



# **PI Implementation on a Brown Field Aluminium Smelter Project: Total Integration Approach**

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# AGENDA

- **Aluminerie Alouette and Hatch**
- **Project overview**
- **Brownfield integration**
- **PI applications:**
  - **Production Intranet**
  - **PI-ACE**
  - **Batch tracking**
  - **Environmental system**
  - **Real time production data integration**
  - **System monitoring**
- **Conclusions**



# COMPANY OVERVIEW

- **Alouette originally started production in June 1992**
- **Single plant = Pechiney AP-30 technology**
- **Located in Sept-Îles, Québec**
- **Approximatively 900 employees**
- **One of the most efficient aluminum producers in the world**
- **Owned by five partners:**
  - **Alcan (Canada 40 %)**
  - **Austria Metal (Austria, 20 %)**
  - **Hydro Aluminium (Norway, 20 %)**
  - **SGF Québec ( Canada, 13,33 %)**
  - **Marubeni (Japan, 6.67%)**



# ALUMINERIE ALOUETTE



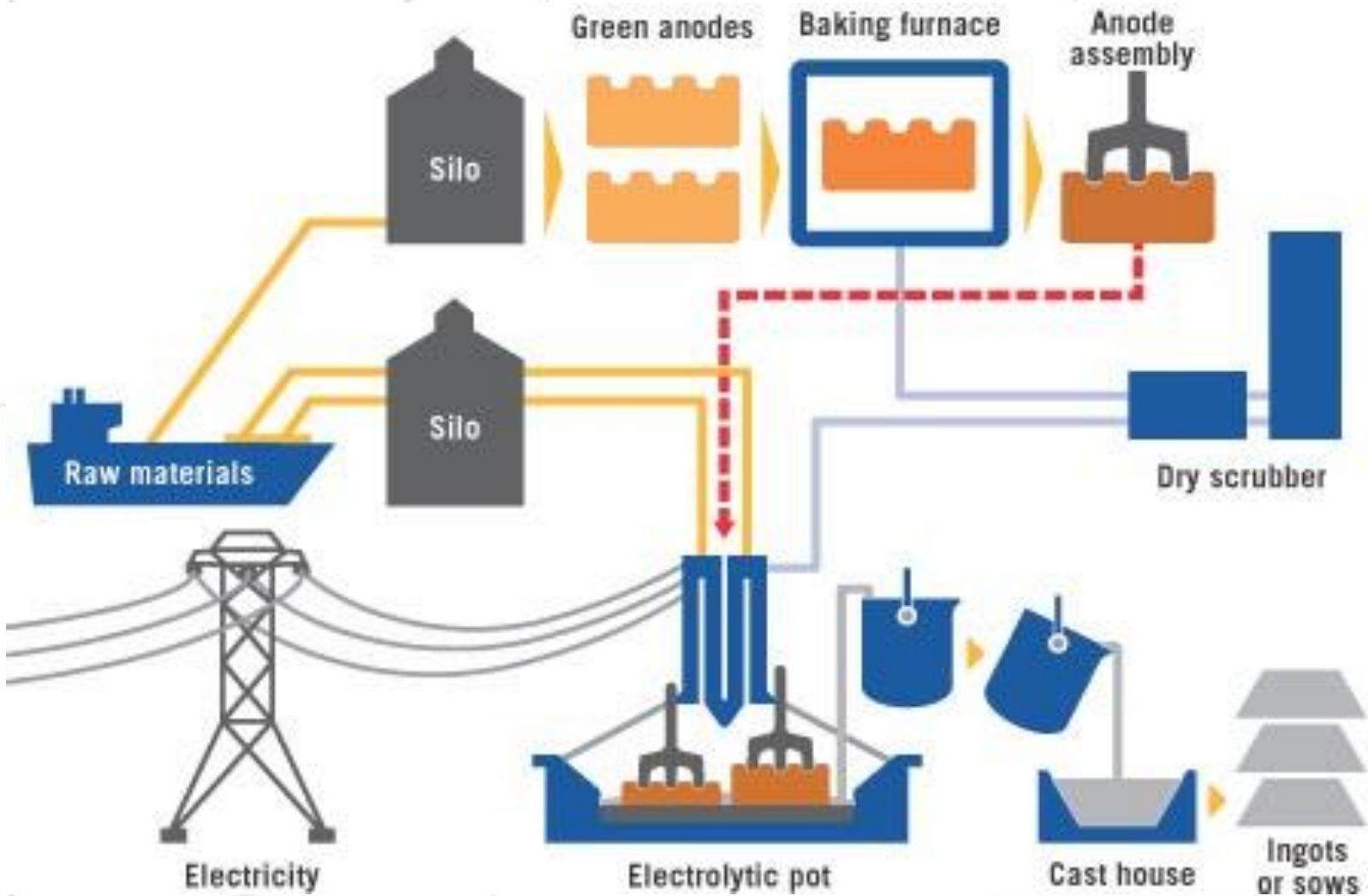


# EXPANSION PROJECT OVERVIEW

- Expansion project (1B\$ USD) began in mid 2002 and will be completed mid 2005
- Phase II expansion will add 307,000 tpy capacity, bringing the total plant production over 550,000 tpy
- Alouette will become the largest aluminum smelter in the Americas
- 594 aluminum reduction pots will be in operation
- Total electric power consumption will be 895 MW
- Brownfield expansion of existing facilities:
  - Challenge: keep existing operations running efficiently
- Project scope included modernization of IT and control systems
- EPCM
  - SNC Lavalin HATCH Joint Venture
  - Lead System Integrators



# ALUMINUM MAKING PROCESS



# ANODE BAKING



**Anode baking: batch process; 14 to 17 days  
at a maximum temperature of 1200 C**



# ALOUETTE PHASE 2 : New Pot Room



- Plant includes:
  - New pot lines include 312 pots
  - Power supply: 350 kA in series
  - Total power consumption is more than 800 MW



# Product : Pure Aluminum Sows



## Product:

- High quality pure aluminum
- Multiple end-user in Canada, US and the world

# Aluminum smelting business context

- **Primary aluminum is a commodity**
- **Business factors**
  - **Operating costs are critical**
  - **Alouette produces pure aluminum in a make to stock operation**
  - **Total world production: 31.5 Mtons.**
    - **Alouette: 0,5 Mtons**
  - **Mature process**
- **Alouette is one of the most efficient smelter in the world**
  - **Process optimization is an important factor**



# ABOUT HATCH

- **Established in 1955: worldwide leader in consulting, information systems, project management and construction and engineering for metallurgy, infrastructure and energy**



- **Innovative organization**
- **Head office located in Canada; over 60 global offices on all continents**
- **6,000 professionals worldwide, 500 in control and systems**
- **Currently managing over US \$15 Billion dollars in projects**
- **Work closely with OSIsoft since 1996**

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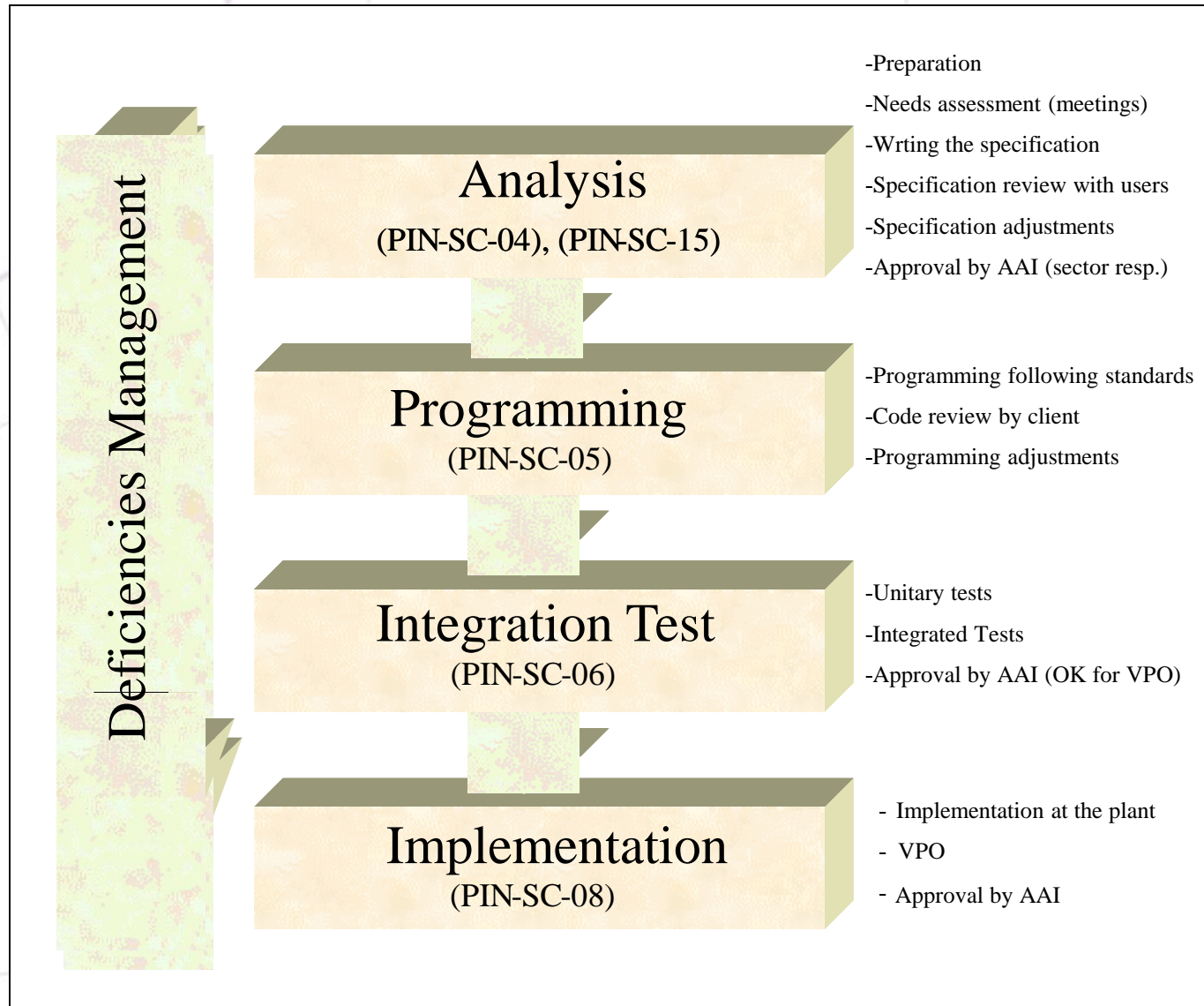




