OSIsoft.

REGIONAL SEMINAR 2012

APAC

The Power of Data

The Integration of PI and SAP to Enhance Asset Maintenance Planning

Presented by **Gutti Gudjonsson** **Contact Energy Limited - and**
Roland Rich **Dimension Software Limited**

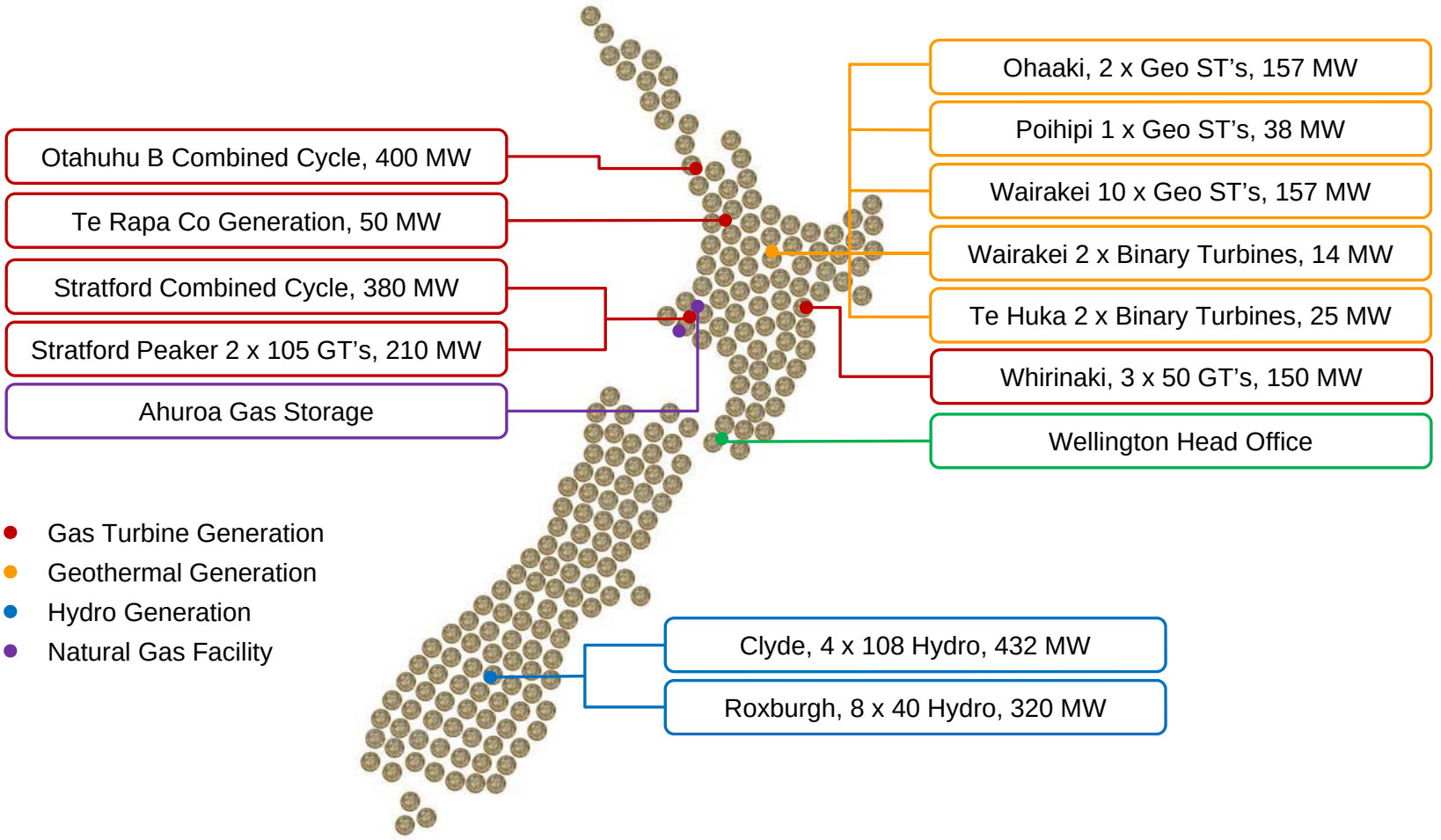
Introduction

- Gutti Gudjonsson – Production Engineer C & I
- Worked in Power Generation industry 25 years
- 20 years on gas fired, steam driven turbines
- 5 years on combined and open cycle gas turbines
- Previously 6 years in Oil and Gas industry, I & E
- 20 years exposure to PI, 15 years working with PI

Stratford Power Station

Contact Energy Limited

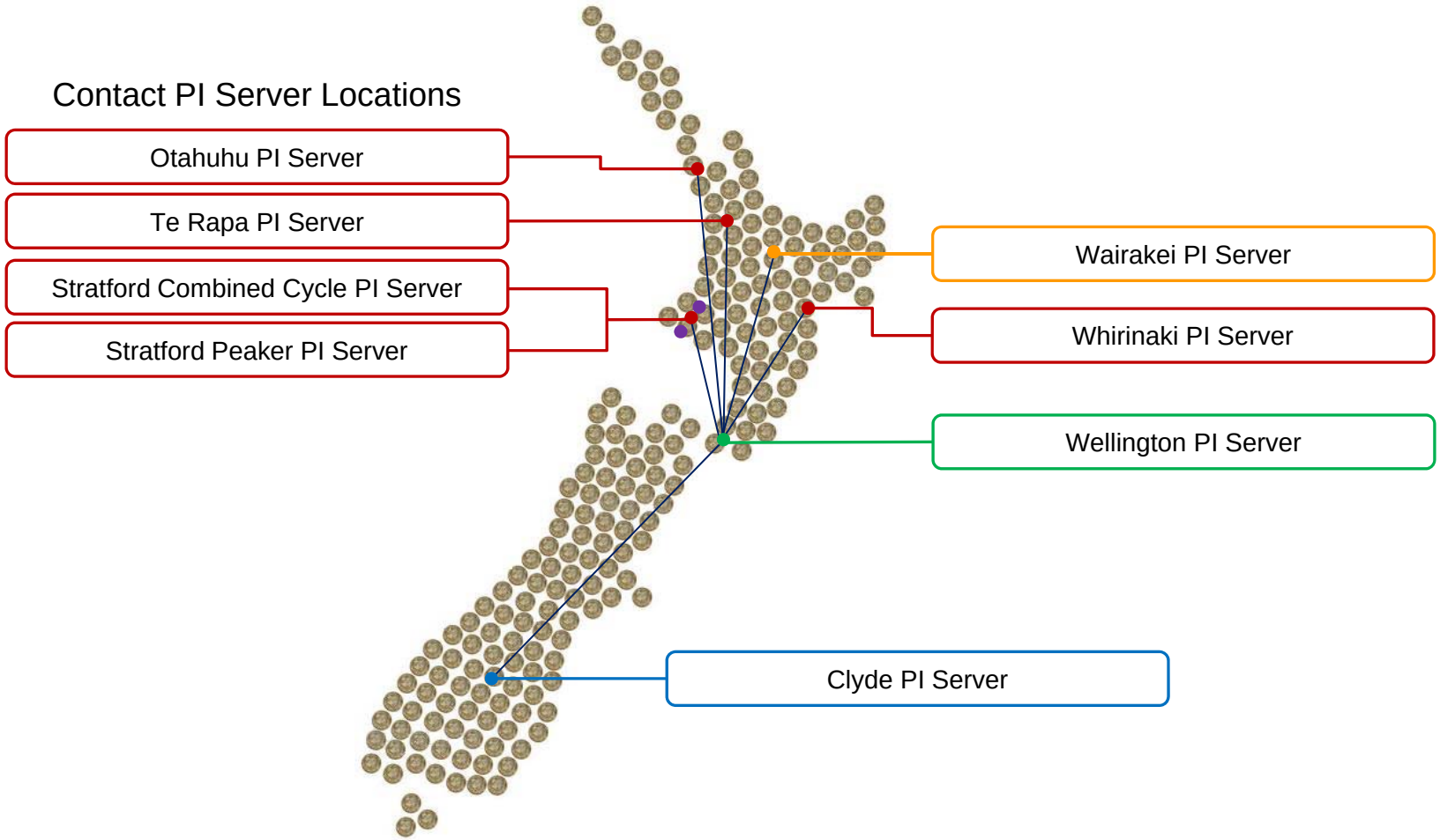
- Contact is one of New Zealand's leading energy generators and retailers
- Provide approx. 25% of N.Z. Electricity
- Also a wholesaler of Natural Gas and LPG
- In operation since 1996, previously part of ECNZ
- Origin Energy a major shareholder since 2004


Otahuhu B Combined Cycle, 400 MW
Te Rapa Co Generation, 50 MW
Stratford Combined Cycle, 380 MW
Stratford Peaker 2 x 105 GT's, 210 MW
Ahuroa Gas Storage
Ohaaki, 2 x Geo ST's, 157 MW
Poihipi 1 x Geo ST's, 38 MW
Wairakei 10 x Geo ST's, 157 MW
Wairakei 2 x Binary Turbines, 14 MW
Te Huka 2 x Binary Turbines, 25 MW
Whirinaki, 3 x 50 GT's, 150 MW
Wellington Head Office
Gas Turbine Generation
Geothermal Generation
Hydro Generation
Natural Gas Facility
Clyde, 4 x 108 Hydro, 432 MW
Roxburgh, 8 x 40 Hydro, 320 MW

Contact PI System Setup

- PI servers installed locally at main generation sites, behind firewalls
- Central PI server at Wellington Head Office
- All PI3, versions vary from 3.4.375 to PI2010

Contact PI Server Locations



Traditional PI Usage

- Traditional uses include:
  - Operations, - Plant long term trends, reporting and monitoring remote systems.
  - Engineering, - Condition monitoring, plant analysis and performance checks
  - Chemists, - Plant condition monitoring and reporting, (out of limits reporting)
  - Environmental, - Consent monitoring and reporting
  - Electricity and Gas Trading, - Real time energy flow data analysis and reconciliation
  - Management, - Plant operation, local and company wide, reporting

Reliability Centered Maintenance

- Contact Energy has been developing and rolling out it's RCM program for the last 5 years
- The objective of RCM is to raise the maturity of our maintenance approach from reactive to preventative
- RCM strategies are applied for critical assets; thereby ensuring that maintenance is carried out at the most appropriate time. Not too soon, or too late.
- Achievement of RCM objectives relies on integrated systems

New PI Opportunities

- Enterprise Resource Planning Software upgrade to **SAP** created opportunity to use real time plant information to:
  - Drive some of the condition based maintenance plans derived from the RCMO process
  - Activate plant manufacturer recommended, run hour based maintenance plans
  - Use plant data to trigger store checks or ordering
  - Transfer production values into SAP for reconciliation.

