



Energy Transportation Maintenance: Real Time Monitoring with SharePoint/ PI WebParts and Event Frames

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Hydro-Québec TransÉnergie



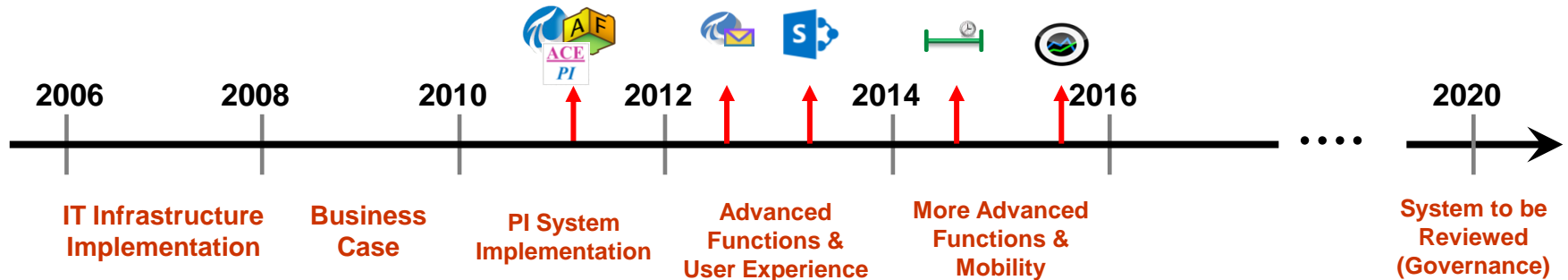
- Division of Hydro-Québec Enterprise along with the Production and Distribution divisions
- Transmission assets: 19.9 B\$
- Peak power demand in Québec 38,743 MW
- Generating facilities
 - Hydroelectric 36,100 MW
 - Thermal 543 MW
- Other sources of supply (not HQ)
 - Hydroelectric 5,428 MW
 - Wind farms 2,857 MW
- 4,700 employees (19,505 total for HQ) located in more than 50 sites in the province

Hydro-Québec TransÉnergie

- The most extensive transmission system in North America
- 34,187 km (21,242 miles) of power transmission lines
 - Including 7259 miles of 735 kV lines
- 530 transmission substations
- 17 interconnections with neighboring markets (8,038 MW)
 - Other Canadian provinces
 - U.S. Northeast



Project's Timeline



- Integrate more than 530 substations over a 12-year timeframe (2009–2020) Monitoring of 240 strategic transformers by 2015
(Gas and moisture, Temperature, Bushing and tap changer monitors)
- Monitoring of electrical events (protection relays, faults, equipment degradation, etc.)
- Deploy the OSIsoft PI System for the Maintenance group along with the Operational group
 - 250,000 tags for Maintenance initially and 1,200,000 tags at maturity in 2020
 - 200,000 tags for Operations (another project) initially and 1,000,000 tags at maturity in 2020

What's the Engineers Want ?

- To be notify promptly of important electrical events
- Access all data, anywhere using a multi-platform web interface to 400 users
- Web access must be tightly secured and respect NERC standards/rules
- The engineers must be autonomous and be able to built their own web page and give access to the members of their « ecosystem »
- The solution must be evolutive and adapt quickly to business changes... and minimizing IT department involvement



What was in Place...

- PI Server 2012 with 250,000 tags running in parallel of the Corporate PI Servers
- PI Server with real time interface for maintenance data with 120/530 sub-stations
- Automated MS Powershell scripts for tags maintenance
- Asset Framework (AF) server with 1 database and 5,000 elements and many Custom Data Reference
- A series of PI-ACE calculations
- Citrix server with 20 concurrent licenses of PI ProcessBook and PI DataLink

