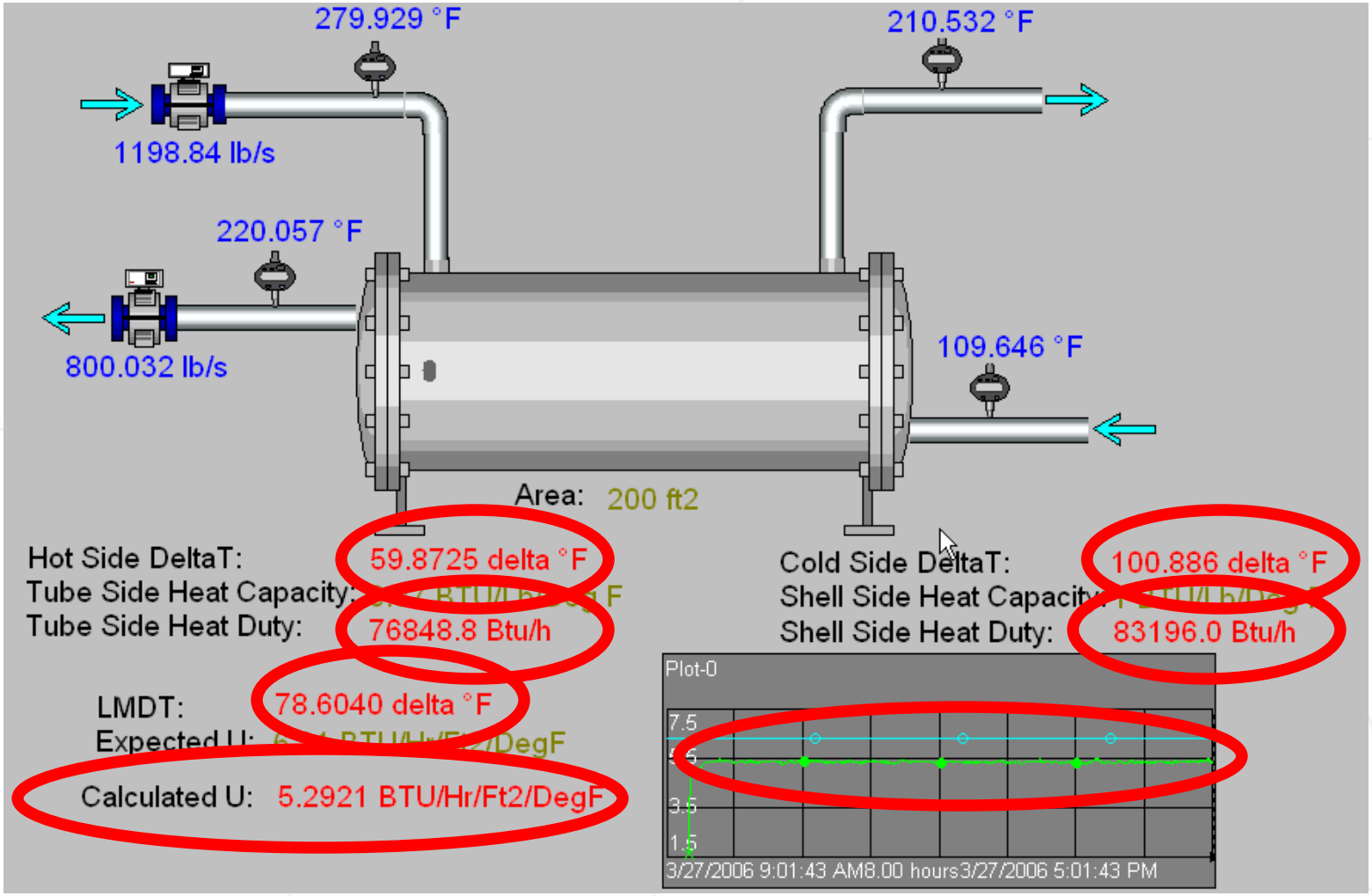
Expected U: 6.31 BTU/Hr/Ft2/DegF

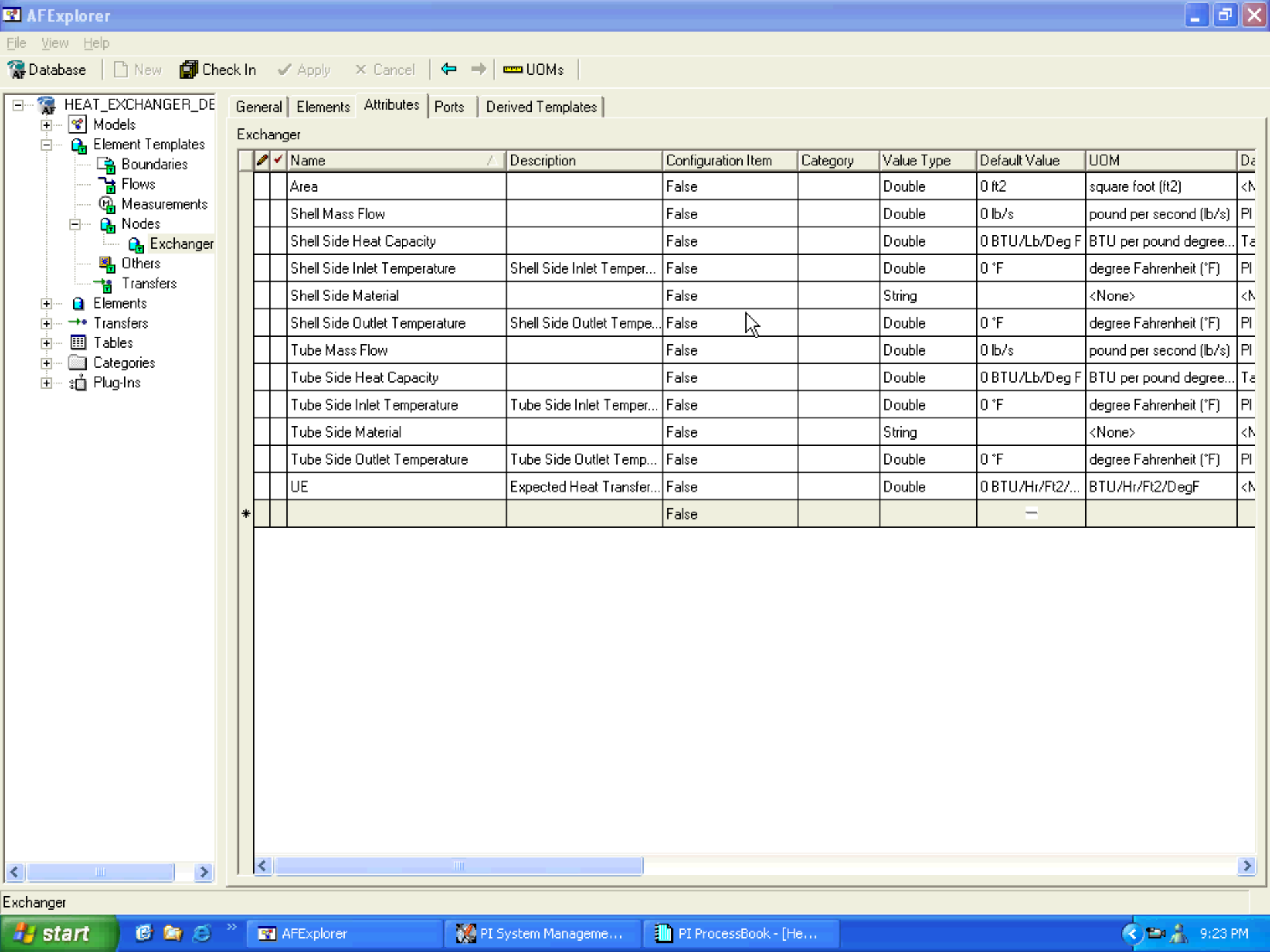
Ready

Server Time

start AFExplorer PI ProcessBook - [He... 2000Server - Microso... 5:42 PM

Step 4: Add calculations




AFExplorer
File View Help
Database New Check In Apply Cancel UOMs
HEAT_EXCHANGER_DE
Models
Element Templates
Boundaries
Flows
Measurements
Nodes
Exchanger
Others
Transfers
Elements
Transfers
Tables
Categories
Plug-Ins
General Elements Attributes Ports Derived Templates
Exchanger
Name Description Configuration Item Category Value Type Default Value UOM