Planning and Design

- Early on, Dimension Software was identified as preferred company for the detailed design and installation work of a PI to SAP interface.
- Project planning meeting of personnel from ICT, WIPRO, Dimension Software and Contact PI administrators considered the following
    - Networking requirements, system architecture and security
    - What type of data needs to be transmitted across to SAP for each message.
    - Handshaking, confirmation of message received and processed.
    - Message filtering, i.e. don't send multiple messages for the same event. (minimum re-send time, hysteresis etc.)
    - What calculations to make available, if any in the PI-SAP interface.
    - Testing requirements, testing environment, and outcome measures.

How it Works

- Specialist New Zealand based PI system integrator since 2008
- Provide all aspects of PI integration from solution design through to implementation, software development and training
- Cover many industries including power, oil & gas, mining and pulp & paper

PI to SAP Engine

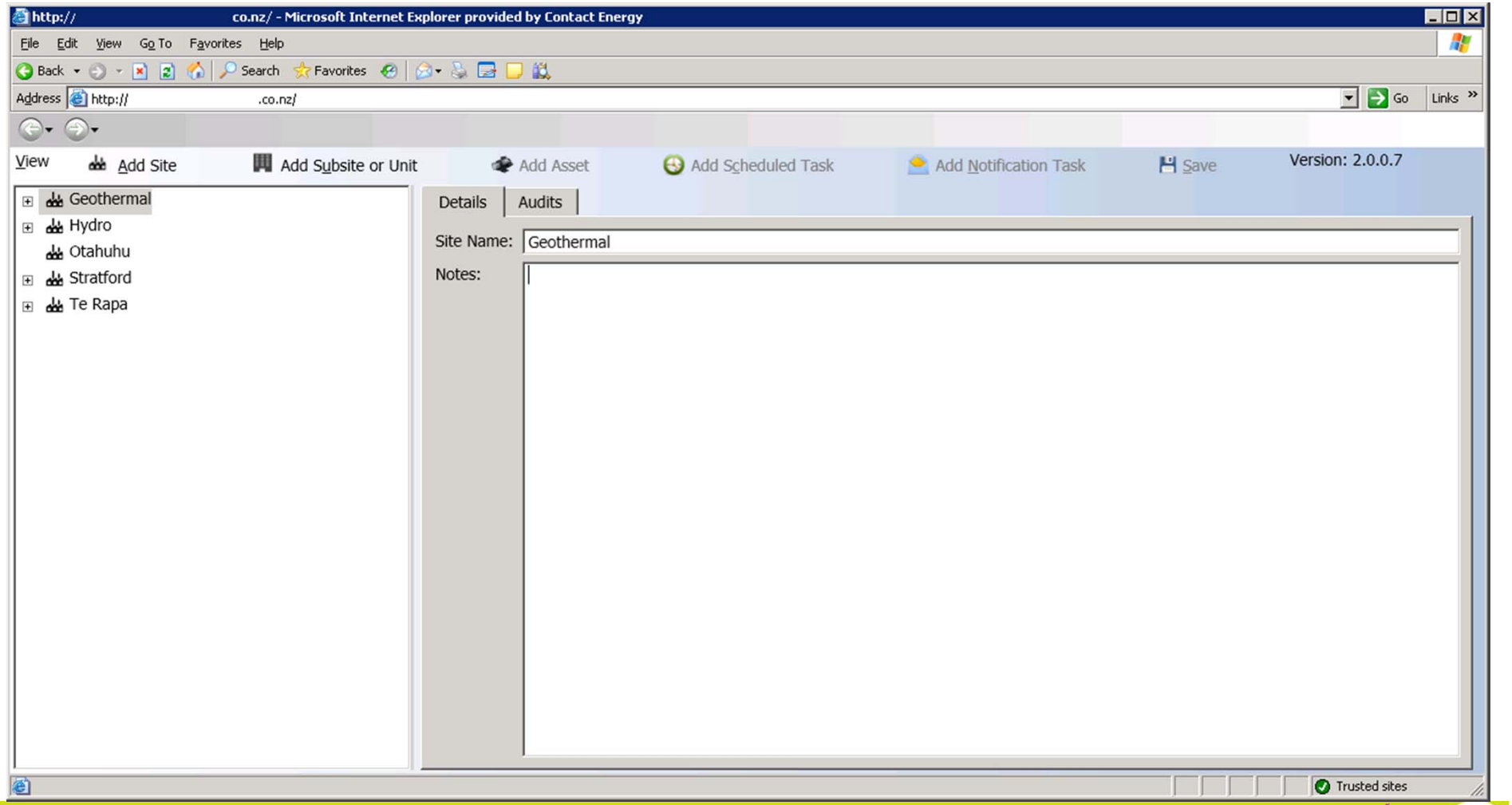
- ACE application that sends data from PI to SAP
- Scheduled Tasks – occur regularly
- Notification Tasks – triggered by a condition
- Based on the Asset Framework, using a hierarchical tree of Assets in the system

Scheduled Based Tasks

- Report to SAP on a scheduled regular interval
- Reports a PI tag value or calculation thereof (value, difference, maximum, total, count)
- Can have multiple calculation periods within one reporting period
- Examples:
  - Daily Gas Compressor Run Hours
  - Daily Circuit Breaker operations
  - Hourly Steam production reported daily

Notification Based Tasks

- Report to SAP after a condition is triggered
- Condition is a PI tag value compared against a defined value (with optional hysteresis)
- Uses the PI Notification Engine for the trigger
- Can limit send rate
- Examples:
  - Air inlet pressure > 11.75mbar
  - Flow rate < 3.2 kg/s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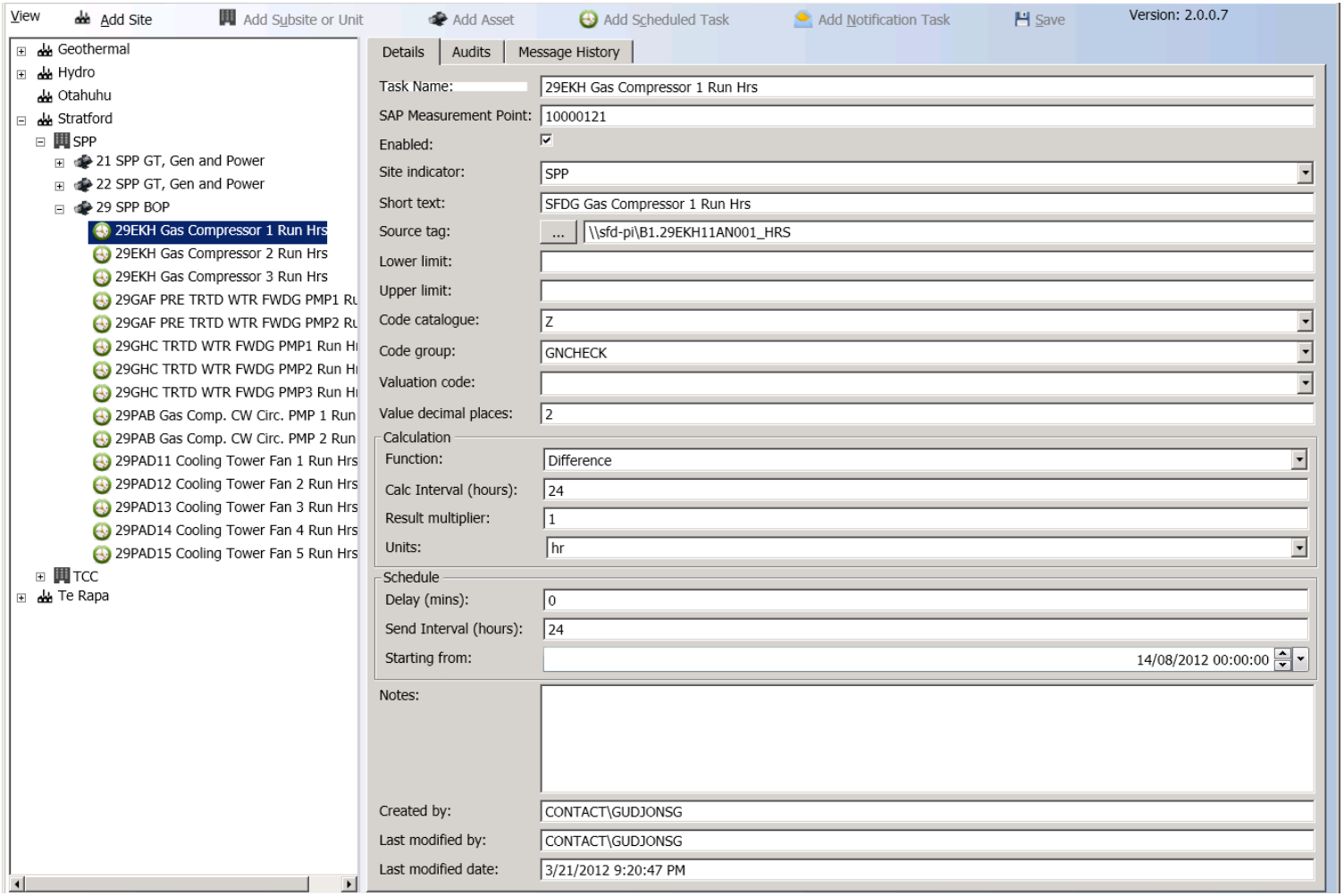
Trusted sites