# PROJECT ORGANIZATION : OBJECTIVES

- Hatch played a key role as lead system integrator providing key advantages:
  - Integration in Engineering workflow
    - Simplifies change management
    - Reduces costs
- Strong emphasis on:
  - Development methodology
  - Reducing maintenance cost through program uniformity
- Alignment to Alouette business objectives

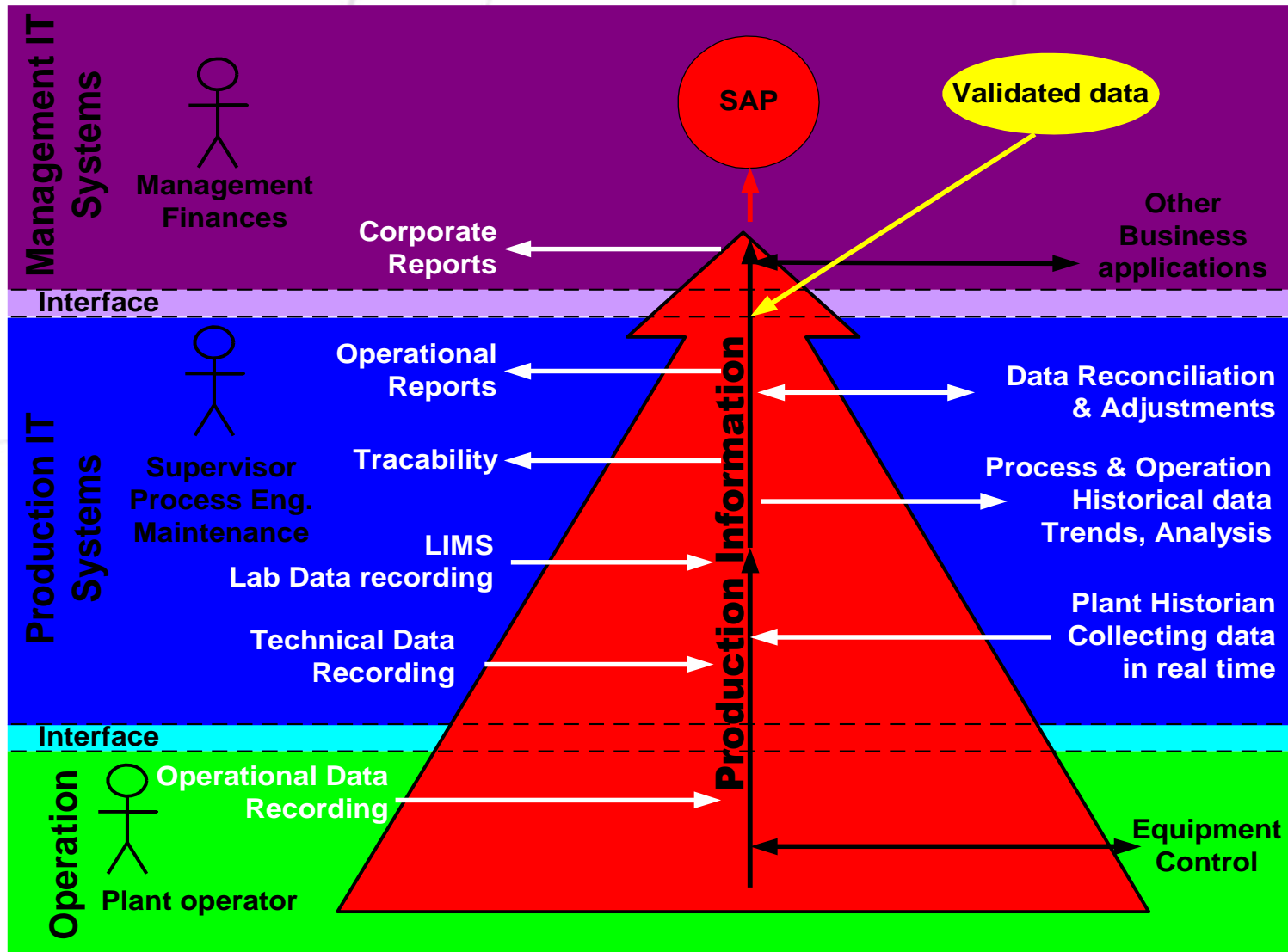
# DEVELOPMENT METHODOLOGY



# SYSTEMS ALOUETTE VISION

**« Provide a simple, efficient,  
integrated and scalable Plant  
Information System »**

# PRODUCTION SYSTEM : VISION





# IMPLEMENTED TECHNOLOGIES

- **Automation & Control**
  - Siemens PCS7
  - ABB MicroScada
  - Proprietary systems:
    - Pechiney and Schneider: ALPSYS (pot regulation)
    - Innovatherm ProBake (Anode Baking Furnace), etc...
    - Invensys: Vision system (anode defect inspection)
- **OSIsoft PI Systems real time data base**
  - PI ProcessBook, PI-SQC, ActiveView, Batchview, ...
  - PI-ACE
  - PI-OLEDB
  - PI-BATCH including PI Batch Generator interface



# IMPLEMENTED TECHNOLOGIES

- **Oracle Relational Database**
  - Version 9.2.0.6
  - Sector databases storing all transactional production data
  - Oracle Application Server (OAS) for Web reporting and interface and also scheduled Reports
- **Uniface**
  - 4GL development tool highly platform and database independent
  - Programming tool used to develop production IT applications through all plant areas
- **Legato (co-standby server – AAM)**
  - Redundancy of the PI acquisition node
  - A single server running Legato provides redundancy for all acquisition nodes

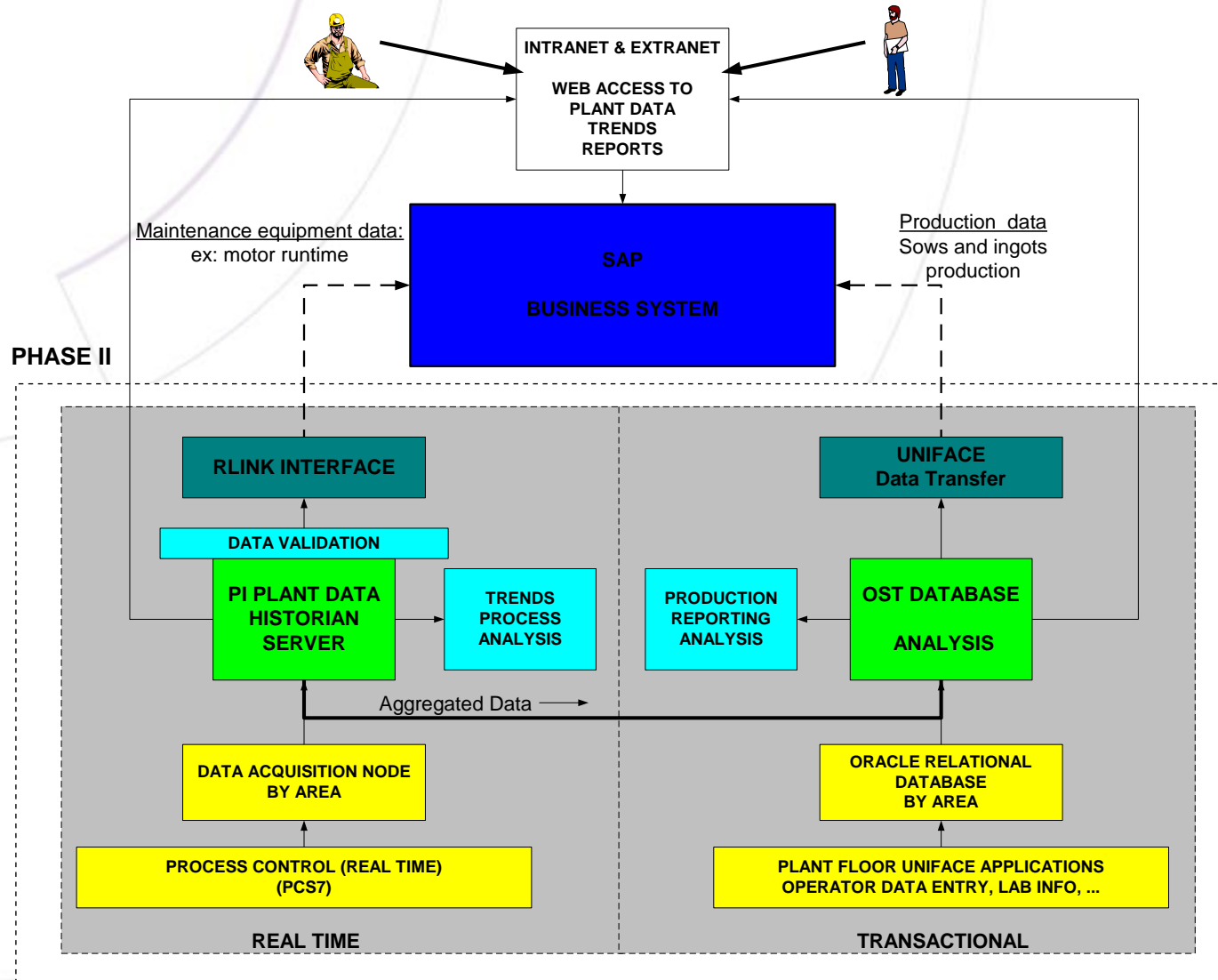


# PI IMPLEMENTATION

- **4 Plant Data Historian servers**
  - Carbon plant, Services, Electrolysis, Casthouse
- **More than 60,000 tags in use**
- **6 acquisition nodes with redundancy**
  - 4 OPC (Siemens) for process control
  - 1 OPC (ABB) for energy management system
  - 1 OPC for anode baking furnace
  - 1 BatchFI for meteorological data
- **Project includes the purchasing of Rlink for future integration with SAP.**
  - Maintenance information will be transferred to SAP using Rlink.