Area False Double 0 ft2 square foot (ft2)
Shell Mass Flow False Double 0 lb/s pound per second (lb/s)
Shell Side Heat Capacity False Double 0 BTU/Lb/Deg F BTU per pound degree...
Shell Side Inlet Temperature Shell Side Inlet Temper... False Double 0 °F degree Fahrenheit (°F)
Shell Side Material False String <None>
Shell Side Outlet Temperature Shell Side Outlet Tempe... False Double 0 °F degree Fahrenheit (°F)
Tube Mass Flow False Double 0 lb/s pound per second (lb/s)
Tube Side Heat Capacity False Double 0 BTU/Lb/Deg F BTU per pound degree...
Tube Side Inlet Temperature Tube Side Inlet Temper... False Double 0 °F degree Fahrenheit (°F)
Tube Side Material False String <None>
Tube Side Outlet Temperature Tube Side Outlet Temp... False Double 0 °F degree Fahrenheit (°F)
UE Expected Heat Transfer... False Double 0 BTU/Hr/Ft2/... BTU/Hr/Ft2/DegF
False
Exchanger
start
AFExplorer
PI System Manageme...
PI ProcessBook - [He...
9:23 PM

PI ProcessBook - [HeatExchanger4B.PDI*]

File Edit View Insert Tools Draw Arrange Window Help

AF Browser

HEAT_EXCHANGER

Elements Templates

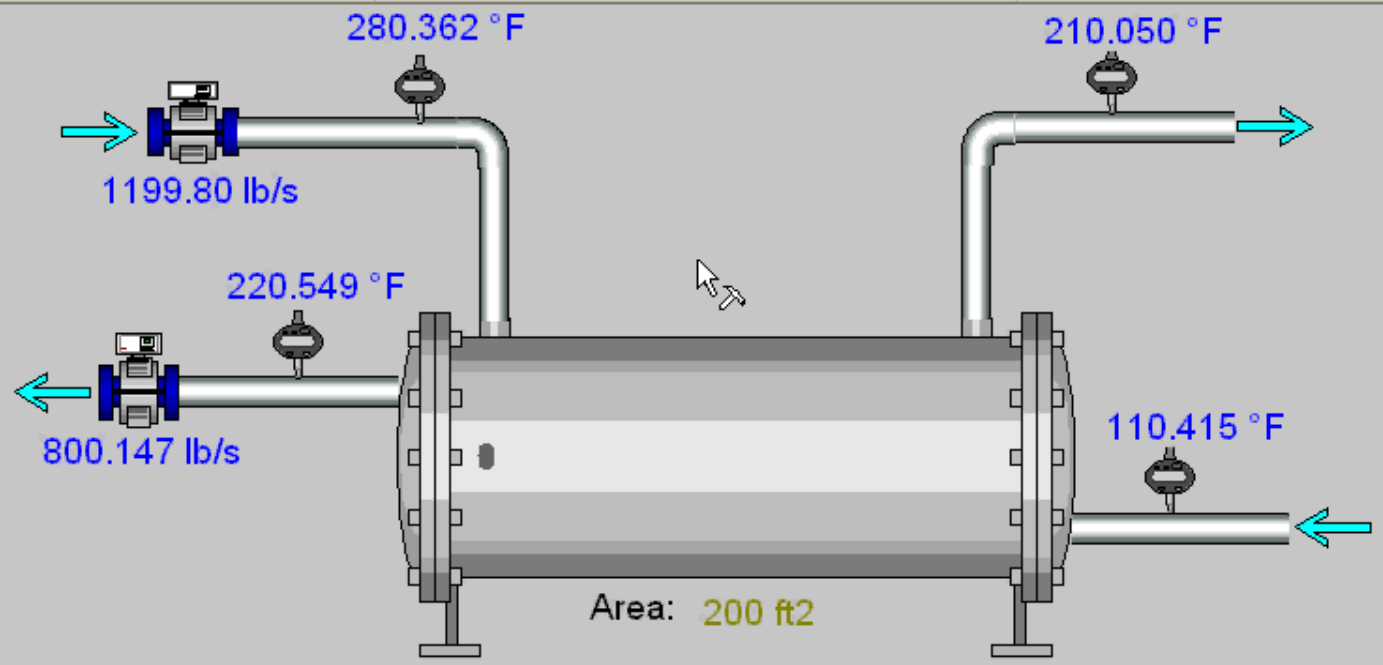
- Elements
  - Exchanger2
  - Exchanger3
  - Exchanger4
  - FlowMeter1