View
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Geothermal
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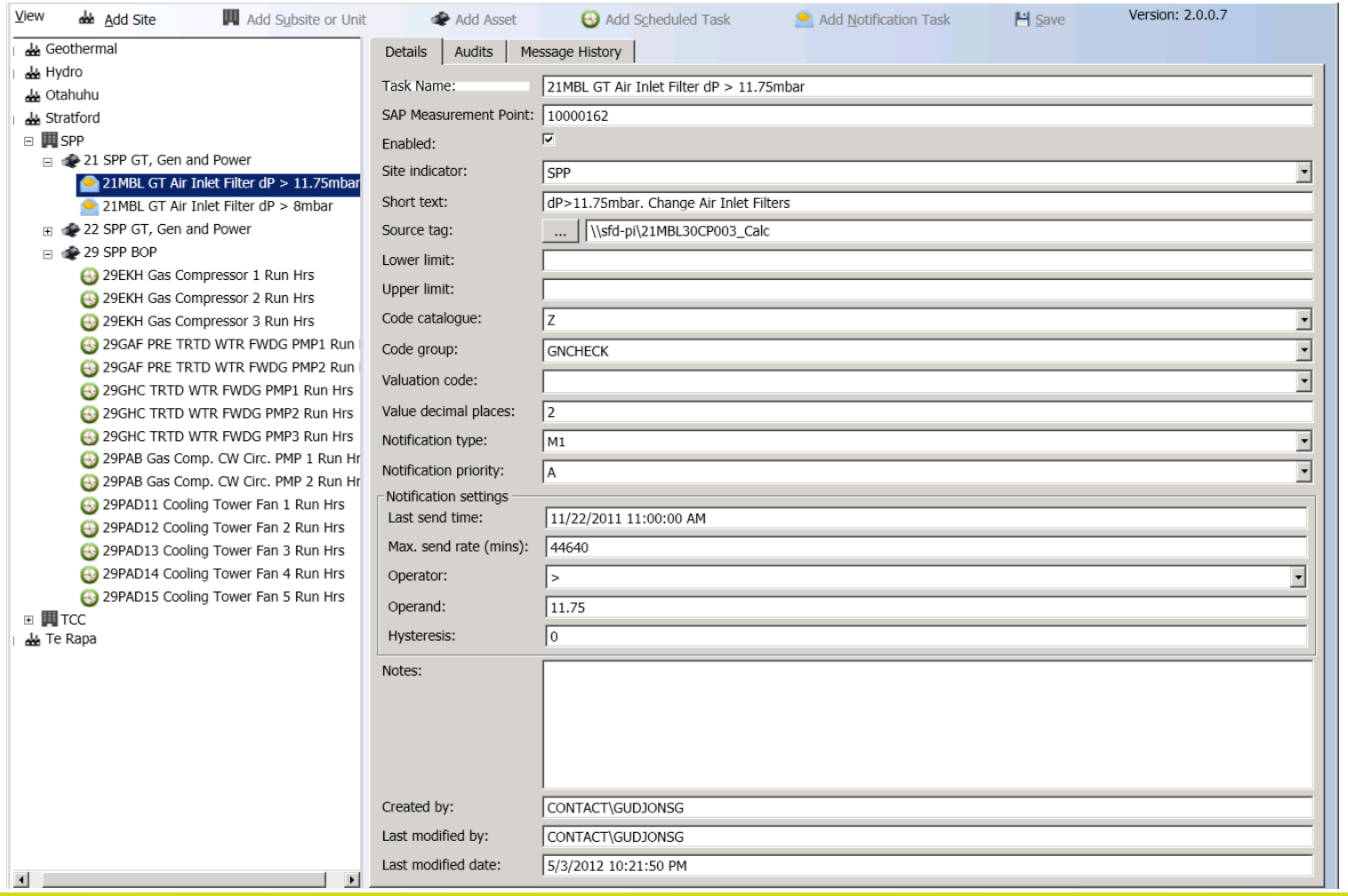
Stratford
SPP
21 SPP GT, Gen and Power
22 SPP GT, Gen and Power
29 SPP BOP
29EKH Gas Compressor 1 Run Hrs
29EKH Gas Compressor 2 Run Hrs
29EKH Gas Compressor 3 Run Hrs
29GAF PRE TRTD WTR FWDG PMP1 Ru
29GAF PRE TRTD WTR FWDG PMP2 Ru
29GHC TRTD WTR FWDG PMP1 Run Hr
29GHC TRTD WTR FWDG PMP2 Run Hr
29GHC TRTD WTR FWDG PMP3 Run Hr
29PAB Gas Comp. CW Circ. PMP 1 Run
29PAB Gas Comp. CW Circ. PMP 2 Run
29PAD11 Cooling Tower Fan 1 Run Hrs
29PAD12 Cooling Tower Fan 2 Run Hrs
29PAD13 Cooling Tower Fan 3 Run Hrs
29PAD14 Cooling Tower Fan 4 Run Hrs
29PAD15 Cooling Tower Fan 5 Run Hrs
TCC
Te Rapa
Details
Audits
Message History
Task Name: 29EKH Gas Compressor 1 Run Hrs
SAP Measurement Point: 10000121
Enabled:
Site indicator: SPP
Short text: SFDG Gas Compressor 1 Run Hrs
Source tag: ... \\sfd-pi\B1.29EKH11AN001_HRS
Lower limit:
Upper limit:
Code catalogue: Z
Code group: GNCHECK
Valuation code:
Value decimal places: 2
Calculation
Function: Difference
Calc Interval (hours): 24
Result multiplier: 1
Units: hr
Schedule
Delay (mins): 0
Send Interval (hours): 24
Starting from: 14/08/2012 00:00:00
Notes:
Created by: CONTACT\GUDJONSG
Last modified by: CONTACT\GUDJONSG
Last modified date: 3/21/2012 9:20:47 PM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SPP
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22 SPP GT, Gen and Power
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29EKH Gas Compressor 1 Run Hrs
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29GAF PRE TRTD WTR FWDG PMP1 Run
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29GHC TRTD WTR FWDG PMP1 Run Hrs
29GHC TRTD WTR FWDG PMP2 Run Hrs
29GHC TRTD WTR FWDG PMP3 Run Hrs
29PAB Gas Comp. CW Circ. PMP 1 Run Hr
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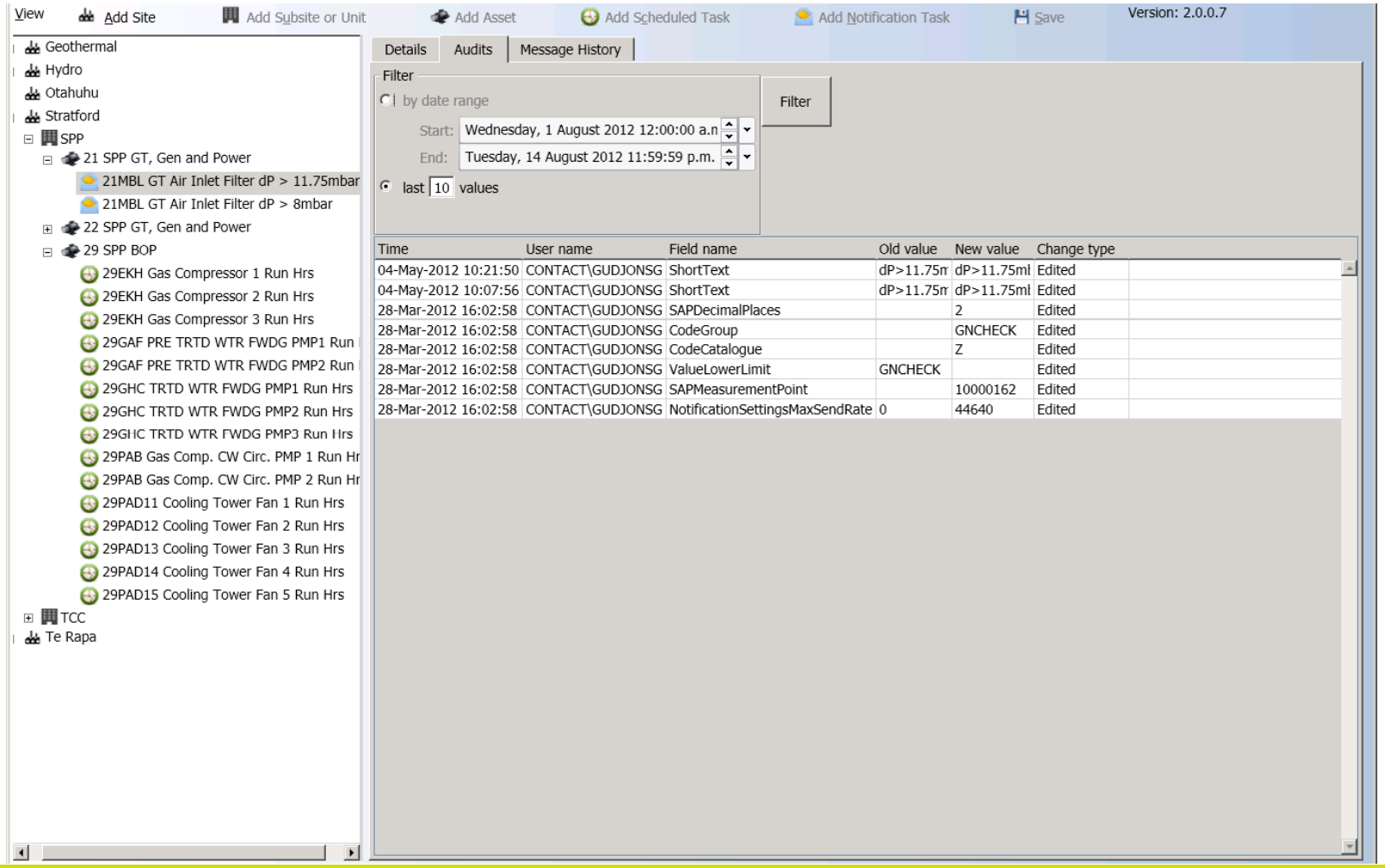
29PAD11 Cooling Tower Fan 1 Run Hrs
29PAD12 Cooling Tower Fan 2 Run Hrs
29PAD13 Cooling Tower Fan 3 Run Hrs
29PAD14 Cooling Tower Fan 4 Run Hrs
29PAD15 Cooling Tower Fan 5 Run Hrs
TCC
Te Rapa
Details
Audits
Message History
Task Name: 21MBL GT Air Inlet Filter dP > 11.75mbar
SAP Measurement Point: 10000162
Enabled:
Site indicator: SPP