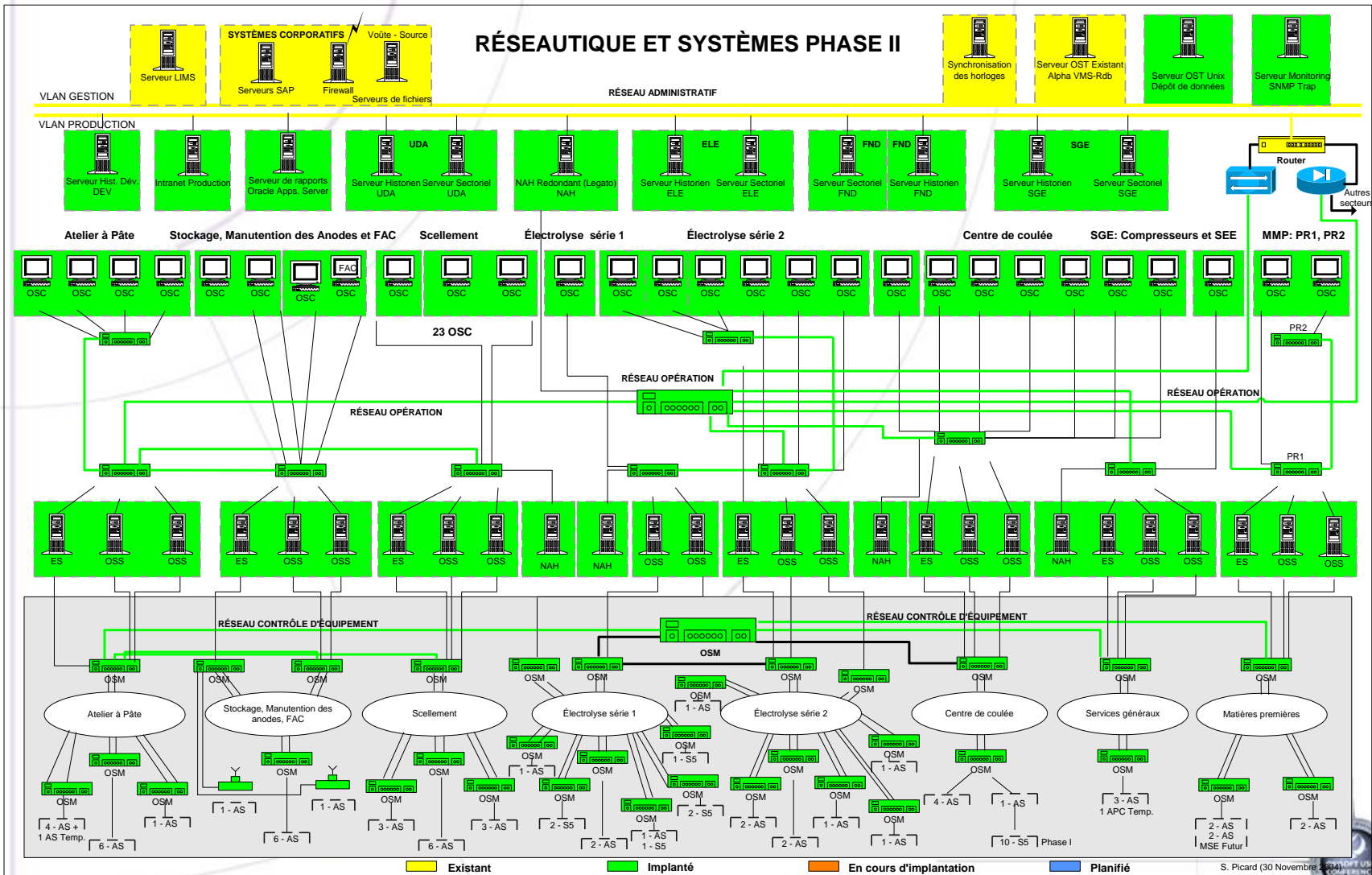


# TECHNOLOGY MODEL PROPOSED





# SYSTEM ARCHITECTURE (global)



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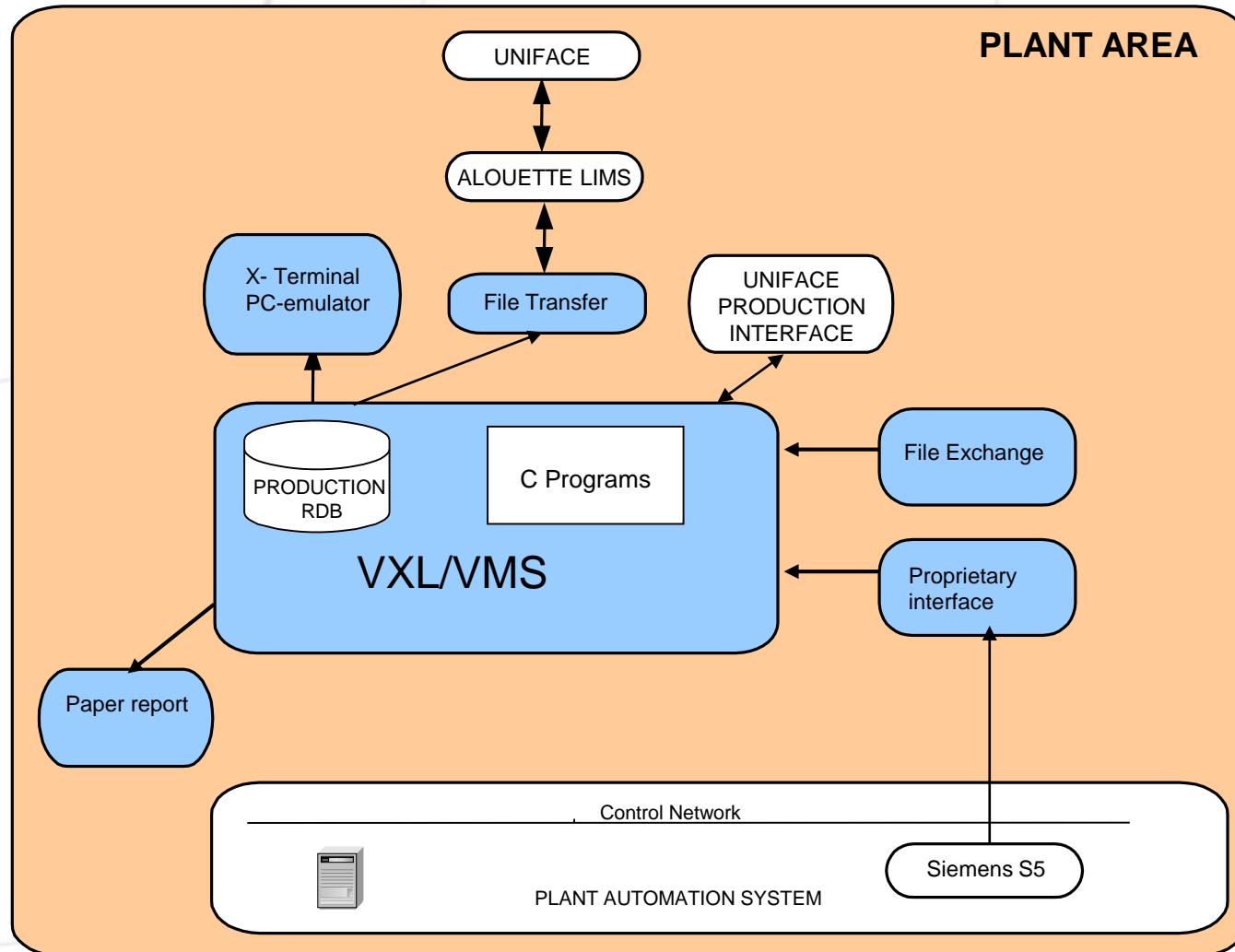
# BROWNFIELD INTEGRATION

- **Challenges**

- **Existing system provides critical information to operation**
  - Reports
  - Data storage
  - Trends
- **Existing systems merge Operator interface and data management**
- **System must be migrated without extended downtime to new systems**
  - New Control platform (Siemens PCS7)
  - PI RTPM
- **Due to operational constraints:**
  - For each plant area: system are migrated individually
  - Maximum plant shutdown duration is one week
    - Production data must be available at all times