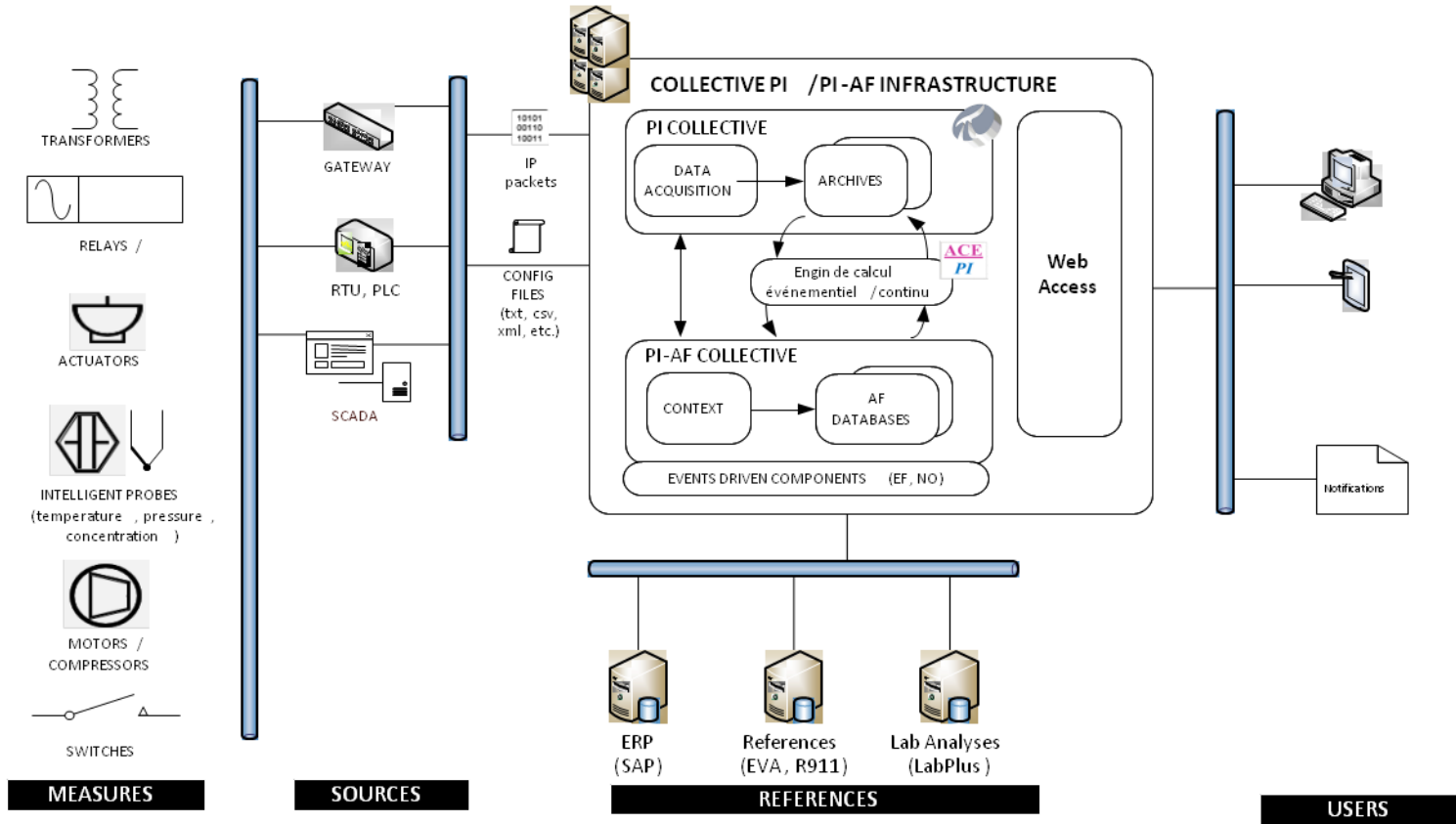
Project Scope

- Implementation of MS Sharepoint 2010 and PI WebParts
- Create MS Sharepoint pages to replace PI ProcessBook files
- Develop AF templates to support the new MS Sharepoint pages
- Create MS Powershell scripts for Sub Station electrical events capture to Event Frames
- Create MS-RS reports accessible through MS Sharepoint
- Transfer ACE calculation to PI Analysis Services and AF Custom Data References

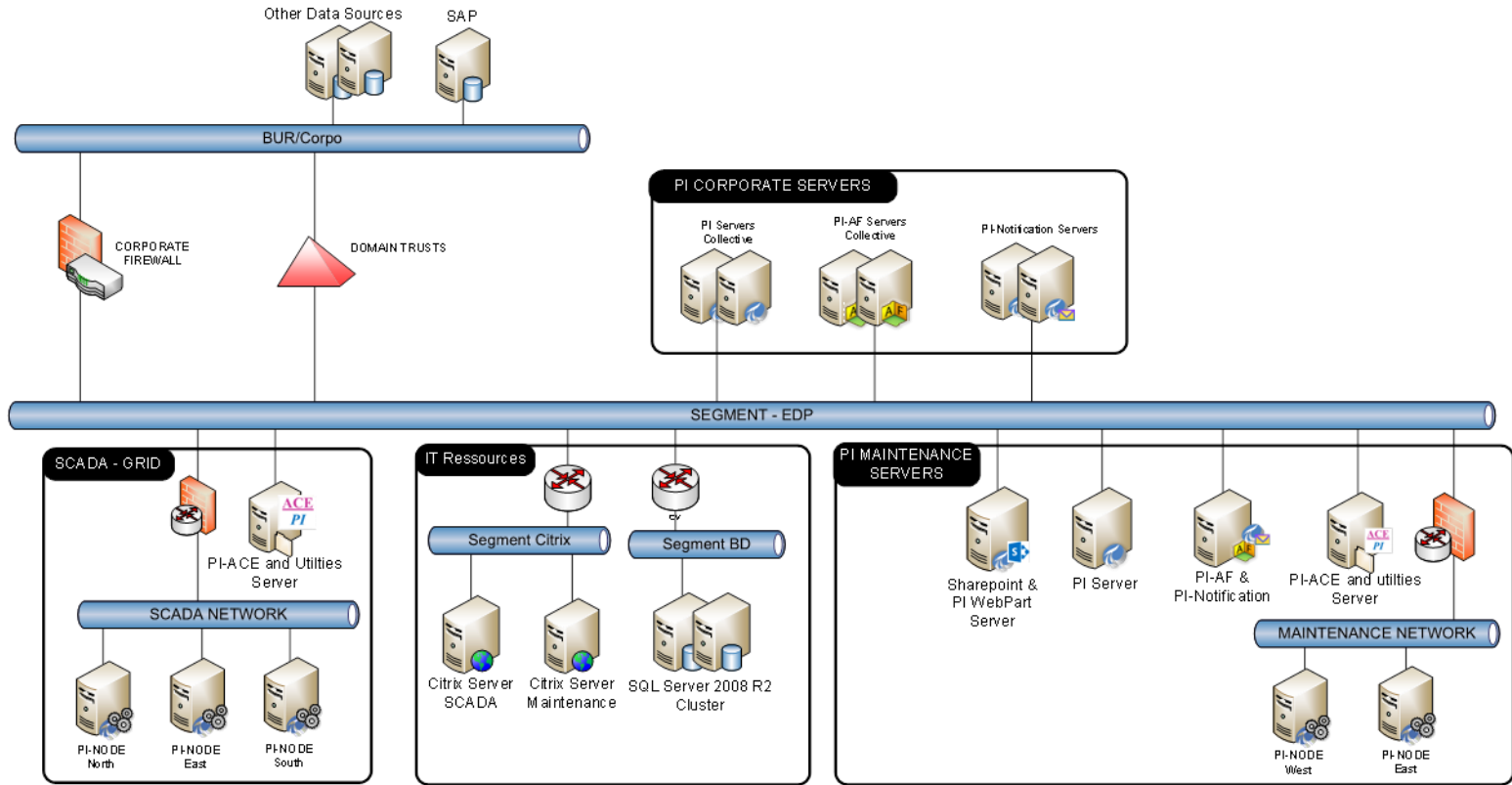
Design Criteria

- The PI Tags and AF Element naming convention must be rigorously respected
 - This is the way to bound tags to AF structure
- Use of AF templates... no direct entry in Elements
- Minimize programming and limit it to:
 - AF Custom Data References with C#
 - Server based script with Powershell
- Maximize the use of PI Analysis Services
- Maximize the use of PI WebParts Services
 - Use of PI OLEDB Enterprise that shall be replaced by PI Web Services

High Level Architecture



Systems Architecture





SharePoint & PI WebParts Overview

Maintenance Web Site Access...

