Power Generation Commercial Monitoring at ESB, Ireland.

OSI Pi Conference

San Francisco

April 2004
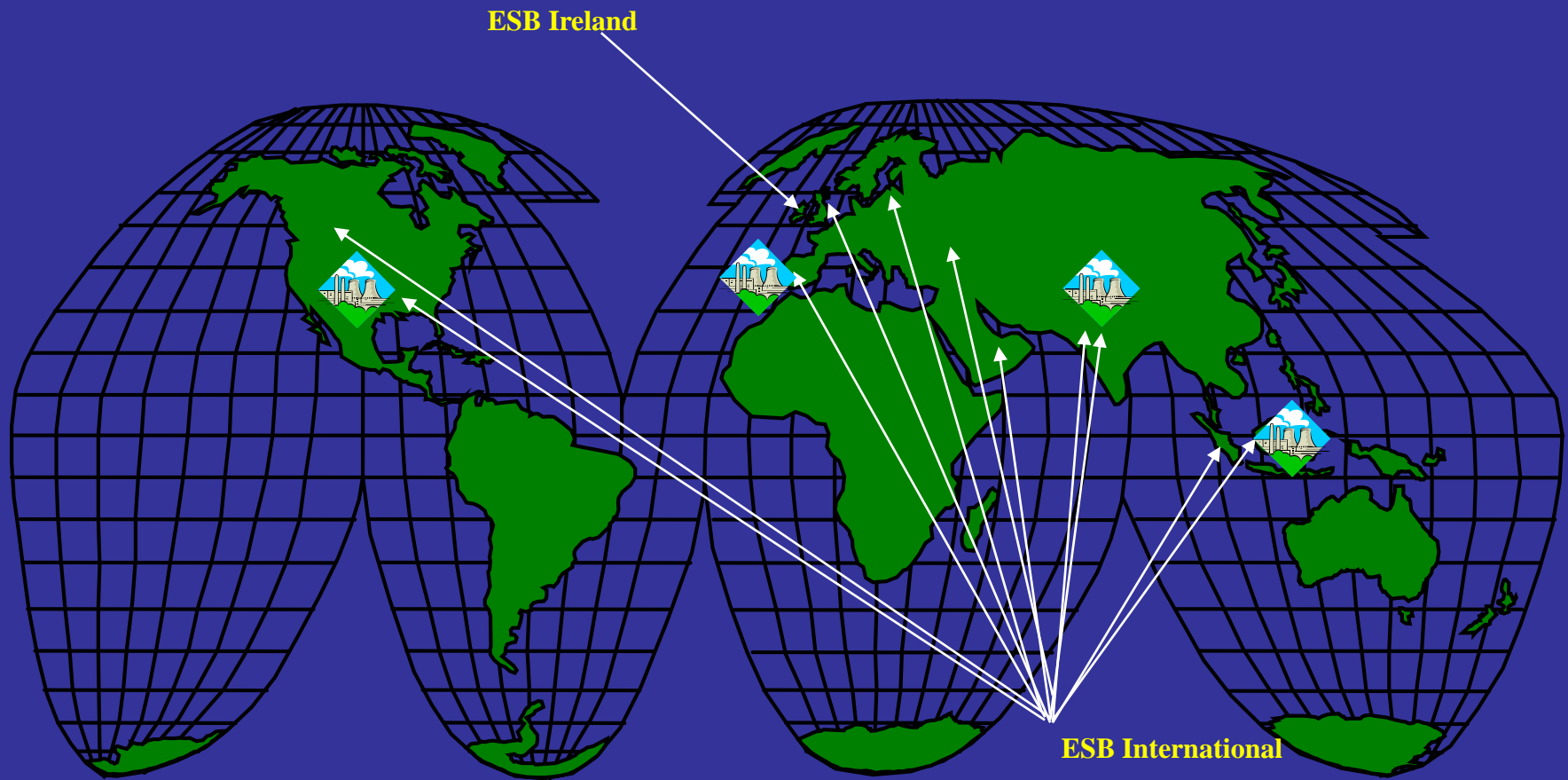
Introductions
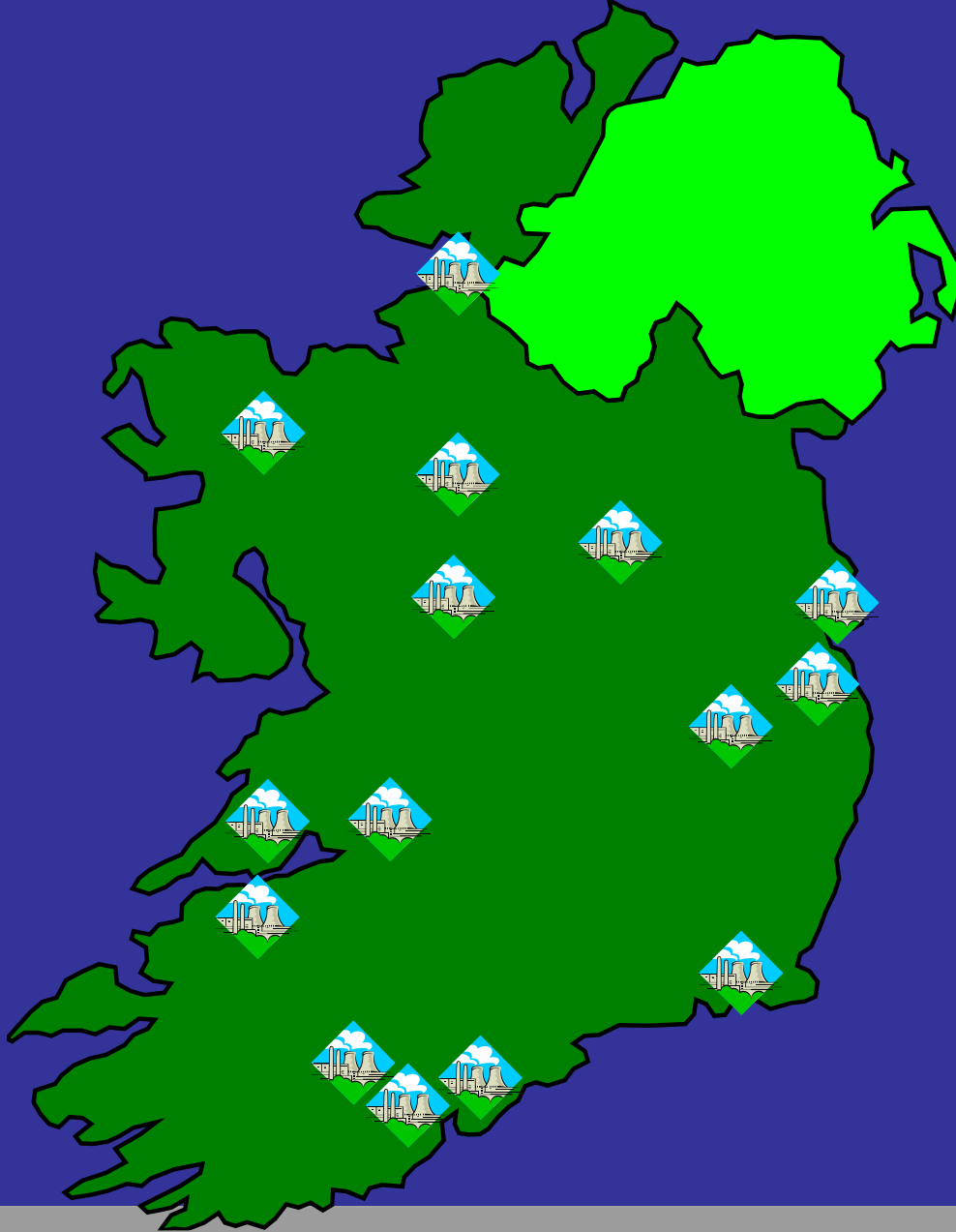
- Charlie O'Neill,