AF Property

General Elements Attributes Ports

Exchanger3

Name
Area
Cold Side Temperature D...
Fouling Factor
Hot Side Temperature Di...
LMTD
Shell Mass Flow
Shell Side Heat Capacity
Shell Side Heat Duty
Shell Side Inlet Temperat...
Shell Side Material
Shell Side Outlet Temper...
Shell Temperature Differ...
Tube Mass Flow
Tube Side Heat Capacity



Hot Side DeltaT:
Tube Side Heat Capacity: 0.87 BTU/Lb/Deg F
Tube Side Heat Duty:

Cold Side DeltaT:
Shell Side Heat Capacity: 1 BTU/l
Shell Side Heat Duty:

LMDT:
Expected U: 6.31 BTU/Hr/Ft2/DegF

Calculated U:

Plot-0

Ready

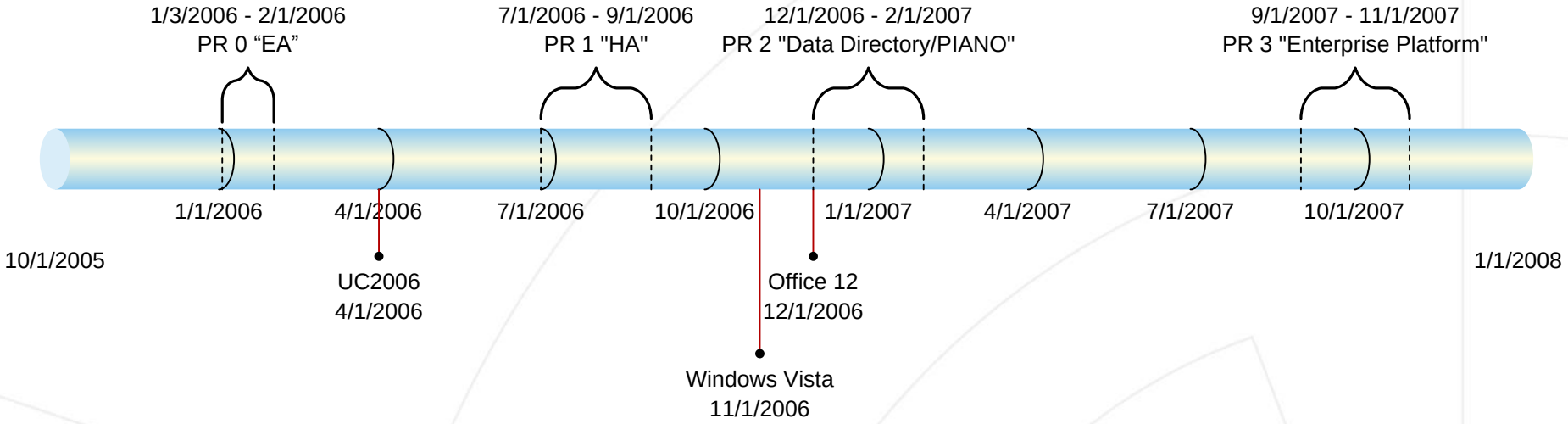
Server Time

start AFExplorer PI ProcessBook - [He... 2000Server - Microso... 5:48 PM

Demonstration Summary:

- An interesting application can be quickly configured
- The data comes from multiple sources
  - PI and external systems (Material properties)
- Application includes configured calculations
  - Temperature differences
  - Heat duty
  - Heat transfer coefficient
- The model information was applied to ProcessBook
  - Time-Series and other data
- Simple deployment and maintenance
- Demonstration was current shipping AF