Alarms

Avertissements en vigueur

Date	Etat	Poste	Transfo
17/02/2015 10:34:23	Avertissement Hydran	SUETE	T2

Informations poste

Description	Valeur
Nom du poste	Saint-Maxime
État du poste électrique	Normal

Transformateurs

NoExpl	Hydran	Qualitrol	ION	Etat
T21	X	X	X	Normal
T22	X	X	X	Normal
T23	X	X	X	Normal
T24	X	X	X	Normal
T25	X	X	X	Normal
T26	X	X	X	Panne Communication

USDI/Passerelles

Equipement

USDI

Système d'air

Bâtiment

No Data

Units d'installation

- BAIE-JAMES
- BEAUHARNOIS-GATINEAU-ABITIBI
- ILE DE MONTREAL
- LAURENTIDES
- MANICOUAGAN EST
- MANICOUAGAN OUEST
- MATAPEDIA
- MONTMORENCY & MAURICIE
- RICHELIEU
- SAGUENAY

Substations list

- Du Tremblay
- Iberville
- L'Acadie
- Magog
- Marie-Victorin
- Montérégie
- Richelieu
- Saint-Basile
- Saint-Bruno-de-Montarville
- Saint-Maxime
- Sorel

Substations list

Equipments info

From AF Attributes to PI WebParts...

1

2

3

4

Name	Value
ETATPOSTE	Normal
ETATSONDE_HYDRAN	Normal
ETATSONDE_QUALITROL	Normal
ETATTRANSFO	Normal

-- dialogue de page Web

PI WebParts
Edit Query

SQL Statement

```
select
max(eh.path) as fullPath,
eh.name as NoExpl,
max(snap.valueStr) as Etat,
case when max(coalesce(et_hydran.name,"")) <> " " then 'X' else " " end as Hydran,
case when max(coalesce(et_qualitrol.name,"")) <> " " then 'X' else " " end as Qualitrol,
case when max(coalesce(et_ion.name,"")) <> " " then 'X' else " " end as ION,
'https://timpvisaa02.te.hydro.qc.ca/AADT/SitePages/Transformateurs.aspx?path=' +
cast(eh.elementID as string) + '&fullPath=' + '\\TMIPVDSHD01\AADT_DEFAULT' +
```

1

2

3

4

NoExpl	Hydran	Qualitrol	ION	Etat
T21	X	X	X	Normal
T22	X	X	X	Normal
T23	X	X	X	Normal
T24	X	X	X	Normal
T25	X	X	X	Normal
T26	X	X	X	Panne Communication

Transformer Page...

Liste transfos

- ✓ NoExpl
- T1
- T2
- T3
- T4
- T5
- T6

Informations générales


Description	Valeur
Nom de la région administrative	MONTMORENCY_&_MAURICIE
Nom du poste	La Suede
Numéro d'exploitation	T2
État du transformateur	Normal

[Schéma Unifilaire](#)

Données moniteur de gaz

Descriptor	Value	UM
Gaz dissous		24 ppm
Humidité		5 ppm

[Page Hydran](#)



Données inventaire

Description	Valeur	UM
Numéro d'exploitation	T2	
Numéro d'équipement	1U-1543	
Fabricant	FEDERAL PIONEER	
Date de fabrication	01/01/1978	
Numéro de série	61-01-65517	
Puissance maximum	66 MVA	
Tension au primaire	225 KV	
Tension au secondaire	26,4 KV	
Mode de refroidissement	ONAN/ONAF ONAF	

[Plaque signalétique \(DSR\)](#)

Données IÉTI

Description	Valeur	UM
Âge de l'équipement	25 yr	
Âge apparent	32,135 yr	
Probabilité	3	

[Page IÉTI](#)

Analyse d'huile

Description	Valeur
Date dernière analyse physico-chimique	16/01/2007 00:00:00
Date dernier gaz dissous	15/01/2007 00:00:00

[Analyse gaz dissous](#)

Données Qualitrol

Descriptor	Value	UM
Température ambiante	-15,82	°C
Température de l'huile au sommet	37,95	°C
Température enroulement basse tension	62,86	°C
Température enroulement haute tension	46,85	°C

[Page Qualitrol](#)

Données ION

Descriptor	Value	UM
Courant moyen 3 phases	1244,3	A
Courant moyen 3 phases en PU	0,86	PU

[Page ION](#)

Données CPC

Descriptor	Value
Fabricant du CPC	ABB
Modèle du CPC	UZERN
Date du dernier IC	27-Sep-01
Nb opérations depuis début télésurveillance	644
Nb opérations depuis dernière IC	644

[Page CPC](#)

Données traversées

No datasets selected

Substation Page...

AF Elements

Liste transfos NoExpl T1 T2 T3 T4 T5 T6	Informations générales Description Nom de la région administrative Nom du poste Numéro d'exploitation État du transformateur Données inventaire Description Numéro d'exploitation Numéro d'équipement Fabricant Date de fabrication Numéro de série Puissance maximum Tension au primaire Tension au secondaire Mode de refroidissement Données IÉTI Description Âge de l'équipement Âge apparent Probabilité Analyse d'huile Description Date dernière analyse physico-chimique Date dernier gaz dissous	Données moniteur de gaz Description Gaz dissous Humidité Données Qualitrol Description Température ambiante Température de l'huile au sommet Température enroulement basse tension Température enroulement haute tension Données ION Description Courant moyen 3 phases Courant moyen 3 phases en PU Données CPC Description Fabricant du CPC Modèle du CPC Date du dernier IC Nb opérations depuis début télésurveillance Nb opérations depuis dernière IC Données traversées No datasets selected
---	--	--

Custom Data Reference - URL

PI Points Gas sensor

PI Points Temperature sensor

Table lookup ERP data

Table lookup Lab data

Formula

Custom Data Reference – Child Attribute

PI WebParts Relational Datasets – PI OLEDB

No Sharepoint programming – Maximize AF Structure

Information Access from Other Sites

The image shows several overlapping browser windows displaying technical information from different sites:

- teleconduite.te.hydro.qc.ca/encadsolex/teleconduite.webctrl.handle.solex.aspx?no=34729-0**: Shows a complex electrical schematic diagram.
- etatransfo.hydro.qc.ca/WebTRE/Rapports/ETAT/etatTransfo.aspx?equipement=1U-1543**: Displays a detailed technical report for 'Fiche de l'appareil - Rang 1443'.