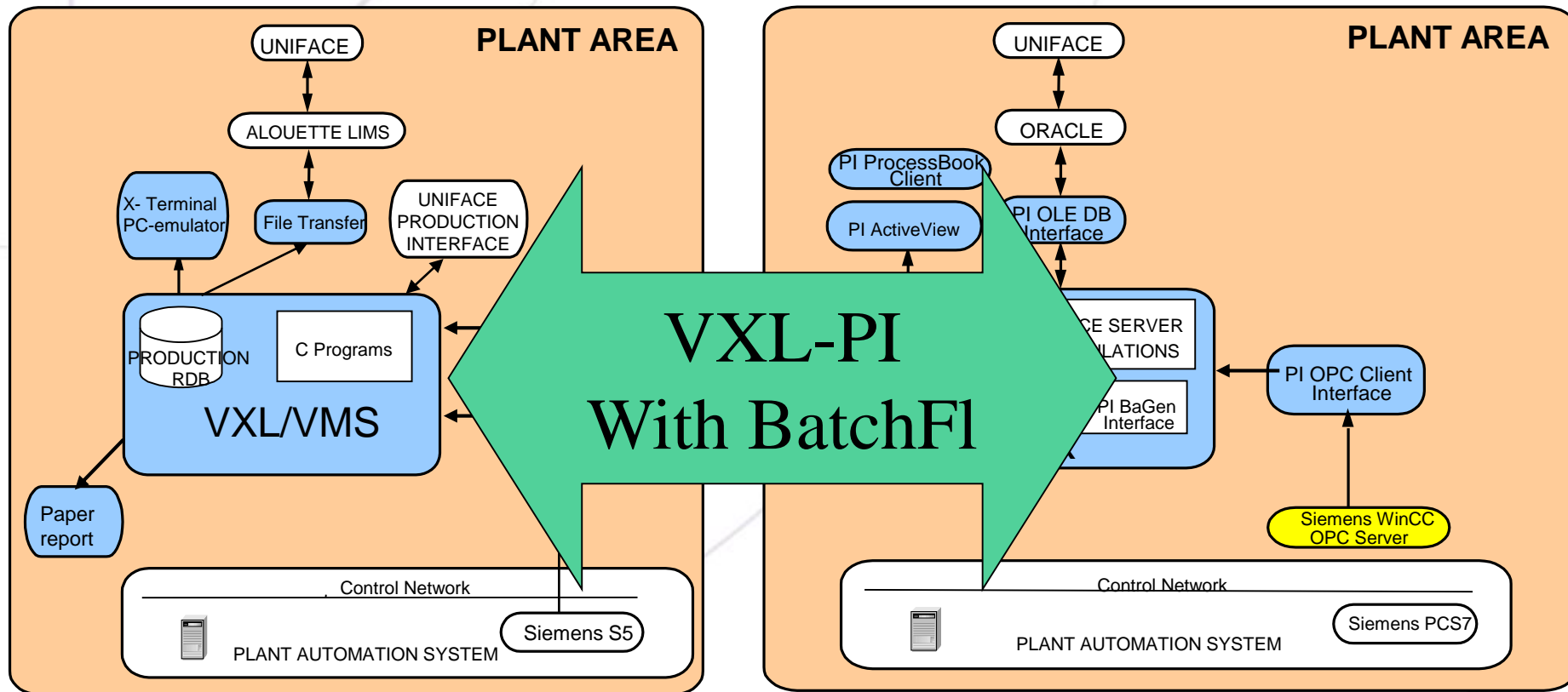
# EXISTING PRODUCTION SYSTEMS ARCHITECTURE



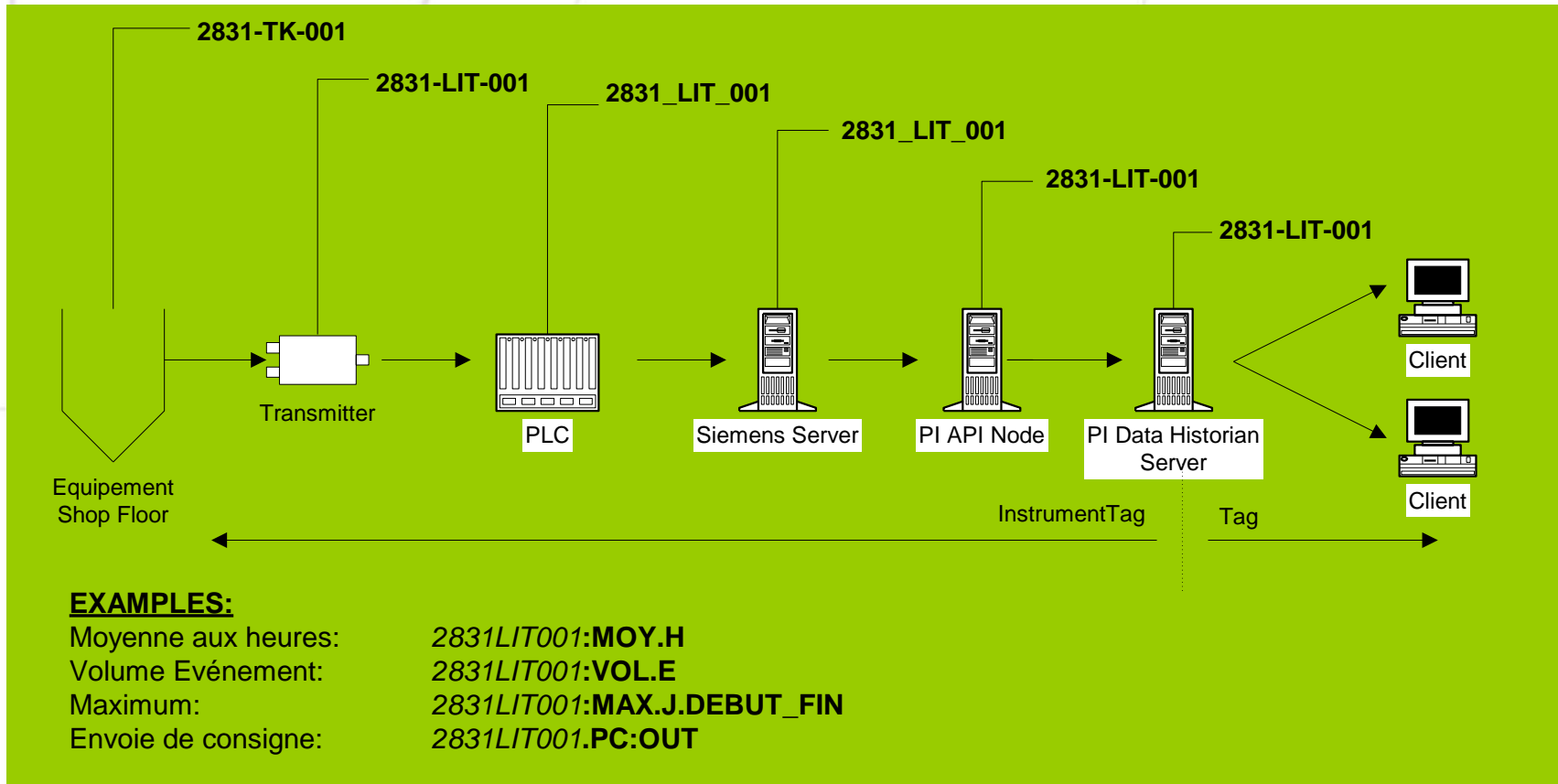


# TRANSITION ARCHITECTURE

- Based on VXL PI developed interface
- Allows progressive system migration

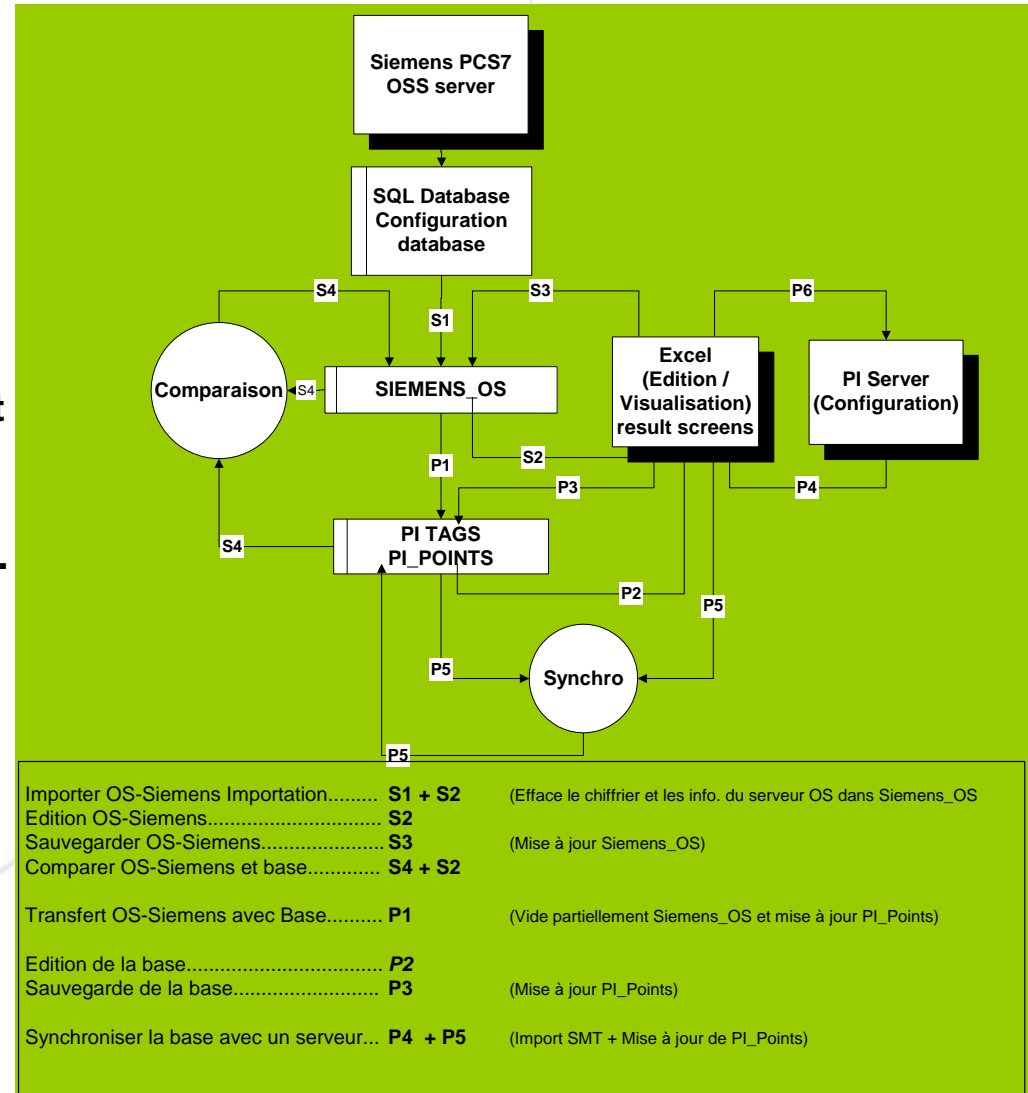


# TAG STANDARD IDENTIFICATION



# AUTOMATIC TAG CONFIGURATION

- **Tools were developed in order to automatically retrieve all tags information and properties from the Siemens PCS7 database.**
- **Imported information from PCS7 is exported to an Oracle database for validation.**
- **Validation rules have been developed in order to ensure that the standards were respected.**
- **The editing of the result is done through excel using SQL queries.**
- **All tags have editable fields in order to insert notes, add reference etc....**
- **Generation of a comparison report between tags in a PI server vs the Siemens PCS7 in order to process only the variation.**
- **PI information have priority over the basic Siemens configuration database**