Short text: dP>11.75mbar. Change Air Inlet Filters
Source tag: ... \\sfd-pi\21MBL30CP003_Calc
Lower limit:
Upper limit:
Code catalogue: Z
Code group: GNCHECK
Valuation code:
Value decimal places: 2
Notification type: M1
Notification priority: A
Notification settings
Last send time: 11/22/2011 11:00:00 AM
Max. send rate (mins): 44640
Operator: >
Operand: 11.75
Hysteresis: 0
Notes:
Created by: CONTACT\GUDJONSG
Last modified by: CONTACT\GUDJONSG
Last modified date: 5/3/2012 10:21:50 PM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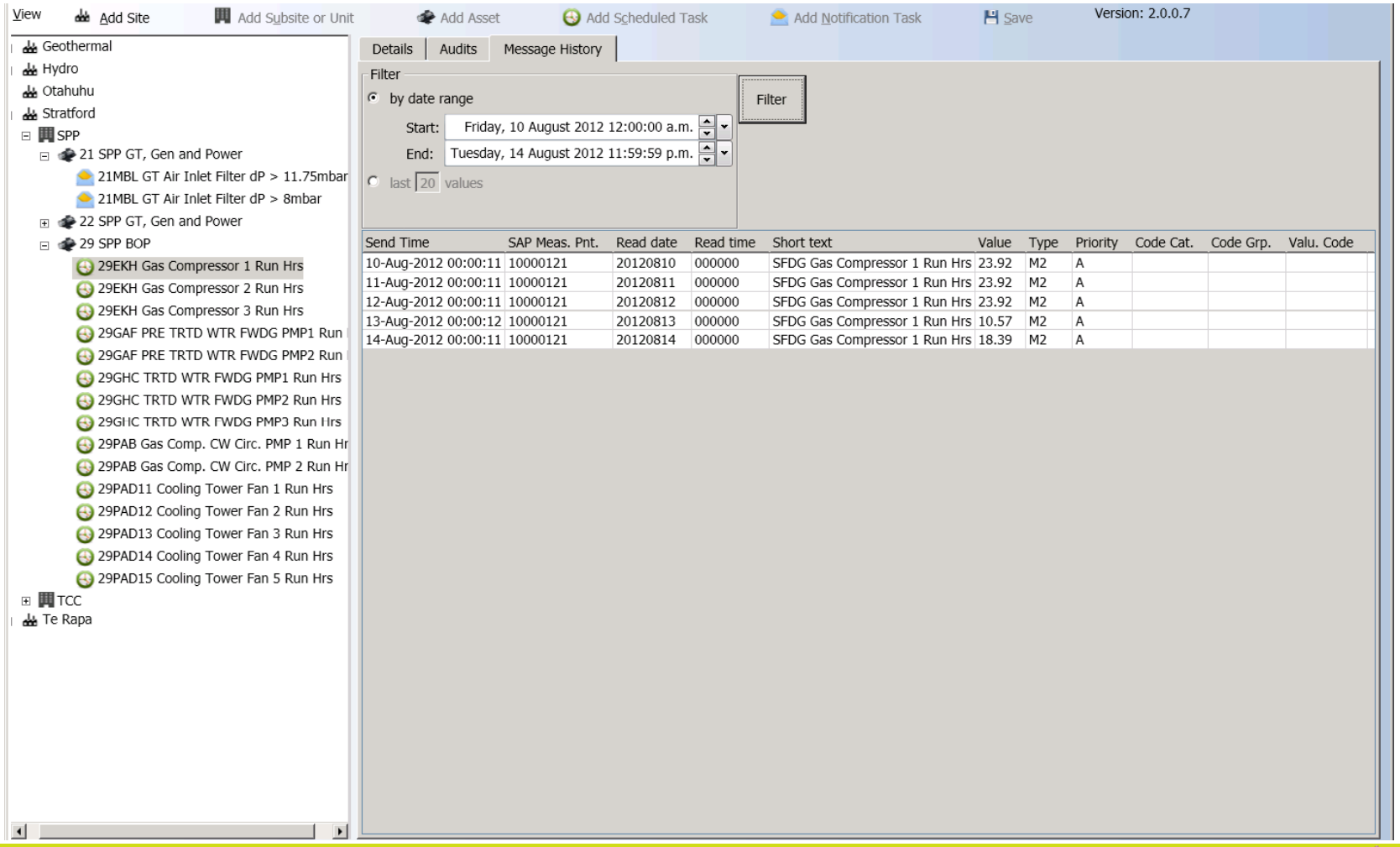
Details
Audits
Message History
Filter
by date range
Start: Wednesday, 1 August 2012 12:00:00 a.n
End: Tuesday, 14 August 2012 11:59:59 p.m.
last 10 values
Filter
Time
User name
Field name
Old value
New value
Change type
04-May-2012 10:21:50 CONTACT\GUDJONSG ShortText dP>11.75r dP>11.75ml Edited
04-May-2012 10:07:56 CONTACT\GUDJONSG ShortText dP>11.75r dP>11.75ml Edited
28-Mar-2012 16:02:58 CONTACT\GUDJONSG SAPDecimalPlaces 2 Edited
28-Mar-2012 16:02:58 CONTACT\GUDJONSG CodeGroup GNCHECK Edited
28-Mar-2012 16:02:58 CONTACT\GUDJONSG CodeCatalogue Z Edited
28-Mar-2012 16:02:58 CONTACT\GUDJONSG ValueLowerLimit GNCHECK Edited
28-Mar-2012 16:02:58 CONTACT\GUDJONSG SAPMeasurementPoint 10000162 Edited
28-Mar-2012 16:02:58 CONTACT\GUDJONSG NotificationSettingsMaxSendRate 0 44640 Edited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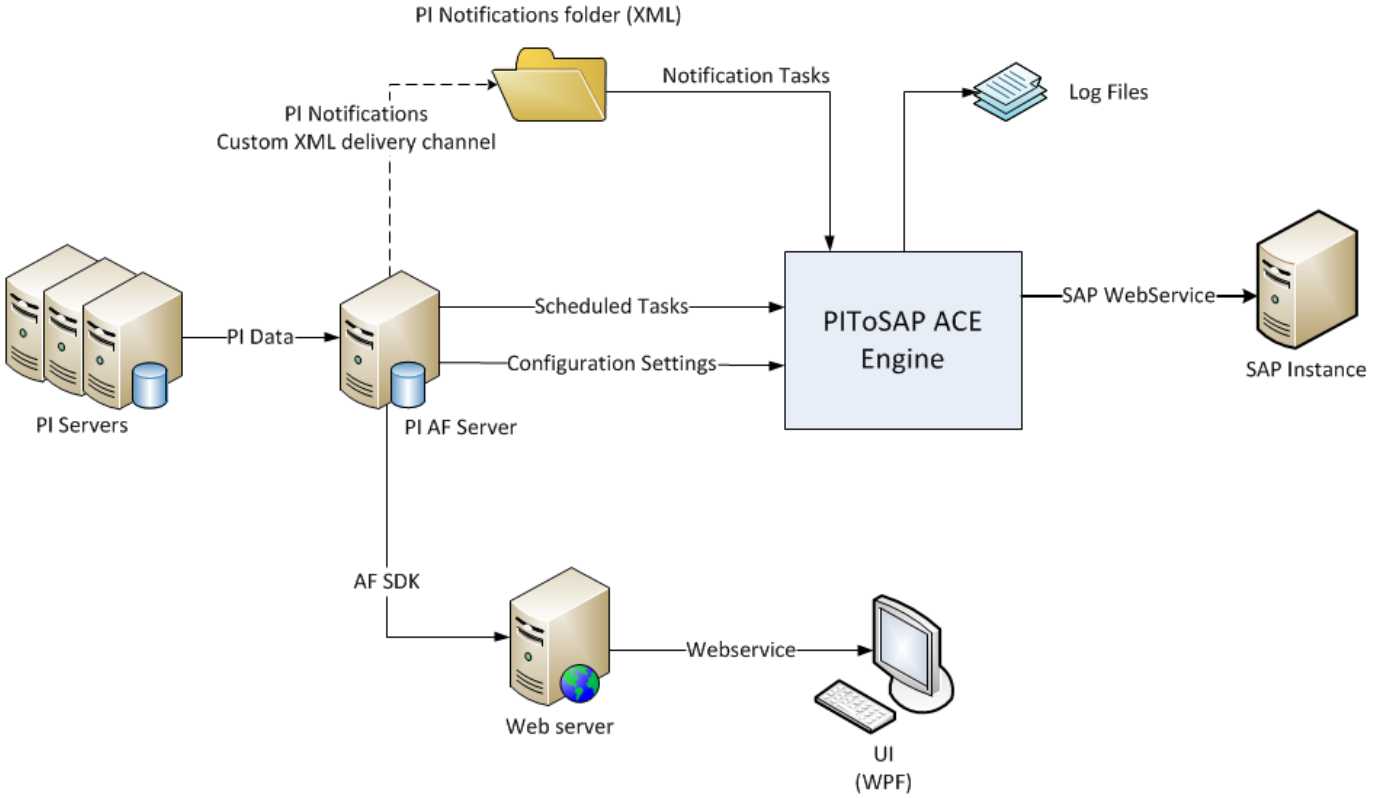
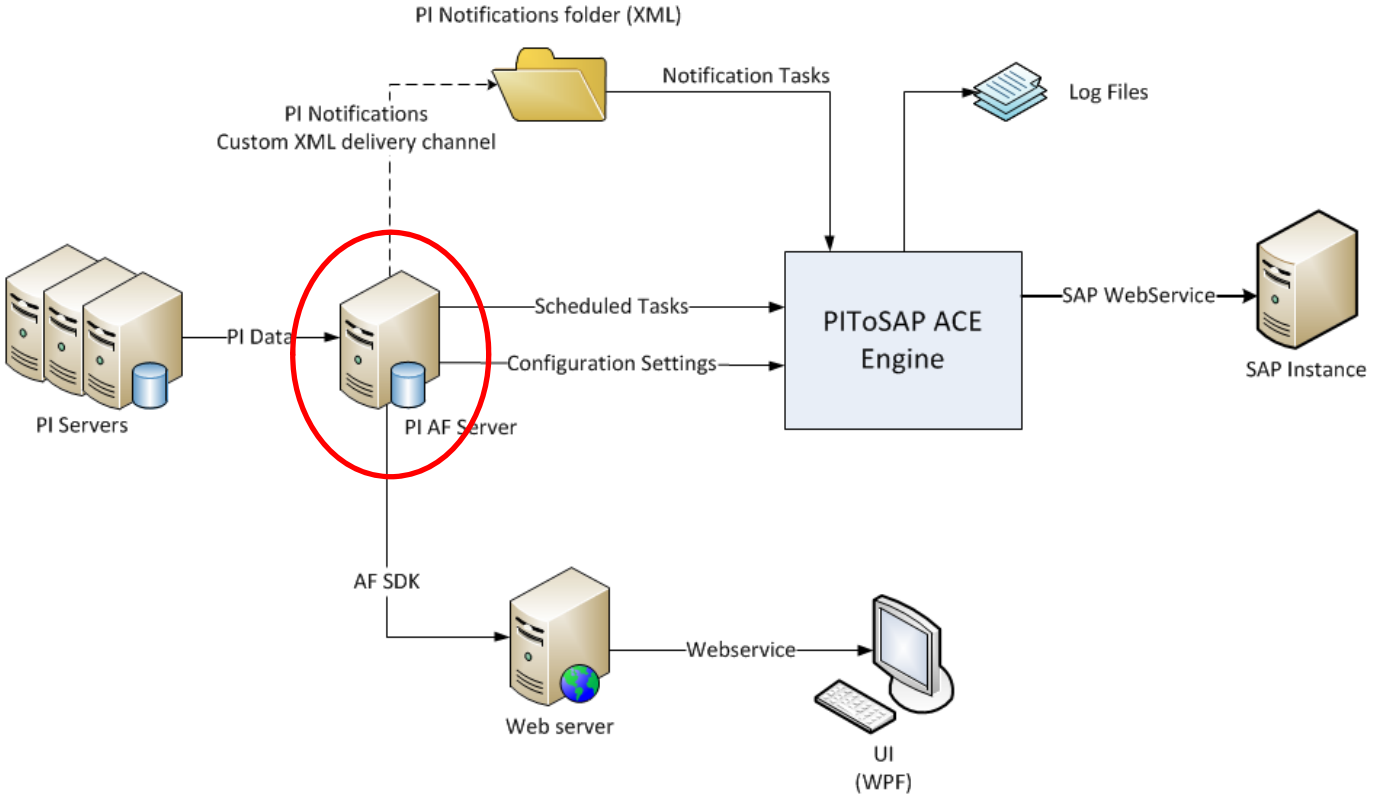
29PAD14 Cooling Tower Fan 4 Run Hrs
29PAD15 Cooling Tower Fan 5 Run Hrs
TCC
Te Rapa
Details
Audits
Message History
Filter
by date range
Start: Friday, 10 August 2012 12:00:00 a.m.
End: Tuesday, 14 August 2012 11:59:59 p.m.
last 20 values
Filter
Send Time SAP Meas. Pnt. Read date Read time Short text Value Type Priority Code Cat. Code Grp. Valu. Code
10-Aug-2012 00:00:11 10000121 20120810 000000 SFDG Gas Compressor 1 Run Hrs 23.92 M2 A
11-Aug-2012 00:00:11 10000121 20120811 000000 SFDG Gas Compressor 1 Run Hrs 23.92 M2 A
12-Aug-2012 00:00:11 10000121 20120812 000000 SFDG Gas Compressor 1 Run Hrs 23.92 M2 A
13-Aug-2012 00:00:12 10000121 20120813 000000 SFDG Gas Compressor 1 Run Hrs 10.57 M2 A
14-Aug-2012 00:00:11 10000121 20120814 000000 SFDG Gas Compressor 1 Run Hrs 18.39 M2 A