Direction:	DITNE	Age:	26
Installation:	MONTMORENCY & MAURICIE	Age apparent:	27,48
Poste:	LA SUEITE	Cote:	11
Type:	Poste(s) satellite(s)	Confiance (%):	91
Équipement:	1U-1543	Probabilité:	3
No Expl.:	T2	Ans avant probabilité 9:	40,53
Responsable:	1031SELE	Age apparent potentiel:	23,42
		Probabilité potentielle:	2

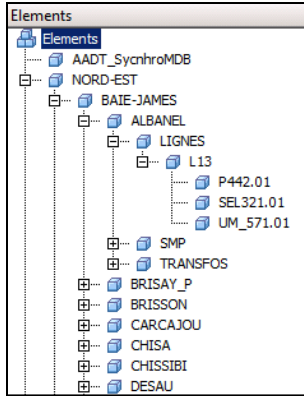
LISTE INDICATEURS				INFORMATIONS SUR L'ÉQUIPEMENT			
Indicateurs	Cote	Conf.(%)	Pond.	Fabricant	FEDERAL PIONEER	Analys	Analys
Ant. Familiaux	0	100	5	Date fabrication	1978-01-01	Éligib	Éligib
Papier	0	100	5	Date Mise en Service	1979-01-01	Trav.	Trav.
Gaz Dissous	0	100	5	Année Remise à Neuf	2008	Eau	Eau
CPC	1	100	3	Tension Primaire (kV)	225,00	Huile	Huile
Traversées	0	100	3	Tension Secondaire (kV)	26,40	Acces	Acces
Eau	1	100	5	Puissance 1 (MVA)	40,00	Fuites	Fuites
Huile	0	100	4	Puissance 2 (MVA)	53,00	Total	Total
Accessoires	0	50	3	Puissance 3 (MVA)	66,00	Anné	Anné
Fuites Huile	1	50	3	CPC Modèle	ABB		
				CPC Modèle	UZERN		
- qualtrol.hydro.qc.ca/4A01/etatPages/Qualtrol.aspx?path=9C2806B-2142-4869-b684-4022601a37725a9&path=11M8P**: Shows a monitoring dashboard with a 'Zone M' graph and 'Informations générales' section.

Description	Date	Valeur UH
Température ambiante	19/02/2015 09:55:29	41,6 °C
Température de l'huile au sommet	19/02/2015 09:55:37	39,0 °C
Température enroulement basse tension	19/02/2015 09:55:37	66,1 °C
Température enroulement haute tension	19/02/2015 09:55:35	45,7 °C
- dsr.te.hydro.qc.ca/archive/PlaqueSignaletique.do?I=1U-1543.PDF**: Displays a scanned technical drawing of a 'TRANSFORMATEUR TRIPHASÉ'.



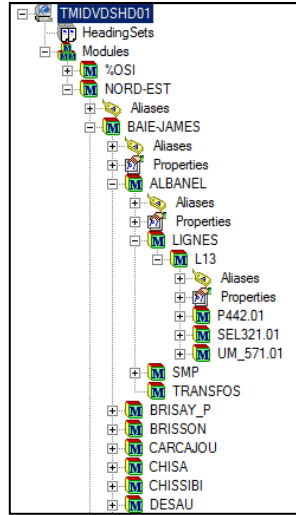
Transformer Page Demo

PI ACE to PI Analyses



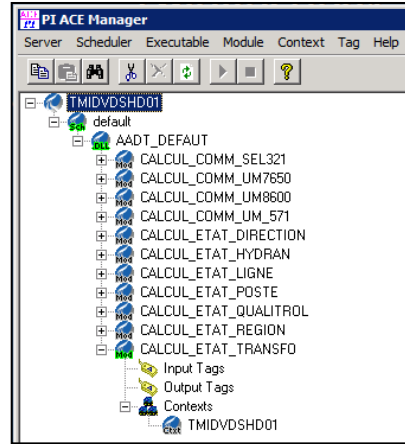
AF

- AF Structure



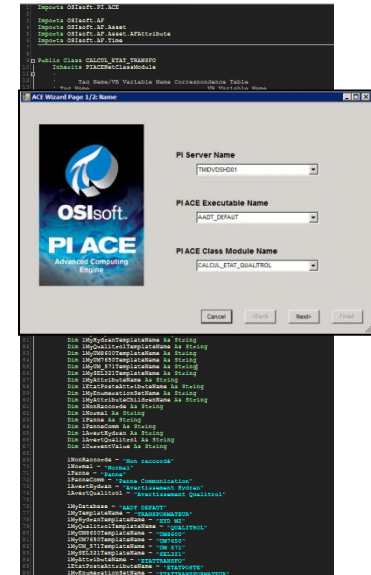
Module Database

- MDB to AF Synchronization



ACE Manager

- Contexts management



Microsoft Visual Studio

- VB or C#

Performance Equations/Totalizer to PI Analysis

Group by: Category Template

Name: PR_TOT

Description: Nb opérations depuis début télésurveillance

Configuration Item: Indexed:

Categories: CALCULS

Default UOM: <None>

Value Type: Int32

Default Value: 0

Data Reference: PI Point

Settings...

```
{|%Server%}%@LOCAL%:%Element%.%..\Element%:%@.|Type%:%Attribute%:%@.|Portee%:%@.|Genre%:TM;ptclassname=Totalizer;pointtype=Float32;compressing=0;descriptor=Compteur opérations changeur de prise;pointsource=T;span=%@.|Span%;zero=%@.|Zero%;calcmode=ALLEVENTS;function=EVENTS;movingcount=1;ratesamplemode=NATURAL;reportmode=RAMPING;totalclosemode=FOREVER;sourcetag=%@LOCAL%:%Element%.%..\Element%:POS:PR_S:%@.|Portee%:SG:TM;excdev=0;excmax=0;typicalvalue=5
```

Server	PS	Point
TMIPVDSHD01	C	39229:UAC.07.T3:STAT:PR_TOT_JOUR:SC.PE:TM

General Equation Scheduling Security Archive Classic System

Event tag:

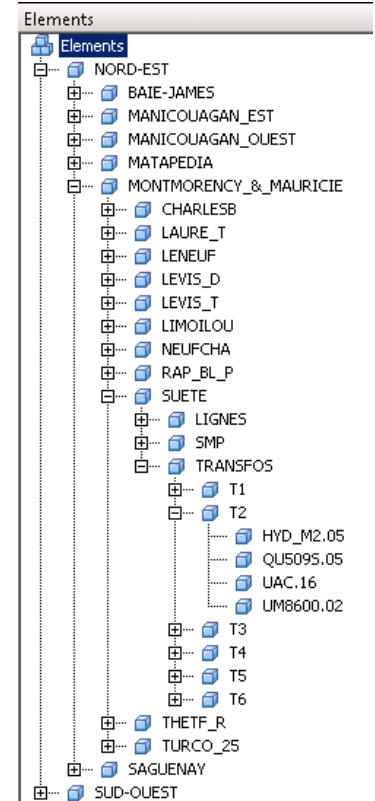
Equation: `if (badval(tagval('39229:UAC.07.T3:STAT:PR_TOT:EX:TO:TM',''))) then 0 else round(tagval('39229:UAC.07.T3:STAT:PR_TOT:EX:TO:TM','') - if (badval(tagval('39229:UAC.07.T3:STAT:PR_TOT:EX:TO:TM','-24h')) then 0 else round(tagval('39229:UAC.07.T3:STAT:PR_TOT:EX:TO:TM','-24h')))`