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# PRODUCTION INTRANET

- **Objectives:**
  - Provide an easy access to plant information for every authorized users and from anywhere in the plant
    - Alouette has over 100 occasional users
  - Provide a central location for the distribution of plant information: trend (activeview), production reports (html, pdf), ...
- **Technology used:**
  - IIS and standard Internet Explorer as a browser
  - PI Activeview (Activex to visualize PI PDI)
  - Adobe acrobat viewer, ...





# PRODUCTION INTRANET

Intranet suivi de production - Microsoft Internet Explorer


File Edit View Favorites Tools Help

Back Forward Stop Home Search Favorites Media Print View Source

Address <http://172.16.2.172/activeview/> Go Links

Google search search Asta-killer search Serial archive Lyrics archive

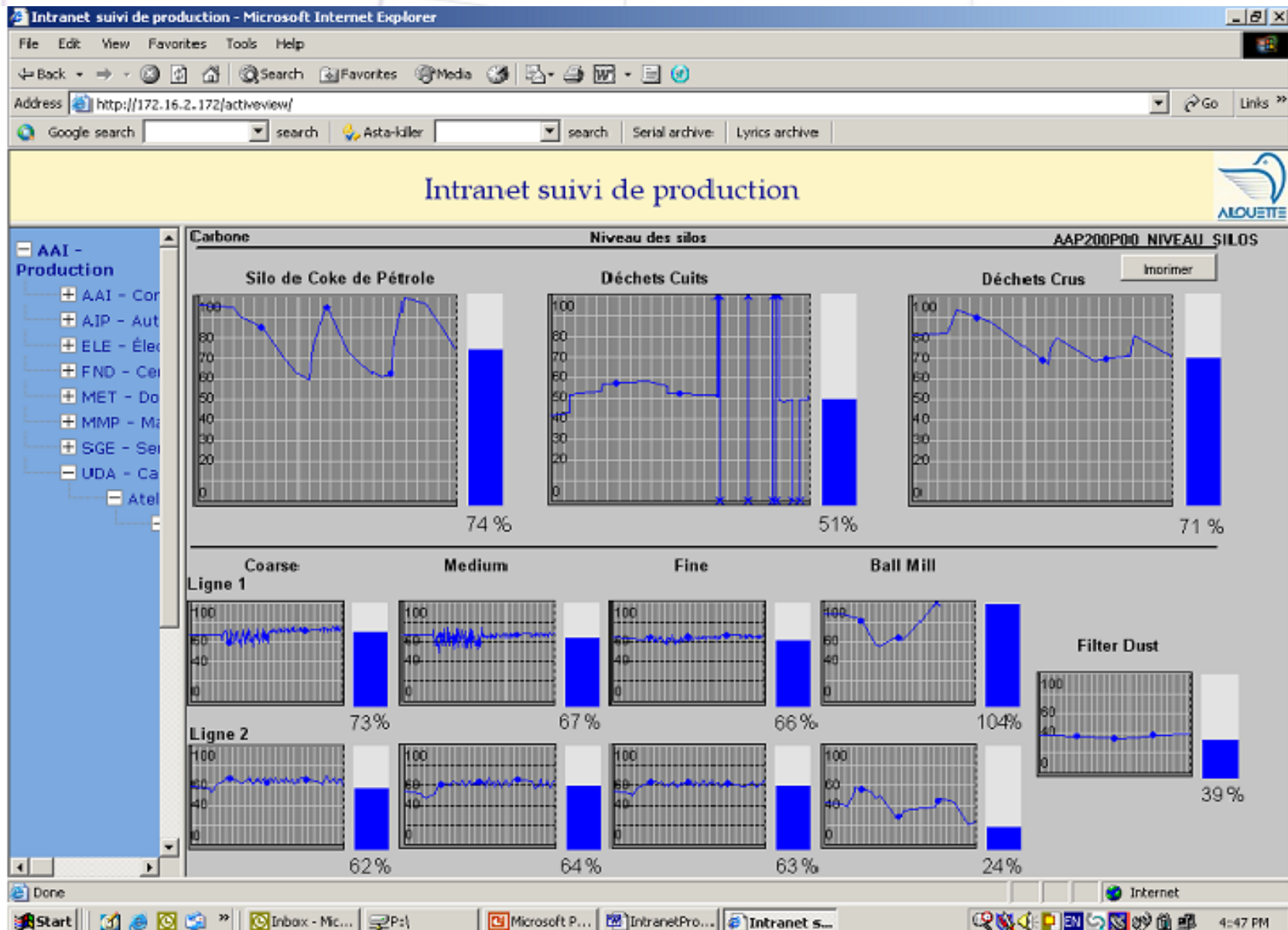
## Intranet suivi de production



- Atelier à pâtes
  - Graphes opération
    - [Niveau Silos Matières Premières](#)
    - [Réservoirs de Brai](#)
    - [Débit Matières Premières](#)
    - [Débit et Consigne Matière Première](#)
    - [Pression et Température des dépoussiéreurs](#)
    - [Trémie Ligne 1](#)
    - [Trémie Ligne 2](#)
    - [Broyeur à boulet](#)
    - [Malaxeur à pâte](#)
    - [Débit des Pompes Doseuses de Brai](#)
    - [Taux de Brai](#)
    - [Température HTM - Circuit A](#)
    - [Température HTM - Circuits B, C, D et E](#)
    - [Température du préchauffeur](#)
    - [Densité sèche](#)
    - [Liste des anodes produites](#)
    - [Pression -- Vacuum Fin des Compacteurs](#)
    - [Carte de contrôle Anodes](#)
    - [Paramètres de la balance du Ball Mill](#)
  - + Suivi et analyse
  - + Rapports sous-secteur
- + Scellement
- + Fours de cuisson