Platform Release Timeline

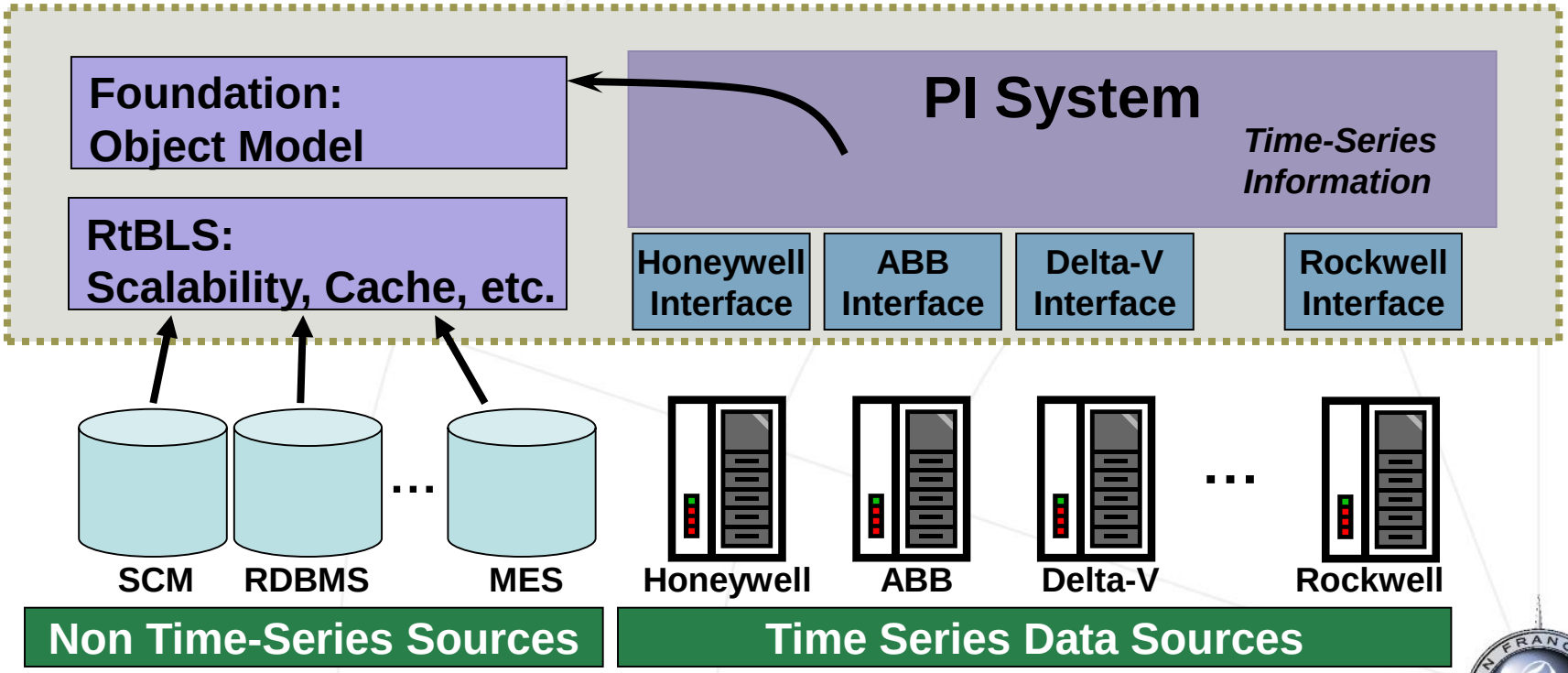


- Platform Release 2:
  - Features of AF and MDB
  - ProcessBook add-in
  - RtWebParts support
  - PI 3.5 MDB back support
  - OLEDB provider support
  - DataLink Support

- Platform Release 3:
  - Enterprise Directory
  - Batch, Event Frame support
  - Product Database
  - Integration with Data Access

A little on Data Access

- Formative stage – Platform Release 3
- The next version of RtBLS



Module Database Back-Support

- You may already use Module Database
- There are several existing clients
  - Batch
  - Module Relative Displays
- To retain this functionality:
  - MDB data will be migrated to Foundation
  - Module Database will continue to work against that data

Summary

- Foundation is:
  - The next generation of Analysis Framework
  - An application building environment on PI
- Foundation helps you:
  - Build applications
  - Build displays
- Foundation is comprised of:
  - Process Objects
  - Models and Hierarchy
  - Access to Other Data
  - Data Directory functions
  - Simple Calculations
- Useful applications can be built quickly

For more information..

- Install and use the current version of AF
- Come see us in the Demo Pod
- Tell us what you would like your PI system to do