- Performance Equations and Totalizers
 - Integration with AF not easy
 - Sometimes needs to restart Windows Service to make it work
 - Equation screen is visually difficult to follow... thus, take more time

ACE to PI Analysis

Name	Expression	Value	Output Attribute
Default	"Normal"	Normal	Click to map
CheckPI	if (BadVal('ETATPOSTE') or BadVal('ETATSONDE_HYDRAN') or BadVal('ETATSONDE_QUALITROL')) then 1 else 0	0	Click to map
CheckPoste	if ('ETATPOSTE') = "Panne Communication" or ('ETATPOSTE') = "Problème Configuration PI" then 1 else 0	0	Click to map
CheckPanneComm	if ('ETATSONDE_HYDRAN' = "Panne Communication" or 'ETATSONDE_QUALITROL' = "Panne Communication") then 1 else 0	0	Click to map
CheckHydran	if (InStr(String('ETATSONDE_HYDRAN'),"Avertissement") > 0) then 1 else 0	0	Click to map
CheckQualitrol	if (InStr(String('ETATSONDE_QUALITROL'),"Avertissement") > 0) then 1 else 0	0	Click to map
Algorithm	if CheckPI then "Non Raccordé" else if CheckPoste then "Non Raccordé" else if CheckPanneComm then "Panne Co" else "Normal"	Normal	Click to map
Output	if (Algorithm = 'ETATTRANSFO') then NoOutput() else Algorithm	-	ETATTRANSFO

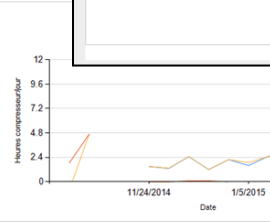
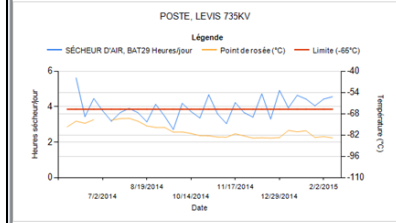
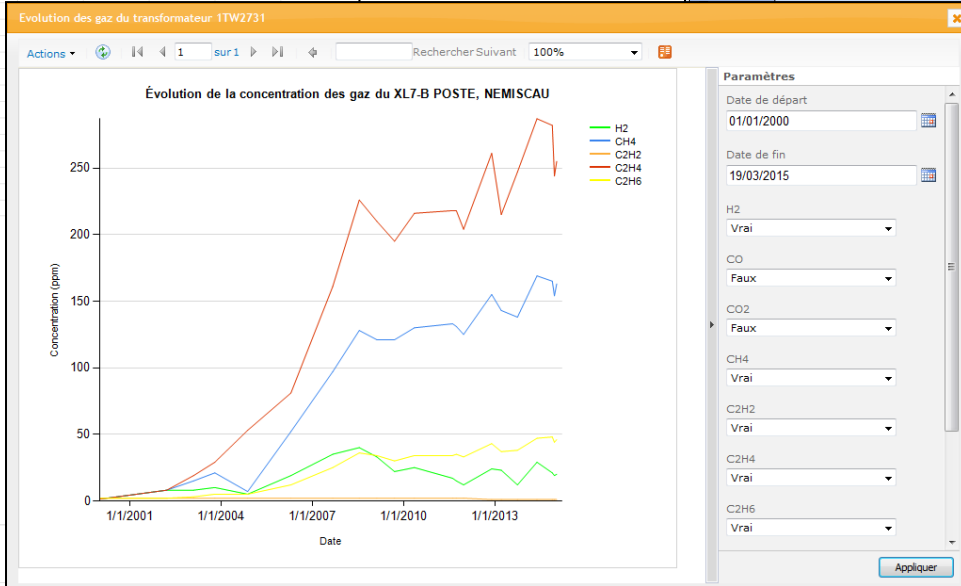
- Pros
 - Only one application (PI System Explorer)
 - Easy to implement into production mode
 - Backfill functionality
 - Intellisense while you're typing
- Wishes
 - Allow to launch custom modules (event/time based) in order to replace ACE
 - Should scale PI Analysis on multiple instances/servers



MS-Report Services Solution...

POSTE, LEVIS 735KV				POSTE, LEVIS 735KV							
SÉCHEUR D'AIR, BAT29				CC 4, BAT29		CC 5, BAT29		CC 6, BAT29		Total heure compresseur par période	
Date relève	Sécheur (Hres)	Différence	Point de rosée (°C)	Date relève	Heures	Différence	Heures	Différence	Heures		Différence
2/9/2015	27466.9	S/O	-83.9	2/9/2015	8528.4	S/O	9239.1	S/O	9046.3	S/O	S/O
2/2/2015	27455.0	4.56	-83.0	2/2/2015	8510.0	2.63					
1/27/2015	27428.4	4.43	-83.6	1/27/2015	8494.9	2.52	9234.0	0.73	9034.0	1.76	5.11
1/19/2015	27396.0	4.05	-79.2	1/19/2015	8479.0	1.99					
1/12/2015	27365.0	4.43	-79.9	1/12/2015	8460.0	2.71					
1/5/2015	27332.5	4.64	-79.0	1/5/2015	8442.4	2.51					
12/29/2014	27305.0	3.93	-83.7	12/29/2014	8431.2	1.60					
12/16/2014	27241.1	4.92	-84.0	12/16/2014	8402.9	2.18					
12/8/2014	27214.7	3.30	-83.8	12/8/2014	8393.3	1.20					
12/2/2014	27186.3	4.73	-84.0	12/2/2014	8378.5	2.47					
11/24/2014	27159.0	3.41	-82.6	11/24/2014	8368.0	1.31					
11/17/2014	27133.4	3.66	-81.2	11/17/2014	8357.5	1.50					
11/11/2014	27108.0	4.23	-83.4	6/16/2014		54.27					
11/4/2014	27086.7	3.04	-83.3	6/9/2014	8274.0	S/O					
10/27/2014	27058.0	3.59	-82.5	5/21/2014	8256.0	0.95					
10/21/2014	27030.0	4.67	-82.4								
10/14/2014	27006.5	3.36	-81.0								
10/1/2014	26958.1	3.72	-80.0								
9/17/2014	26899.5	4.19	-80.1								
9/8/2014	26875.1	2.71	-77.0								
9/4/2014	26861.2	3.47	-77.0								
8/19/2014	26795.2	4.13	-76.0								
8/11/2014	26770.1	3.14	-72.9								
7/29/2014	26722.5	3.66	-71.0								
7/15/2014	26667.9	3.90	-71.2								
7/8/2014	26642.2	3.67	-72.3								
7/2/2014	26623.1	3.18	-89.0								
6/23/2014	26589.2	3.77	-71.9								
6/16/2014	26558.0	4.46	-74.3								
6/9/2014	26534.0	3.43	-72.9								
5/21/2014	26427.0	5.63	-76.6								