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# PRODUCTION INTRANET

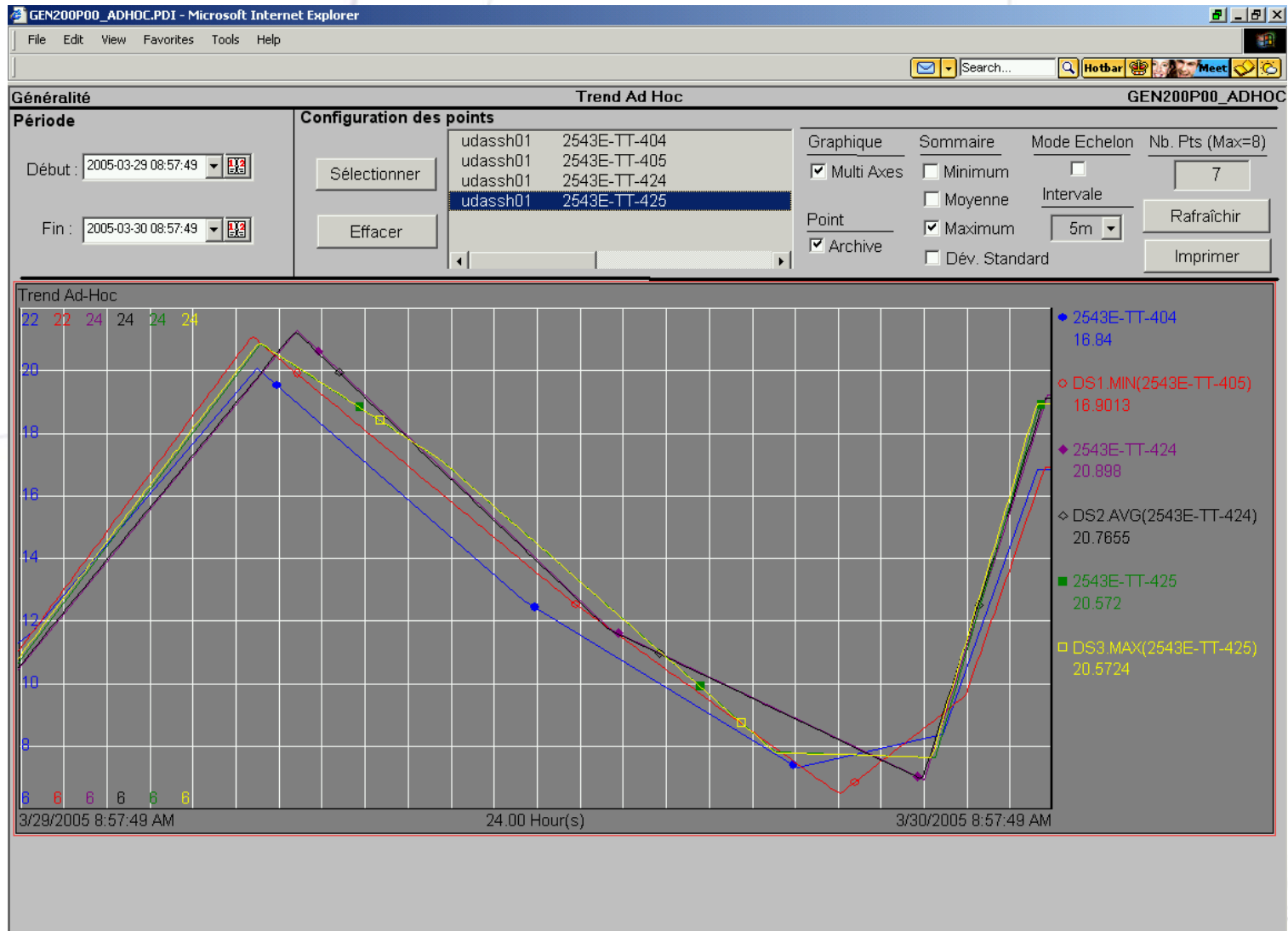


# USER AD-HOC QUERY (Intranet ActiveView)

- **User tool: Ad-Hoc query**
  - Provide a simple way to rapidly create trend in order to monitor closely the process or ...
  - Methods: Through a browser from the production intranet (Activeview)
  - Between 10 and 50 users could access it
  - Approximately 10 concurrent users
  - Available from any PC or thin client in the plant, office



# USER AD-HOC QUERY (Active View)



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# CALCULATION VALIDATION (PI-ACE)

- **Approach to ensure calculations quality in case of communication loss due to a PI server shutdown:**
- **Calculation Clock Based**
  - **Calculation are based on time period (such as: 1 min, 5 mins, etc)**
  - **Standard algorithm that allows to automatically restart calculation from the last stop of the PI-Ace scheduler or server shutdown**
  - **Use the date of the last result in order to restart the calculation. Will increment according to the calculation.**



# CALCULATION VALIDATION (PI-ACE)

- **Calculation Event Based**
  - Calculation based on events (send data to the relational database, send e-mail, etc)
  - Standard algorithm that allows the calculations to be restarted after any type of loss of communication with the server
  - Use the date of the last result in order to restart the calculation will increment based on new events found.
- **Recalculation**
  - Use the manual option "Recalculate" from PI-ACE. Allows to restart all calculations for any period of time.
  - Very useful feature when for any reason we have a gap in the data calculation. The project standard algorithm only allows to recalculate from the last result.



# ENERGY MANAGEMENT SYSTEM

- **PI-ACE validating and processing methodology:**
  - **Complex calculations are executed for the energy consumption reports**
  - **Critical information and results must be validated using this methodology:**
    - **Gross accumulator ---> Filter ---> Summations --> Infinite accumulator**
    - **Filter = Remove Bad Calc, IO Timeout, etc...**
    - **Summations will add the gross value to the infinite accumulator (type int32). Reset will be done at 2,2 billion)**
    - **Infinite accumulator will facilitate the calculation of consumption on long periods of time because it does not require to be reinitialized.**
    - **This approach simplifies calculations**
    - **Use of annotation field to track manual changes**



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# Batch Tracking : Carbon Plant System

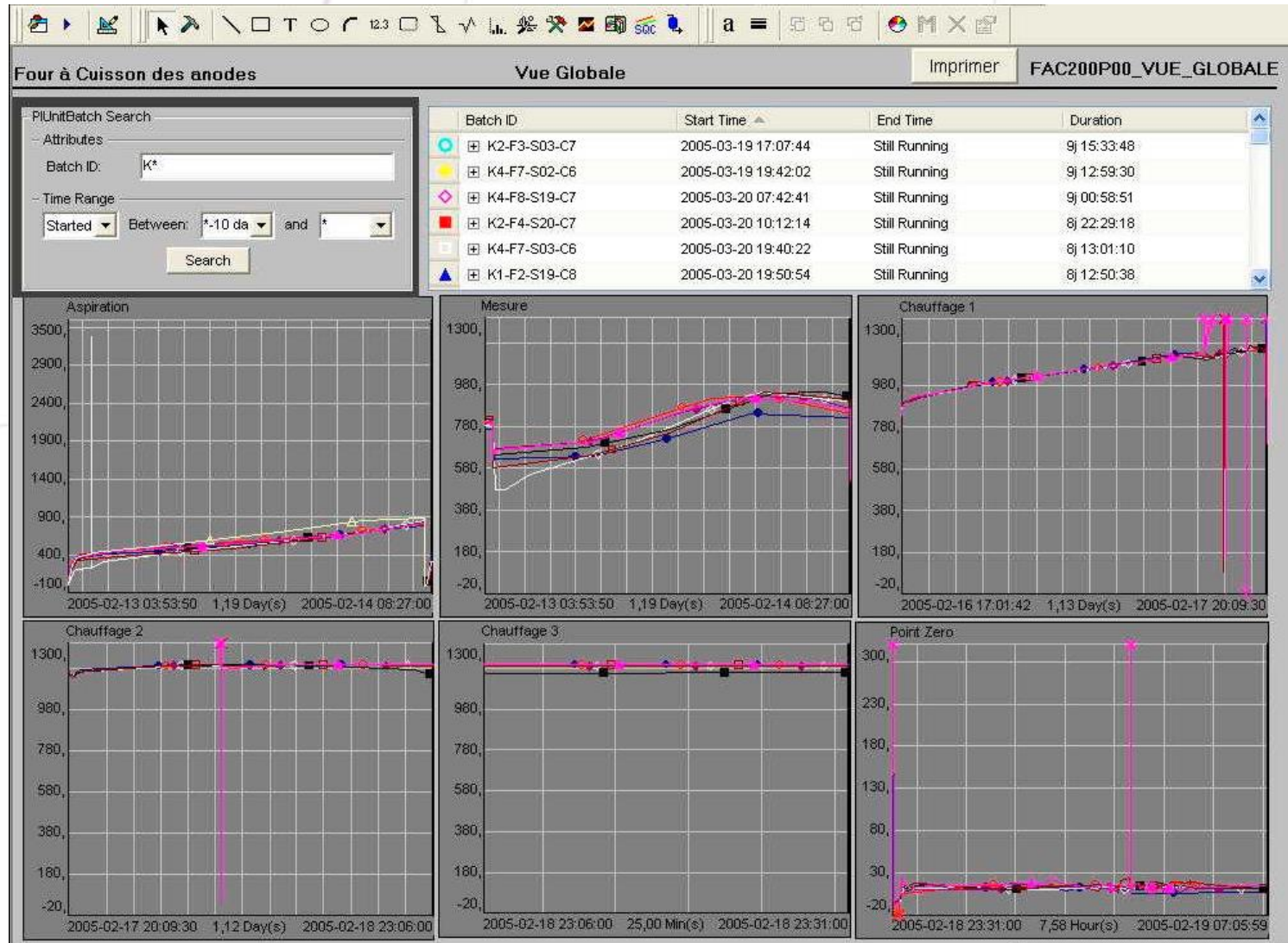
## Carbon anode baking furnace batch tracking:

- The baking furnace uses a complex moving fire system that generates different production batches
- With PI we follow the process variables during the baking process. It affects the performance in the reduction cells
- PI assists in providing information and trends that are required for analysis and optimization of production
- PI records the baking conditions
- Anode tracking process information: All the anodes produced are created in a relational database (Oracle)
- In the anode tracking system we provide in a PI trend information coming from various sources: PI database and Oracle database.