PI to SAP Architecture



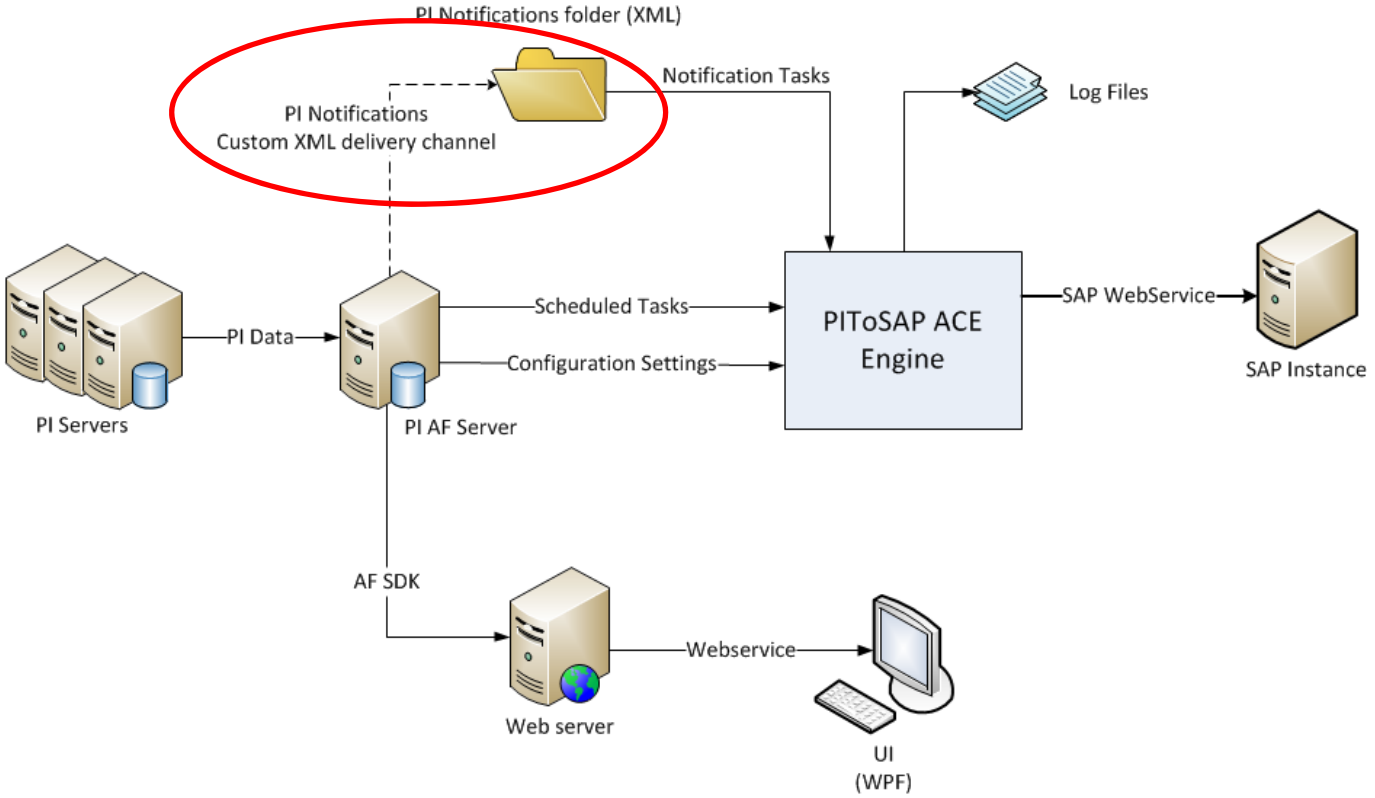
PI to SAP Architecture



Component Detail – Asset Framework

- Asset Framework (AF) is used to store all the configuration details
- Hierarchical structure of all the Contact sites, assets within those sites, and the tasks for each asset
- Each task includes SAP specific data as well as the notification or scheduling configuration
- AF Server spans numerous site-based PI servers