STATUT DÉTAILLÉ DES ÉQUIPEMENTS							
Direction	Unité d'installation	Installation	Type	Équipement	#	Statut	Total
	BATE-JAMES						68
	MANICOUAGAN EST						3
	MANICOUAGAN OUEST						29
							70
							207
							90
							59
							10



			Concentration (ppm)						Duval #1				
			CO	CO2	CH4	C2H2	C2H4	C2H6	Défaut				
			152	2160	4	1	5	3	T3				
			339	1983	46	1	50	13	T3				
			199	2504	10	7	3	6	D1				
			1056	10521	10	1	67	10	T3				
			844	1517	8	1	6	1	DT				
6	1T-4131	POSTE, NEMISCAU	TG71	10239ELE	2013-06-09	56	468	1850	15	1	6	DT	
7	1T-4184	POSTE, NEMISCAU	XL6-B	10239ELE	2014-05-21	12	241	2445	23	5	88	9	T3
8	1TA1457	POSTE, NEMISCAU	T1-A	10239ELE	2014-05-23	3	412	7525	15	1	224	20	T3
9	1TW2731	POSTE, NEMISCAU	XL7-B	10239ELE	2015-01-13	20	606	1774	163	1	255	46	T3
10	1T-4137	POSTE, DESAULNIERS	T2	10254ELE	2014-12-19	13	24	345	3	12	23	1	D1
11	1T-3078	POSTE, LA GRANDE 1	T12	10254ELE	2014-03-15	5	753	6316	8	1	89	4	T3