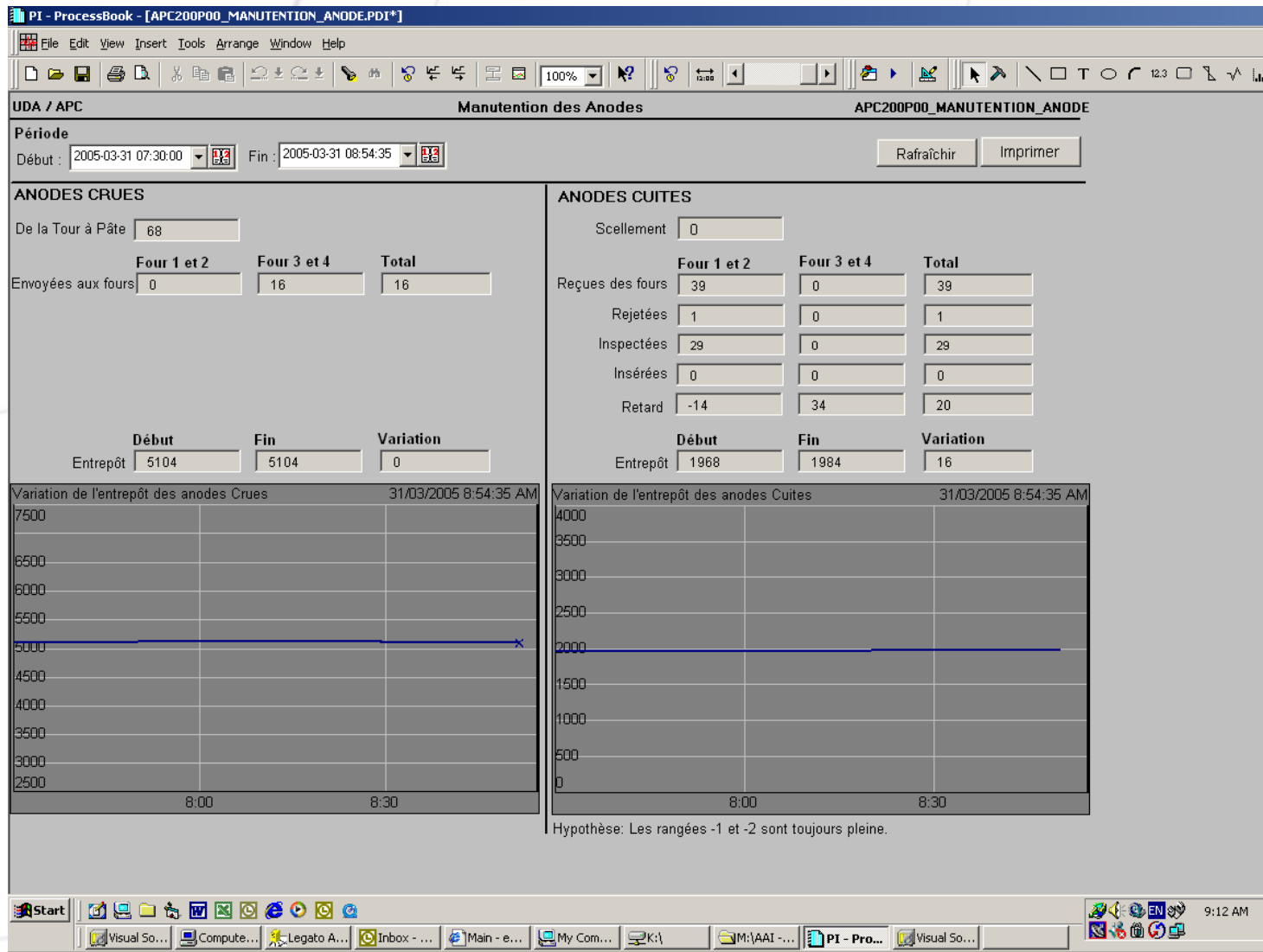




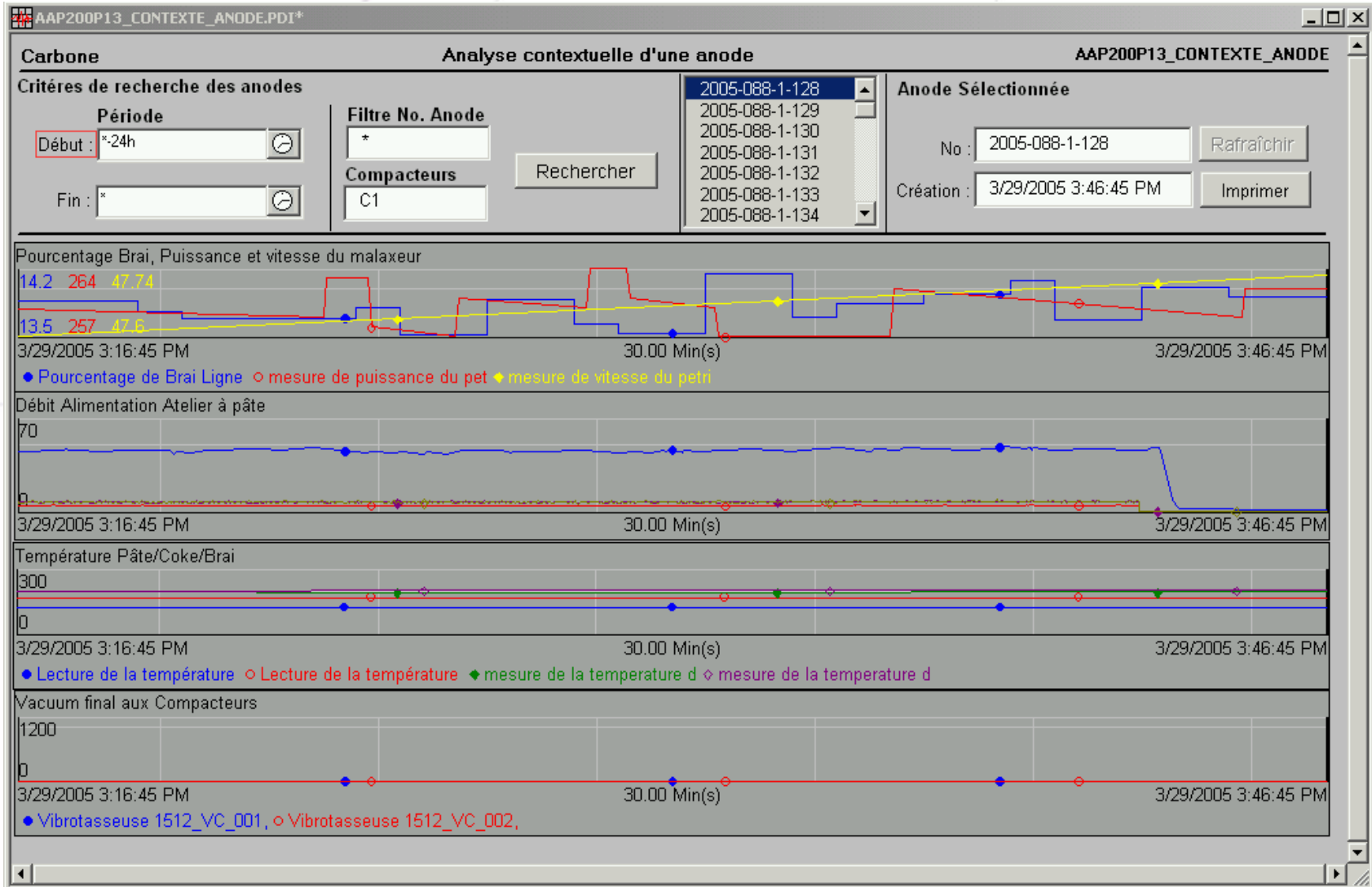
# Anode Baking Furnace (Batch Visualization)



# Anode Tracking Information System



# Anode Production Information System



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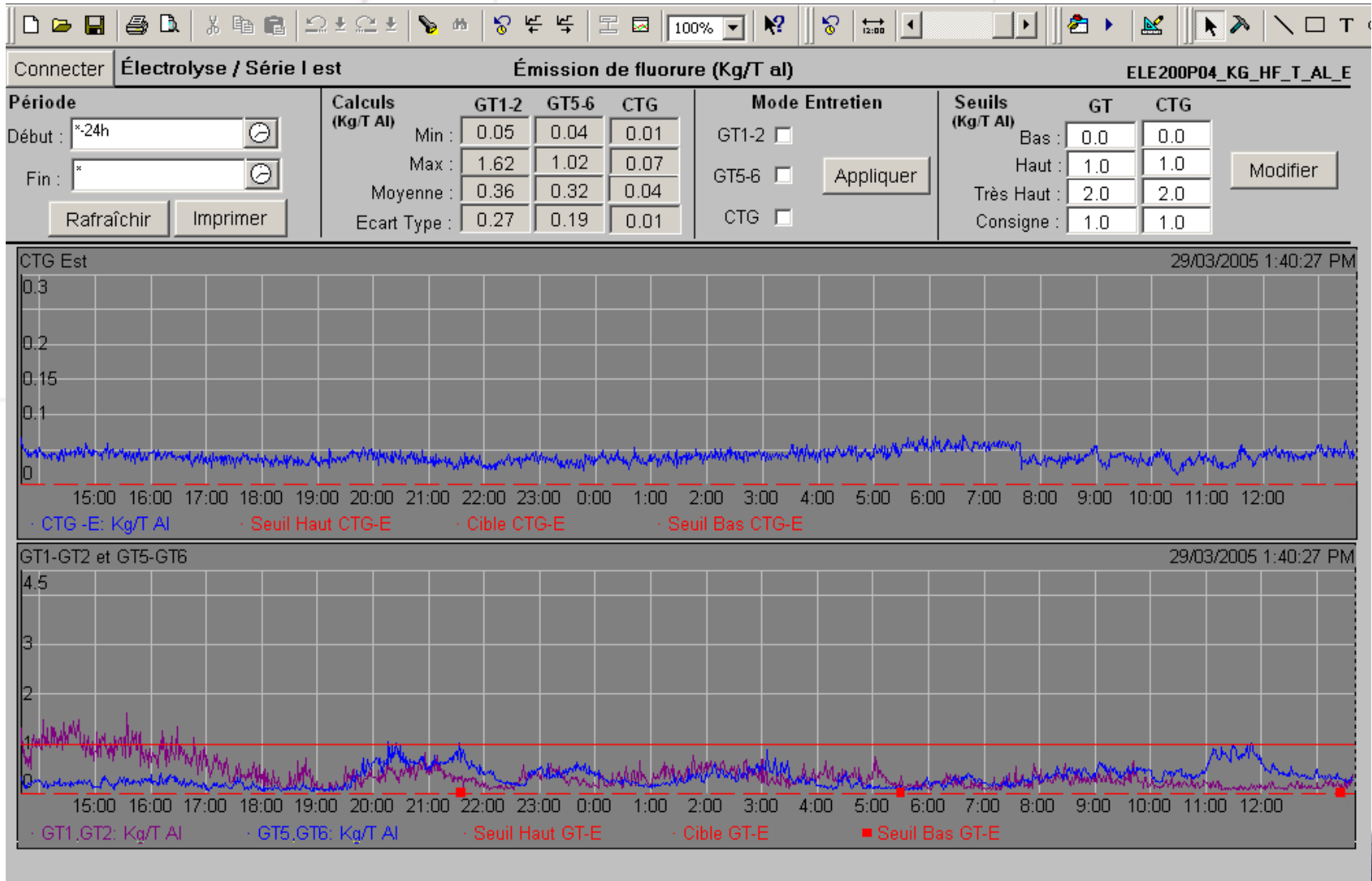