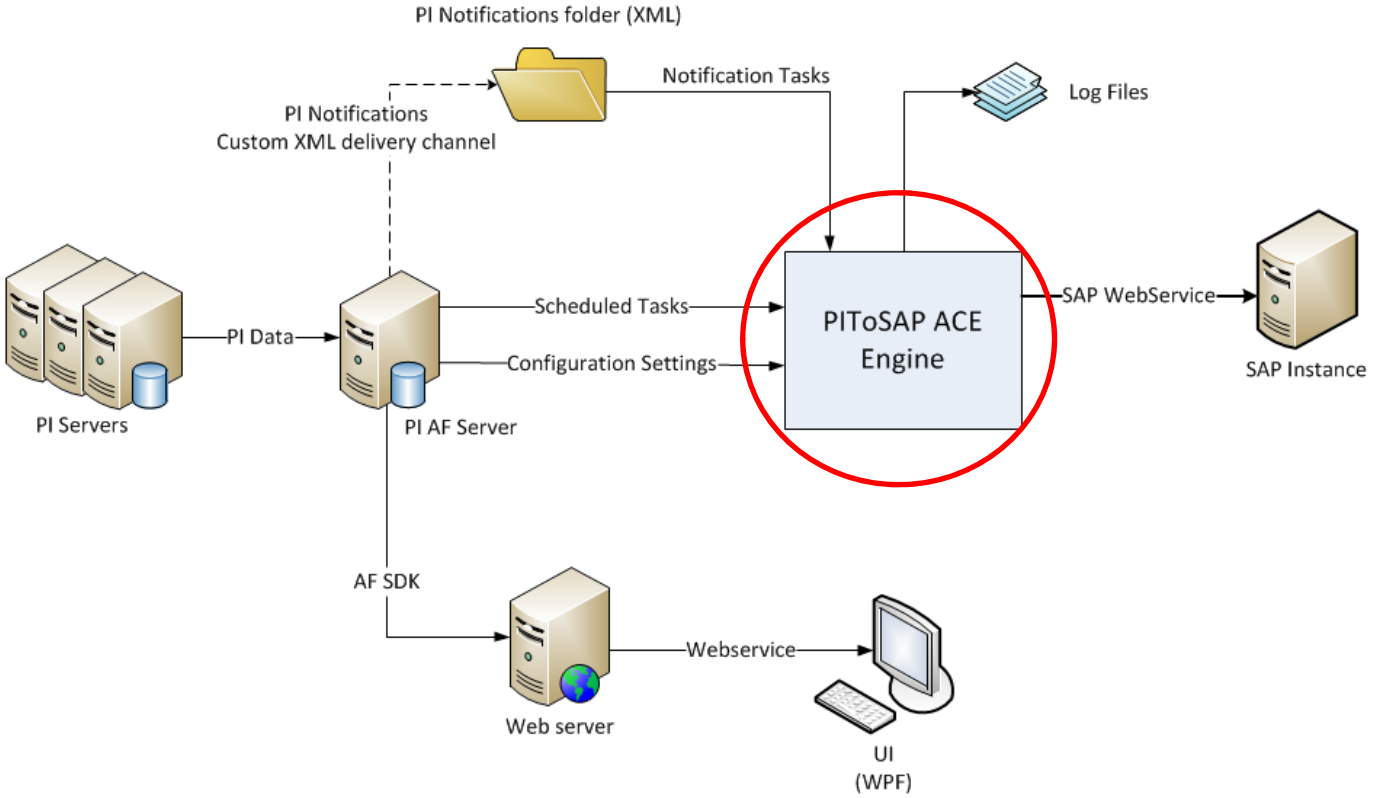
PI to SAP Architecture



Component Detail – Notifications

- PI Notifications used as the engine for the event based Notification Tasks
- PI Notifications created dynamically through the PI Notifications SDK when Notification tasks are created by the user in the UI
- PI Notifications creates XML files via a custom delivery channel for each triggered notification
- These files are then processed by the PIToSAP engine

PI to SAP Architecture



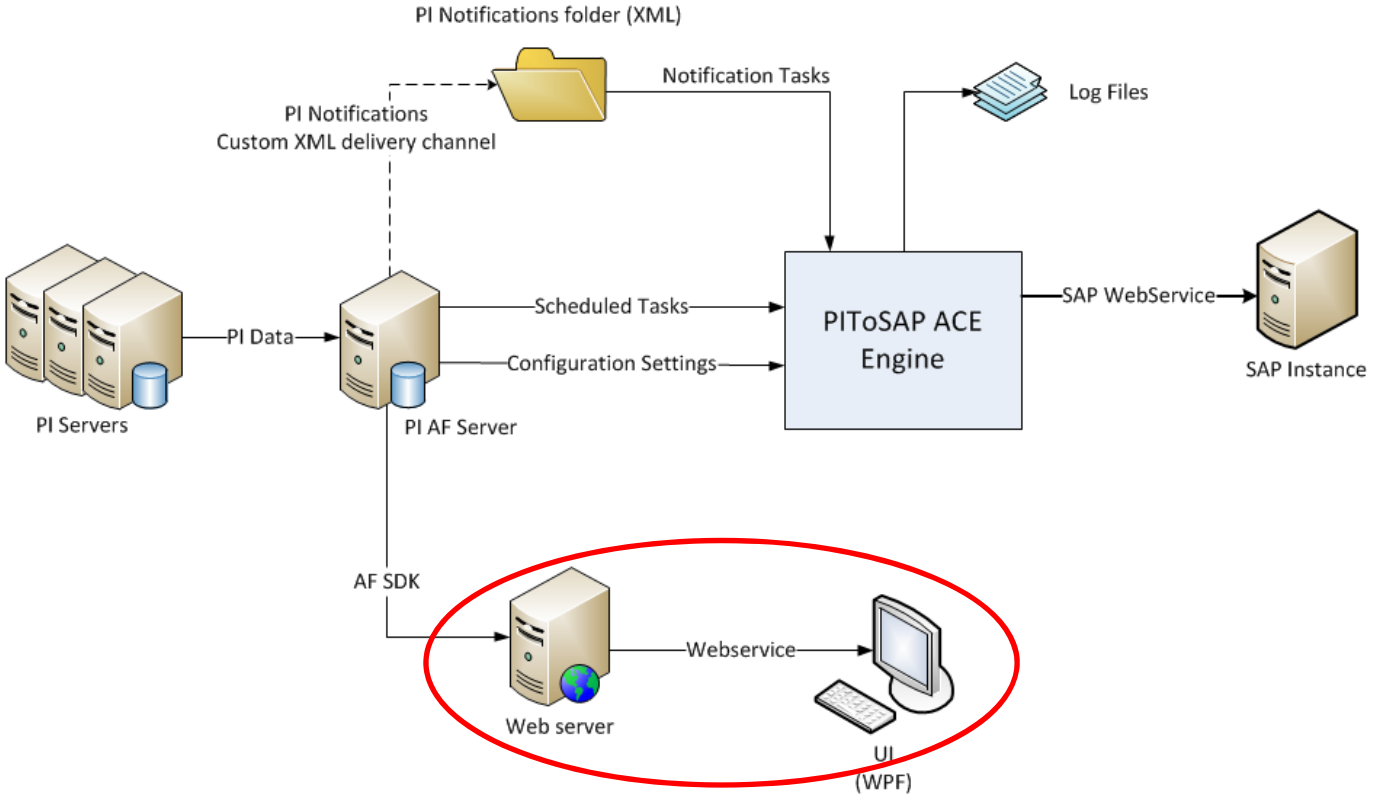
Component Detail – PIToSAP Engine

- Advanced Calculation Engine (ACE) used as the Framework for the PIToSAP engine
- ACE provides scheduling for the engine
- Engine monitors for Notification XML files and runs Scheduled Tasks as scheduled
- Generates a message and ‘pushes’ it to SAP through the SAP webservice. This may then become an SAP work order.

Component Detail – Totalisers

- PIToSAP makes extensive use of Totaliser tags (such as breaker operations, steam production or run hours)
- UI has functionality to create Totaliser Tags in PI
- Abstracts and simplifies the Totaliser tag creation process, especially for non-technical users

PI to SAP Architecture



Component Detail – User Interface

- User Interface is a browser based application
- No installs required on user's machine
- Utilises WPF (Windows Presentation Foundation) technology
- Gets AF data through a custom webservice, preventing the need for the AF SDK on the client machine
- Effectively acts as a front end for AF

Project Structure

- Requirements gathering
- Design workshops
- Development with regular user feedback
- Deployment
- Testing (UAT)
- Go live

Challenges

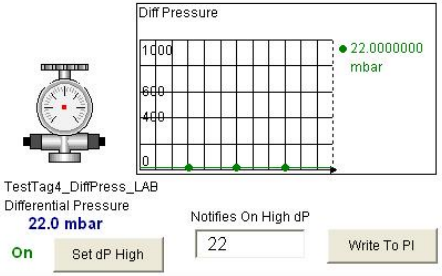
- Security via WPF
- UI presentation
- Working with the PI Notifications SDK

Test Planning

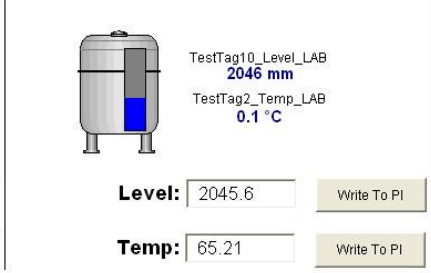
- Test environment created in both PI and SAP
- Test PI tags created on site server, allowing manual input
- Test Measuring Points created in SAP Test Environment
- Test PI Graphic created in PI Processbook, allowing manual entries
- Send message triggers for all types of tags through from the Processbook graphic and observe Measurement Documents being created in SAP for the appropriate Measuring Point.
- Apply filters and observe effects on data transmission

PI to SAP Simulator

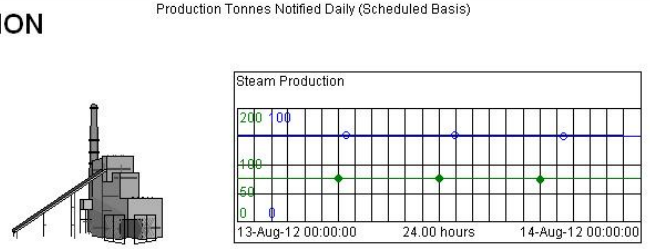
Simulation



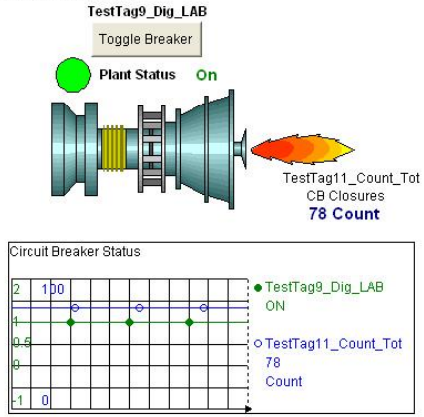
Simulation



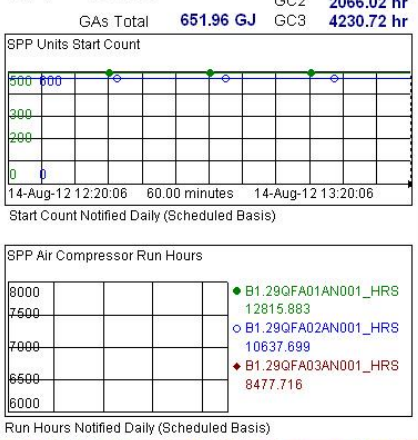
TENON



Simulation



SPP - GT21



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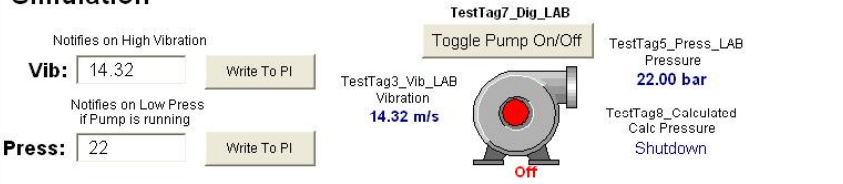