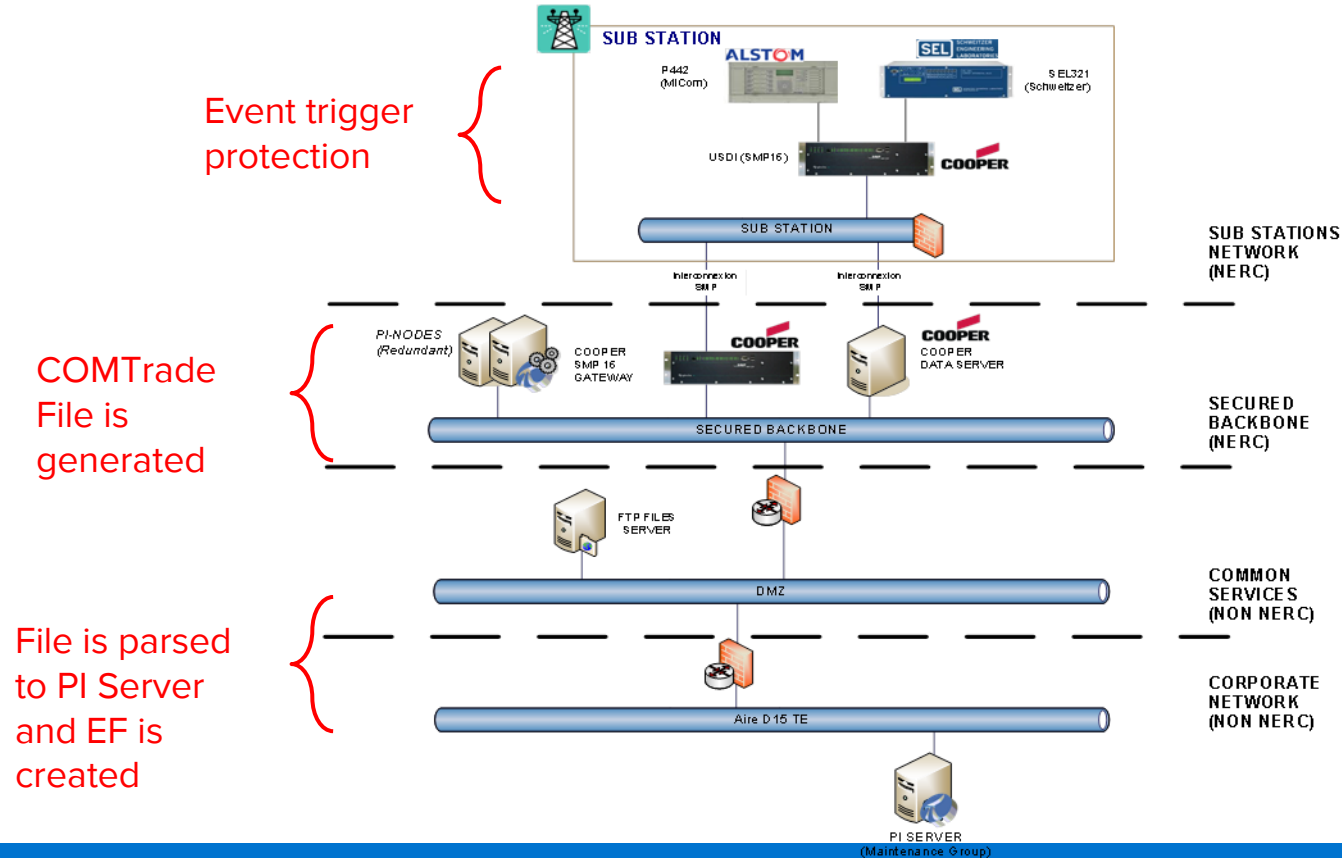


PI WebParts & Reports Demo



Electrical Events Trapping

Electrical Events Trapping



Electrical Events Trapping

```
[identification]
id=Test   PROT A - Level 1
[events]
event1=NO LABEL
=>EVE 3 L
3 12/17/12|15:51:20.731 BG T +58.31 1 TIME ZONE2 EN B G
eventInfo64=130633230807310000
eventTime=1418849480 731
eventAscii=12/17/12 15:51:20.731 +1197251414
EVE 3 L

TEST   PROT A                               Date: 12/17/12   Time: 15:51:20.731
FID=SEL-321-1-R426-V656112pb-Z001221-D20011203

      CURRENTS (pri)                VOLTAGES (kv pri)    RELAY ELEMENTS  OUT  IN
                                     ZZZZZZO  555566L 1357 1357
      IR   IA   IB   IC   VA   VB   VC  ABCABCO 31110770 &&&&& &&&&&
                                     BCAGGGS 2NQPPNPQ 2468 2468
-602    0  -603    1   71.2  18.7 -138.2  ....2.. Q...M1.. .... 1...
-359    0  -359    0   20.3  30.1 -128.6  ....2.. Q...M1.. .... 1...
-60     0   -60    0  -33.6  37.1 -99.6   ....2.. Q...M1.. .... 1...
249     0  249    0  -82.2  38.2 -55.3   ....2.. Q...M1.. .... 1...
517    -1  519    -1 -118.8  33.7  -2.7   ....2.. Q...M1.. .... 1...
709    -1  712    -2 -136.5  23.9  50.4   ....2.. Q...M1.. .... 1...
791     0  793    -2 -134.4  10.6  95.8   ....2.. Q...M1.. .... 1...
753    -1  756    -2 -110.9  -4.4 126.5   ....2.. Q...M1.. .... 1...
599    -1  602    -2  -71.2 -18.8 138.2   ....2.. Q...M1.. .... 1...
356    -1  358    -1 -20.2  -30.2 128.6   ....2.. Q...M1.. .... 1...
56     -1   58    -1   33.7 -37.1  99.5   ....2.. Q...M1.. .... 1...
-253   -1 -251    -1   82.3  -38.3  55.2   ....2.. Q...M1.. .... 1...
-521   -1 -520    0  118.9 -33.7  2.6    ....2.. Q...M1.. .... 1...
-713    0  -713    0  136.5 -23.9 -50.5   ....2.. Q...M1.. .... 1...
-794    0  -794    0  134.4 -10.6 -95.9   ....2.. Q...M1.. .... 1...
-757    0  -757    0  110.8  4.4 -126.6  ....2.. Q...M1.. .... 1...
```

- Powershell script to transfer IED event files to Event Frames (not Event Frames generator)
 - SelEvent, COMTrade
 - Measures and I/O are stored into PI Points
 - Settings are stored into Event Frame attributes
 - Data from event files are compared with SCADA data
 - Objective: apply condition-based maintenance on protection relays

Electrical Events Trapping

États des entrées & sorties

Attribut	Date	Valeur
ETATIN1	27/10/2014 09:24:38	Défectuosité Possible
ETATIN7	27/10/2014 09:24:38	Défectuosité Possible
ETATOUT1	27/10/2014 09:24:39	Défectuosité Possible
ETATOUT2	27/10/2014 09:24:39	Défectuosité Possible
ETATOUT3	27/10/2014 09:24:39	Défectuosité Possible
ETATOUT4	27/10/2014 09:24:39	Défectuosité Possible
ETATOUT5	27/10/2014 09:24:40	Non Validé
ETATOUT7	27/10/2014 09:24:40	Non Validé
ETATOUT8	27/10/2014 09:24:40	Défectuosité Possible
ETATOUT9	27/10/2014 09:24:40	Non Validé
ETATOUT10	27/10/2014 09:24:41	Non Validé
ETATOUT11	27/10/2014 09:24:41	Non Validé
ETATOUT12	27/10/2014 09:24:41	Non Validé
ETATOUT13	27/10/2014 09:24:41	Défectuosité Possible
ETATOUT14	27/10/2014 09:24:41	Défectuosité Possible
ETATOUT15	27/10/2014 09:24:42	Non Validé
ETATOUT16	27/10/2014 09:24:42	Conforme

Entrées numériques

Attribut	Date	État
MA	19/02/2015 14:38:45	Red
/AB1.S1	19/02/2015 14:38:45	Red
/AB2.S1	19/02/2015 14:38:45	Red

Sorties numériques

Attribut	Date	État
/A..A21	19/02/2015 14:38:45	Green
/B..A21	19/02/2015 14:38:45	Red
/C..A21	19/02/2015 14:38:45	Green
A21	19/02/2015 14:38:45	Green
/AB1...	19/02/2015 14:38:45	Red
/AB2...	19/02/2015 14:38:45	Red
/AB1.E2	19/02/2015 14:38:45	Red
/AB2.E2	19/02/2015 14:38:45	Red
A21TAC	19/02/2015 14:38:45	Red
A21TBL	19/02/2015 14:38:45	Red
A21.Z1	19/02/2015 14:38:45	Green
A21.Z2T	19/02/2015 14:38:45	Green
A21.Z3T	19/02/2015 14:38:45	Green
A21.Z4T	19/02/2015 14:38:45	Green
A21.MST	19/02/2015 14:38:45	Red
A21.79B	19/02/2015 14:38:45	Red
A21..74	08/02/2015 00:06:55	Green

Liste de événements

Name	Description	StartTime	EndTime
20141210,182555914,UT,LACHENAIE,SEL321.01_EL1_A,HQTE,,EVE,,,8C16,,.txt	LACHENAIE PROT A - Level 1	10/12/2014 13:25:55	10/12/2014 13:25:56
20141210,182555419,UT,LACHENAIE,SEL321.01_EL1_A,HQTE,,EVE,,,8C16,,.txt	LACHENAIE PROT A - Level 1	10/12/2014 13:25:55	10/12/2014 13:25:55
20141210,162544970,UT,LACHENAIE,SEL321.01_EL1_A,HQTE,,EVE,,,8C16,,.txt	LACHENAIE PROT A - Level 1	10/12/2014 11:25:44	10/12/2014 11:25:45
20140617,184728166,UT,LACHENAIE,SEL321.02_EL4_A,HQTE,,EVE,,,8C16,,.txt	CHARLEVOIX PROT A - Level 1	17/10/2014 14:47:28	17/10/2014 14:47:28

Liste des attributs de l'événement

Attribut	UM	Valeur
27L	V	40.8
3P50R	A	0
3POD	A	1
50ABC	A	0
50G1	A	0.5
50G2	A	0.5
50G3	A	0.5
50G4	A	0
50H	A	5.25
50L1	A	0.5
50L2	A	0.5
50L3	A	0.5
50L4	A	0
50M	A	0.5
50MFD	Cycles	0
50N1	A	0.5
50N2	A	0
50N3	A	0
50N4	A	0
50PP1	A	1.75
50PP2	A	1
50PP3	A	1
50PP4	A	0
50QF	A	0.25
50QR	A	0.25
51NC	A	0
51NP	A	0
51NRS	A	0
51NTC	A	0

Output PI Points

Event Frames list

Event file I/O data

AF Attributes

PI System Components Involved...