# Environmental Systems

- **PI was used in order to develop environment monitoring applications:**
- **Objective:**
  - **Provide real-time information on gas and... so that everyone can take action toward reducing gas emissions**
  - **Information is accessible from any browser, PI .pdi are displayed on screens located on the plant floor  
ex: pots room**



# ENVIRONMENTAL SYSTEMS (HF emissions)





# ENVIRONMENTAL SYSTEMS (on plant floor)

Électrolyse / Série I

Sommaire des Émissions de Fluorures Totaux (Kg/T al) par poste

ELE200P09\_KG\_HF\_T\_AL\_12H\_HA

## HALL A

# 0.40

Kg/t Al

Indice qualité: 100

## CTG

Est

0.02 Kg/t Al

Ouest

0.08 Kg/t Al

## Poste Précédent

0.38

Kg/t Al

Indice qualité: 100



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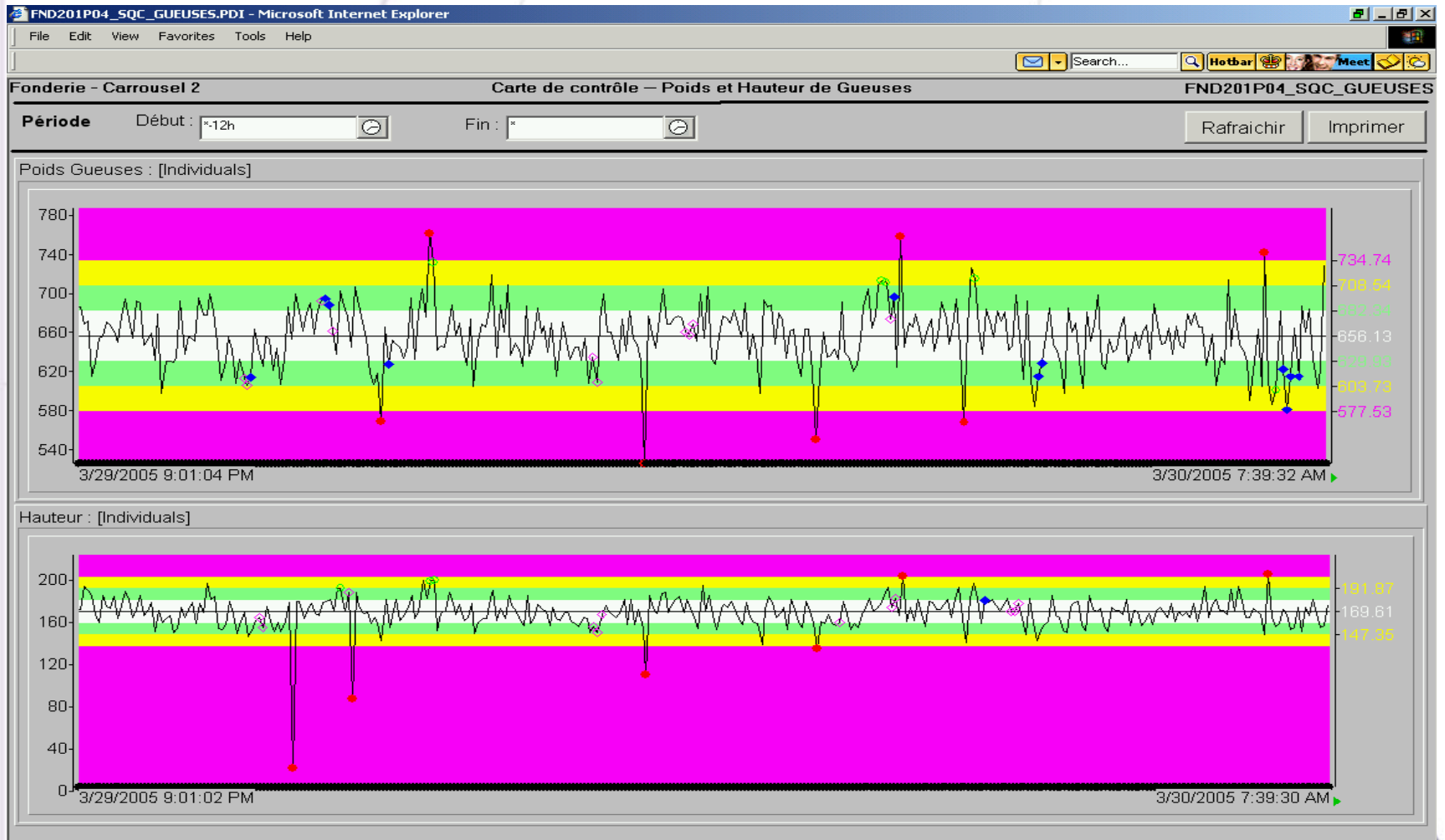


# Real Time Production Data Integration

- **PI interacts with the PLC in a bi-directional way :**
  - **Transmits lab results to the PLC in order to provide information on the level of Fe, Si for the bar code printing on the sow.**
  - **PI receives data from the PLC, such as the stabilized weight of the sow. After, that information is sent to an Oracle database. That information will be used by other applications developed in Uniface.**



# Casthouse Systems (Sow quality: heights and weights)



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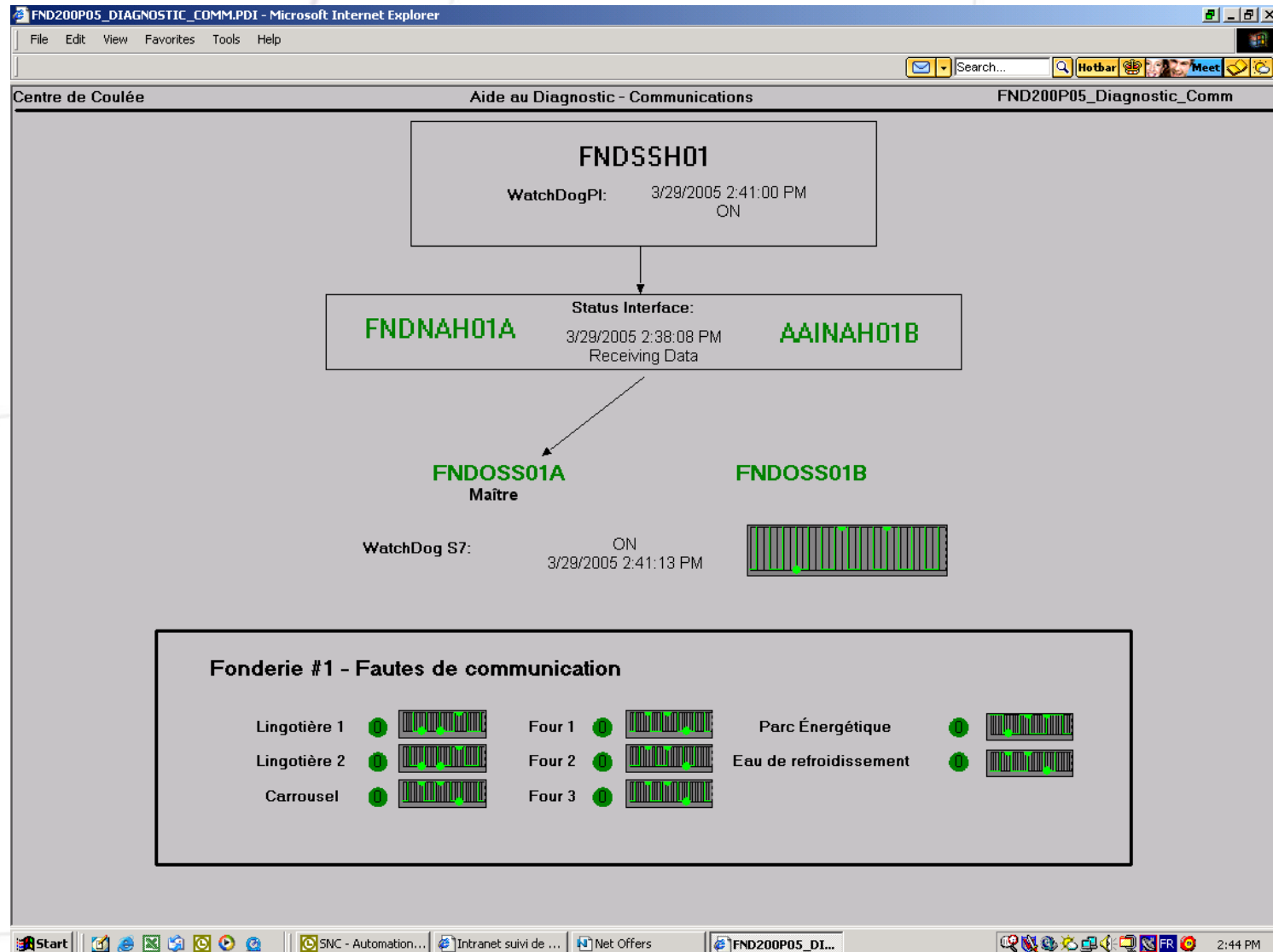


# SUPPORT – DIAGNOSTIC TOOLS

- **PI Diagnostic applications were developed in different plant areas in order to monitor:**
  - **Communication between the various interfaces**
  - **Status and activity of applications on different equipment**
  - **Status of the communication between different servers**



# SUPPORT – DIAGNOSTIC TOOLS





# CONCLUSIONS

# BENEFITS

- **Some of the benefits encountered with PI:**
  - Best visibility on plant operation and process
  - Better information in order to facilitate process improvement and operations. Better control of the different plant process variables
  - Assists management in the decision making process
  - Facilitate problem resolution by providing real time information
  - PI helps in tuning and optimizing process and equipment
- **AAI is experimenting a fast and efficient start-up**
- **Integrated EPCM system integration team provided:**
  - Smooth system migration: Minimum impact on plant
  - Systems integration is under budget



# QUESTIONS



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