PI To SAP Engine - Actions

PI to SAP Engine Running

14/08/2012 1:00:11 p.m. - fc06ebd0-051a-43dd-a4b0-3203ed0fad7e|.\Stratford\TCC\29EKH Gas Comp\SPP Gas Compressor 1 Run Hours|SPP Gas Compressor 1 Run Hours|10000121|20120814|
14/08/2012 12:00:13 p.m. - fc06ebd0-051a-43dd-a4b0-3203ed0fad7e|.\Stratford\TCC\29EKH Gas Comp\SPP Gas Compressor 1 Run Hours|SPP Gas Compressor 1 Run Hours|10000121|20120814
14/08/2012 12:00:12 p.m. - 9314e87a-7c9d-4458-b32b-638fad647abe|.\Te Rapa\Demin Plant\Demin Tank\Demin Tank Level|Demin Tank Level|10000165|20120814|120000|Tank Level|2046|M2|A|||
14/08/2012 12:00:11 p.m. - 9314e87a-7c9d-4458-b32b-638fad647abe|.\Te Rapa\Demin Plant\Demin Tank\Demin Tank Level|Demin Tank Level|10000165|20120814|110000|Tank Level|2046|M2|A|||
14/08/2012 11:00:11 a.m. - fc06ebd0-051a-43dd-a4b0-3203ed0fad7e|.\Stratford\TCC\29EKH Gas Comp\SPP Gas Compressor 1 Run Hours|SPP Gas Compressor 1 Run Hours|10000121|20120814
14/08/2012 10:00:13 a.m. - fc06ebd0-051a-43dd-a4b0-3203ed0fad7e|.\Stratford\TCC\29EKH Gas Comp\SPP Gas Compressor 1 Run Hours|SPP Gas Compressor 1 Run Hours|10000121|20120814
14/08/2012 10:00:12 a.m. - 9314e87a-7c9d-4458-b32b-638fad647abe|.\Te Rapa\Demin Plant\Demin Tank\Demin Tank Level|Demin Tank Level|10000165|20120814|100000|Tank Level|2046|M2|A|||
14/08/2012 10:00:11 a.m. - 9314e87a-7c9d-4458-b32b-638fad647abe|.\Te Rapa\Demin Plant\Demin Tank\Demin Tank Level|Demin Tank Level|10000165|20120814|090000|Tank Level|2046|M2|A|||

PI Test Graphic

Test Results

- User Acceptance Tests were performed by 1 person from Dimension Software and 2 from Contact Energy.
- Several issues / problems were found during the testing, but these were all promptly fixed by Dimension Software or WIPRO engineers
- UAT was completed in 2 to 3 days
- Further on-line tests were performed once we shifted the applications from the test environment to the production environment.

Issues found

- There were several issues found during tests.

  Here are typical examples:

  - Date and Time format in message need to be yyyymmdd hhmmss
  - Number of decimal places in value sent needs to be no more than set up in SAP MP
  - Calculated PI Tag did not trigger an SAP Notification initially
  - Buffering needed in PI for messages not successfully sent to SAP
  - SAP Server would receive messages, but unable to process multiple messages fast enough

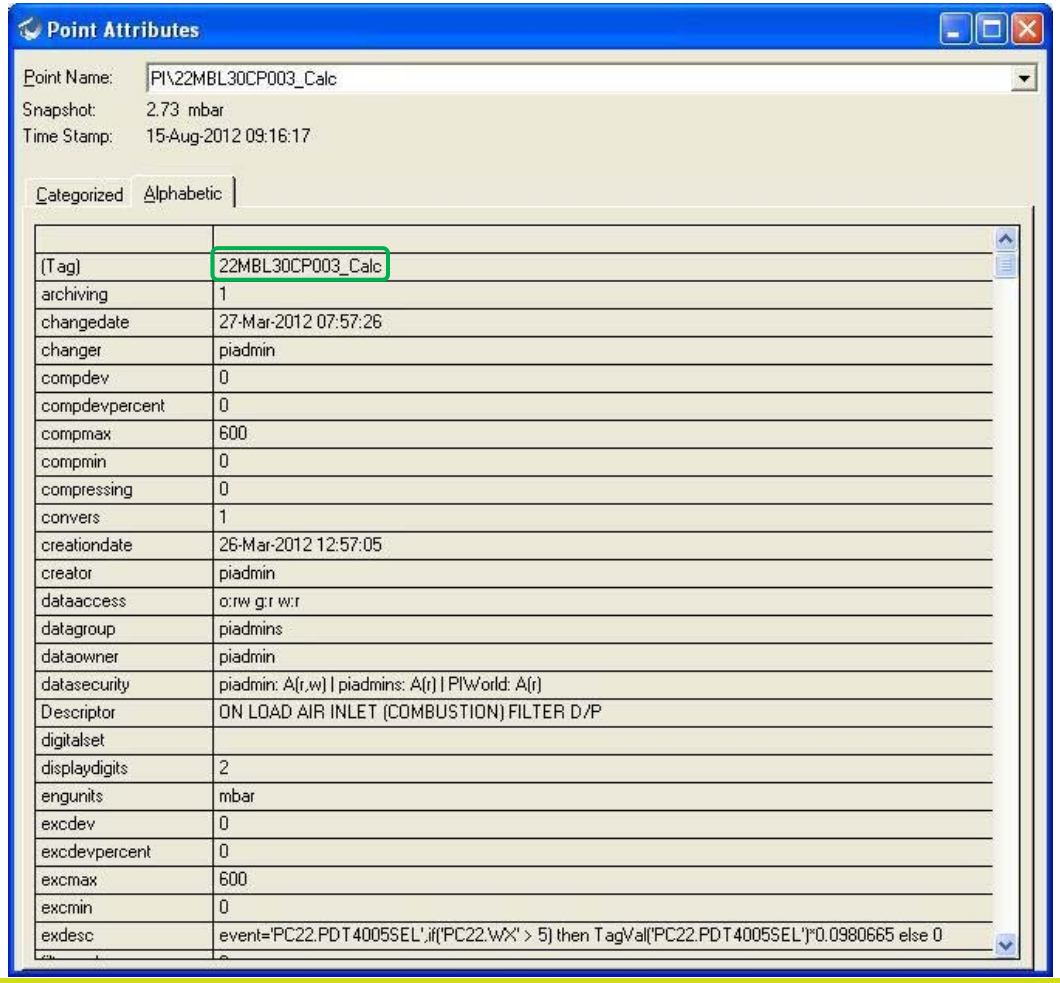
- All issues were resolved

Working Example

- Run Hours and Counters are successfully transferred to SAP daily
- Condition based on analogue value, processed through a PI Calculated tag has now come through once successfully.

Here is an actual example how the system works:

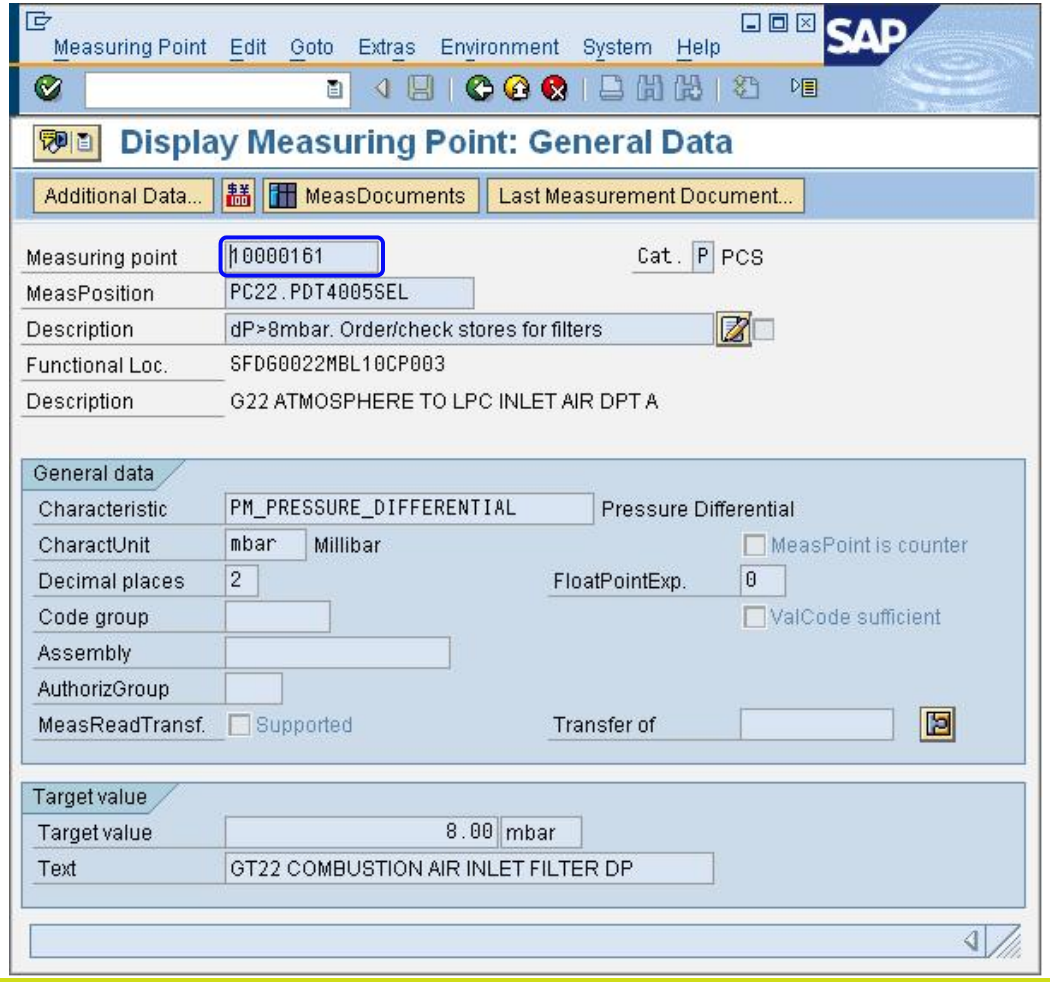
- A Calculated PI Tag was created using Differential Pressure across GT Air Intake Filter
- As we are only interested in the dP when the unit is running, we filter on MW > 5
- As the base dP Tag EU are in mm H_2O and we want the results in mbar we multiply by 0.09806
- 22MBL30CP003_Calc = if('PC22.WX' > 5) then TagVal('PC22.PDT4005SEL')*0.0980665 else 0
- SAP Master Data Team created a Measuring Point (MP) to write to in SAP
- A PI to SAP configuration was performed using PI to SAP interface
- The air filter dP rises above a pre-set value (8mbar), and PI sends a message to MP
- SAP creates a Notification and sends it to the Maintenance Planner