The screenshot shows the PI Event Frames interface. On the left, a tree view displays 'Event Frame Searches' with sub-items 'Event Frame Search 1' and 'Event Frame Search 2'. Below these are several search paths, with the path '20141210,182555419,UT,LACHENAIE,SEL321.01_EL1_A,HQTE,,EVE,,BC16,,.txt' highlighted. On the right, a table lists elements under the category 'EVENEMENT_TEMPS_CONTINU'. The table has columns for 'Name' and 'Value'.

Name	Value
ELEMENTS
IA	-2 A
IB	-2 A
IC	0 A
IN
IN_U	00
IR	0 A
OUT
OUT_U	8101
RELAY
VA	0 kV
VB	0 kV
VC	0 kV

The screenshot shows the 'Edit Query' dialog in PI WebParts. The title bar reads '-- Webpage Dialog' and the main title is 'PI WebParts Edit Query'. Below the title bar is a 'SQL Statement' section with a text area containing the following SQL query:

```
SELECT
    efa.name as Attribut,
    efa_cat.eventframeattributeid,
    snap.valeustr as Valeur,
    uom.abbreviation as UM
FROM [AADT_DEFAULT].[EventFrame].[EventFrame] as ef
left join [AADT_DEFAULT].[EventFrame].[EventFrameAttribute] as efa
    on efa.eventframeid = ef.id
left join [AADT_DEFAULT].[EventFrame].[EventFrameAttributeCategory] as efa_cat
    on efa_cat.eventframeattributeid = efa.id
left join [AADT_Default].[Asset].Category as cat
    on cat.id = efa_cat.categoryid
left join [AADT_Default].[Data].eventframesnapshot as snap
    on snap.eventframeattributeid = efa.id
left join [System].[UnitOfMeasure].[UOM] as UOM
    on UOM.id = efa.defaultuomid
where
    ef.id = ?
and cat.name = 'EVENEMENT'
order by efa.name
option (ignore errors)
```

Buttons for 'Browse...', 'Import', 'OK', and 'Cancel' are visible.

- PI-OLEDB to expose Event Frames
- PI WebParts services
- Same technique as for the AF structure

PI Notifications

- Notifications are critical part of our strategy
- This allow the engineers to react in time (email based)
- Constraints / workarounds:
 - Difficult to handle more than 10 000 notifications
 - Regroup notifications as much as possible
 - No automation to generate notifications from a template with a standardized name
 - Use of a PowerShell script in order to create and apply a rigorous naming convention according to templates
 - The « Contacts » option cannot be used since multiple Active Directories
 - Subscribers emails are stored in a database and linked to notifications according to their localization
 - Notifications not exposed in PI OLEDB
 - Notifications calculations with PI Analysis instead. Output values are stored in PI Point attributes and serve as triggers for Notifications

Notifications

De : TMIPVDSHD01@hydro.qc.ca
À : Di Gaetano, Nicolas
Cc :
Objet : Micoua:T8-A seuil de gaz dépassé et/ou tendance gaz dissous dépassée.

POSTE
Micoua

EQUIPEMENT
T8-A

DATE
2015-02-23 7:00:52 AM Eastern Standard Time (GMT-05:00:00)

MESURES ACTUELLES

- Mesure de gaz actuelle: 85 ppm
- Tendance de gaz horaire: 2 ppm/hr
- Tendance de gaz journaliere: 3 ppm/jour
- Tendance de gaz hebdomadaire: 5 ppm/semaine
- Tendance de gaz mensuelle: 30.9999961853027 ppm/mois

SEUILS

- Les seuils de tendances sont applicables lorsque la mesure de gaz est d'au moins 50 ppm
- Seuil de gaz horaire: 5 ppm/hr
- Seuil de gaz journalier: 10 ppm/jr
- Seuil de gaz hebdomadaire: 20 ppm/sem
- Seuil de gaz mensuel: 30 ppm/mois

[Accéder page web](#)



Equipment
identification

Event Time

Measurements at the
time the thresholds
were exceeded

Thresholds

PI WebParts hyperlink
Custom Data Reference

Business Benefits

- Allow the distribution of displays and reports to a pool of 400 registered users in more than 50 sites across the territory
- User group owners can manage displays content and access for new users
- Brings events in a fast turnaround time to key engineers
- Avoid incidents by timely action
 - Optimize the availability of our equipment
 - Reduce the impact of abnormal heating of transformers
 - Better follow-up after repair
 - Ensure the sensors' reliability (failure, calibration, etc.)
- Reduce significantly investigation time
 - It use to take days to gather the information, now it's all automated!
- Reduce IT cost:
 - Maintenance department autonomy
 - Lower TCO with SharePoint compare to Citrix PI ProcessBook & PI DataLink distribution

The Engineers Got What They Wanted !



Bruno Girard, Transformer Expert,
Senior Engineer

« We can have access to real time maintenance data in a few clicks anywhere. This include significant data and calculations history and trends that send us instant notifications for early abnormalities detection. »



Jocelyn Dubé, Remote Maintenance expert,
Senior Technician

« This project allow us to switch from systematic to condition-based maintenance! It extends the life expectancy of our majors equipment. »



Stéphane Després, Maintenance expert,
Senior Technician

« As support for operations, different tools allow me to have an overview of data quality provided to customers. This allows me to quickly respond to failures of equipment in our facilities.»



Claude Rajotte, Transformer Expert,
Senior Engineer

“This project leads to a new way to manage and maintain substation equipments”

Lessons Learned...

- With up to 250,000 of tags, a rigorous tags naming convention is essential
- Secret of our success: Data access through AF based on Templates...
Never access PI Tags directly !
- Let user groups make their own display and data access strategy... Not IT !
- Use Event Frame everywhere !
- Migrate ACE module to AF Analysis Services
- Notify key decision people in real time to assist the operation team while giving precision context data for decision making

Our Dream User Experience...

- Rich graphical interface as SharePoint & PI ProcessBook & PI Coresight “under the same roof” with
 - Keep capabilities offered by the SharePoint environment
 - Programmability in the .NET environment
 - Integrate manual data capture
 - Keep on allowing user groups to develop their displays, trends, etc... with customize objects
 - “Cloudability” of the user experience
 - Integrated mobile environment allowing customization and application development

To Join Us

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Systems and Automation Consultant

Michel Daigle Consulting

Questions

Please wait for the **microphone** before asking your questions

State your
name & company





THANK
YOU