Working Example

Step 1. - In PI

Calculated Tag Created

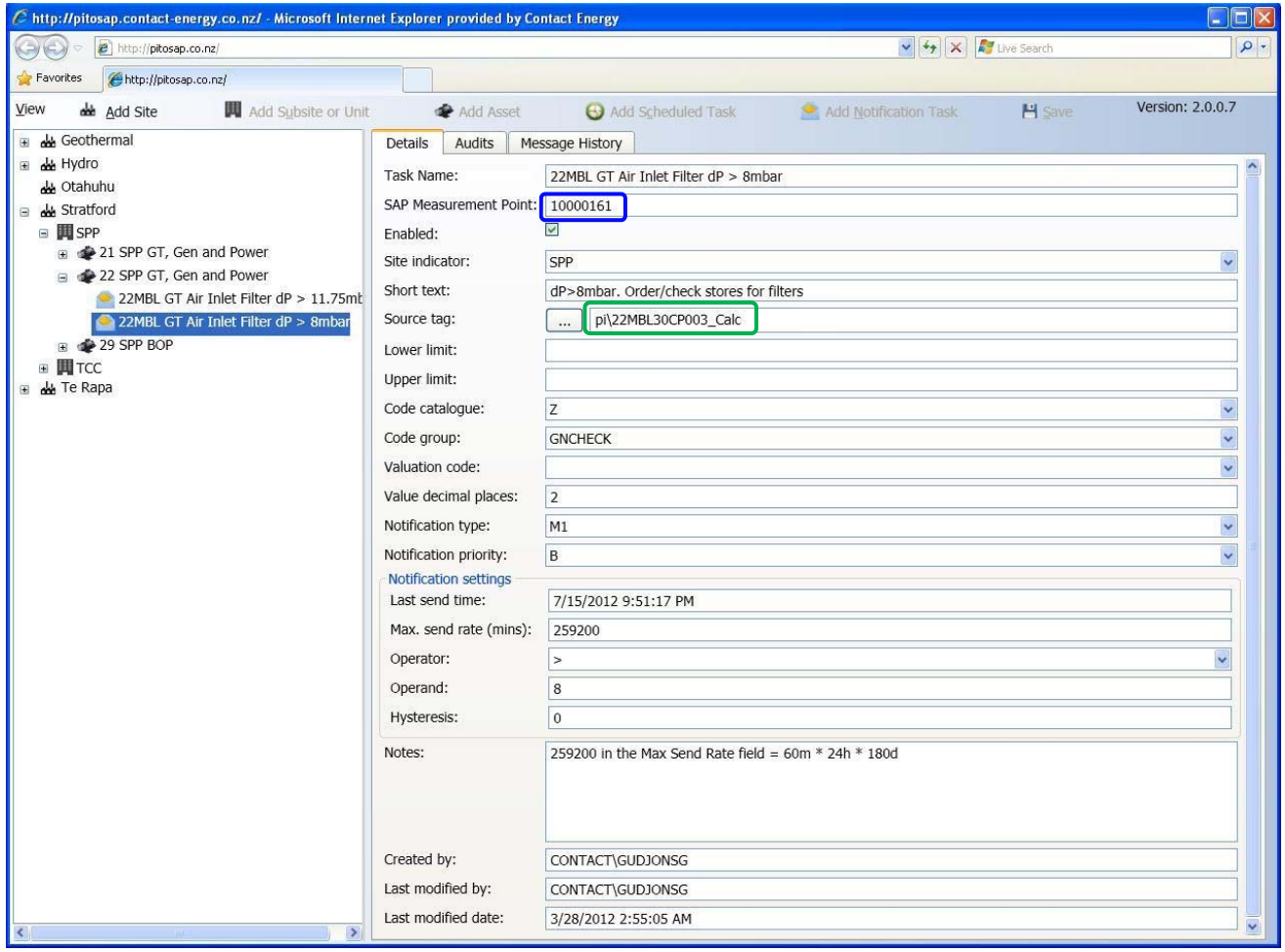


Working Example

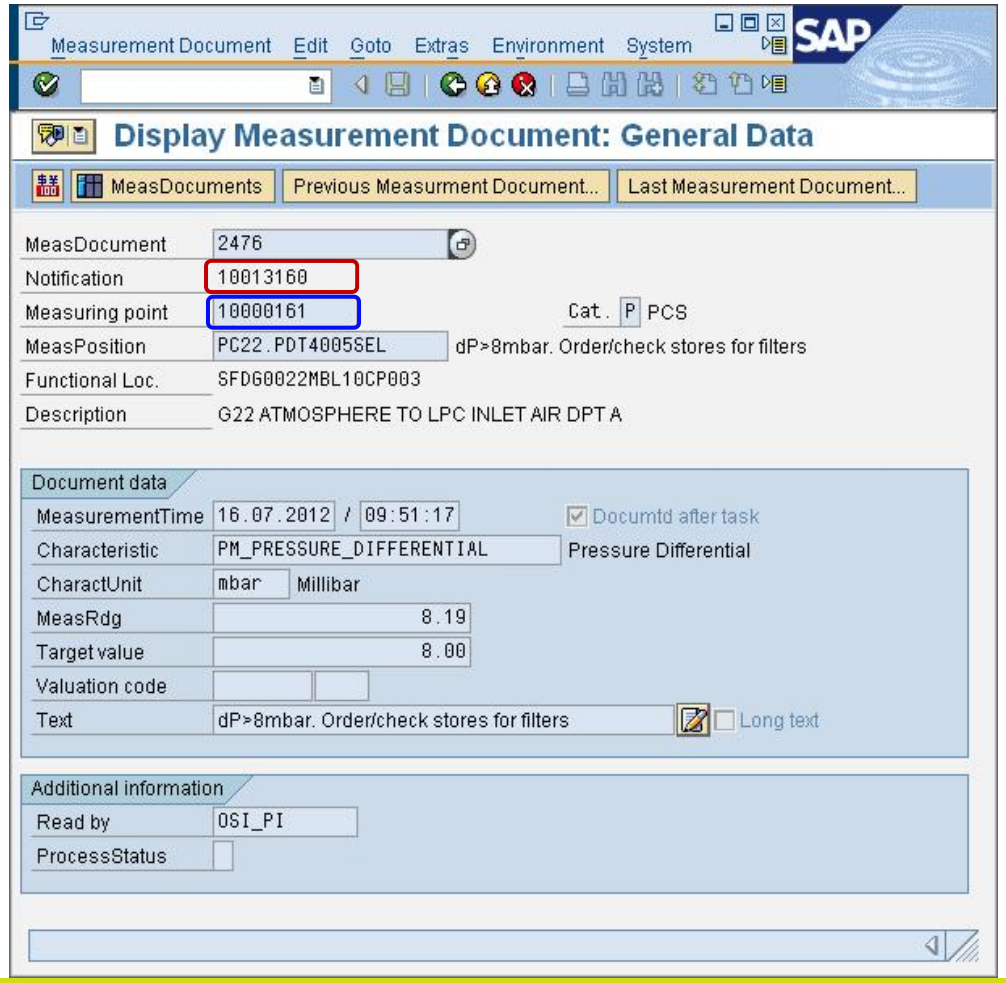
Step 2. - In SAP

Measuring Point Created

Working Example

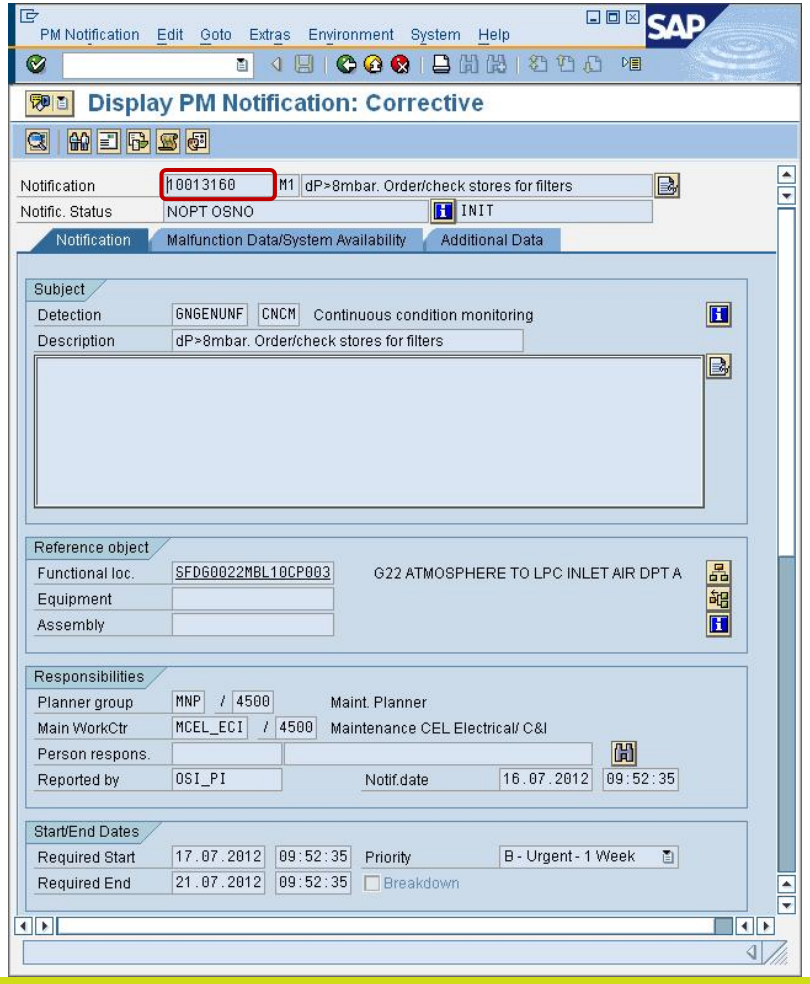


Step 3. - In PI-SAP UI Transaction Created



Working Example

Step 4. - In SAP Measurement Document arrives when dP goes higher than pre-configured value



Working Example

Step 5. - In SAP Notification sent to Maintenance Planner

THANK YOU

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