    ESB Power Generation,

    Dublin, Ireland

- Malcolm Bates

    Process Informatics Ltd

    Darlington, England

ESB Worldwide

ESB Ireland

ESB International

ESB Provide Power Utility Services worldwide

ESB Ireland – Power Generation

- 15 Power Plants
  - 22 Conventional Fossil Units
  - 3 CCGT Units
  - 10 OCGT Units
  - 16 Hydro Units
  - 4 Pumped Storage Hydro Units
- 4750 MW Installed Capacity
- Peak Market demand 4040 MW
- Electricity Sales Growth 5-6% pa
- Over 1.5M Customers
- Currently 13 PI Servers
  - 200+ Pi users and Growing
  - PI PrcessBook
  - PI Datalink
  - Pi ICE
  - OIS PI Applications
    - Client Based
    - Web Intranet Based

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In the Beginning…….

- Initial Development for OIS Application
  - Technical Performance
  - Plant Availability
  - Staff Commercial Awareness

- Cost of controllable losses identified and displayed in Euro, in near real-time.

	Boiler Combustion	Steam Turbine	Generator/Electrical	Fuel/Gas/Air	Auxiliaries	Fuel
	Total Losses	**Condenser**	Condensate	Feed Water	Boiler Water	Steam Generator

LP Turbine

Steam	27.82	C
Steam	3.88	kPa

A Side   B Side

Underfeed

20.45 C   CW out   CW out   20.10 C

9.92 C   CW in   CW in   9.66 C

Emergency
Underfeed

3.63 kPa

999.25 mm

Recirculation
valve

Cooling Water

	Actual	Optimum	Loss €/hr
Total Vacuum kPa	3.63	3.67	-13.09
CW Rise (C)	10.61	11.37	-2.72
TTD (C)	7.61	5.98	-10.37

08-Apr-04 5:55:22 PM	Total Coal Flow (te/hr)	80.54	Final Steam Temp (C)	542.00	Current Unit Cost (€/MWh)	Bad
Output Power (MW) 308.88	Steam Flow (kg/s)	260.45	Boiler Pressure (MPa)	16.68	Total Losses (€/hr)	Bad

Print   Trend
Process Book

Navigation Environment
Overview Reports
Efficiency Manual Entry
Availability What If?
Asset Mgmt

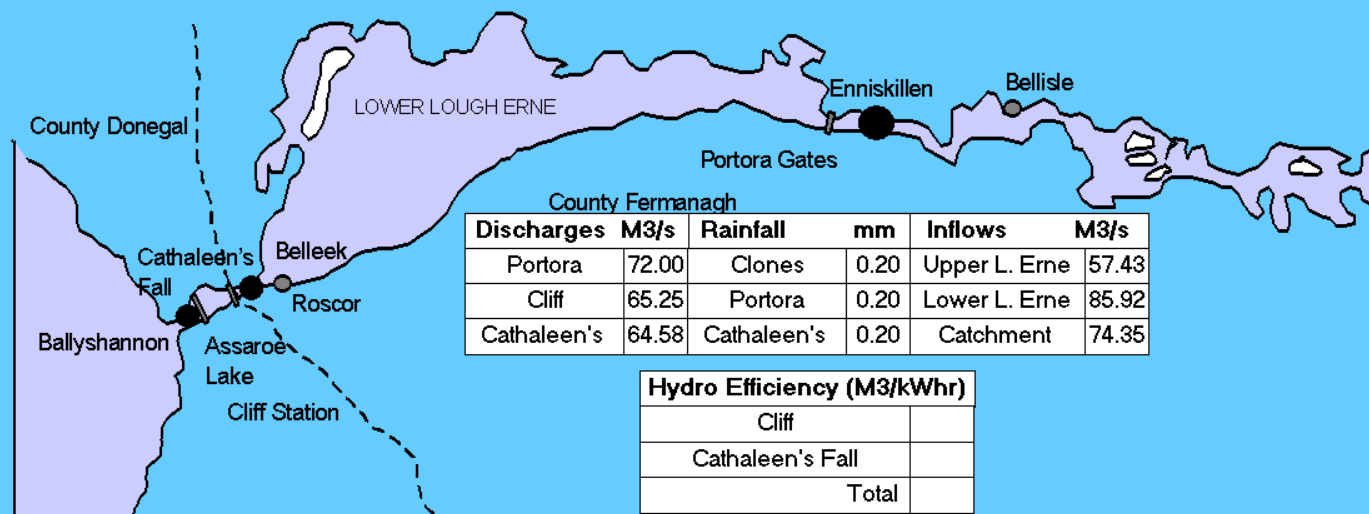Start | pcAnywhere Manager | My Computer | Inbox - Microsoft Outlook | PI - ProcessBook | untitled - Paint | OIS System - Unit03... | 5:55 PM

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Applications Built on Pi Platform

- OIS Hydro
- DAM Monitoring
- OIS Thermal
- OIS Perform
- OIS GPRS
- SCADA Visualisation

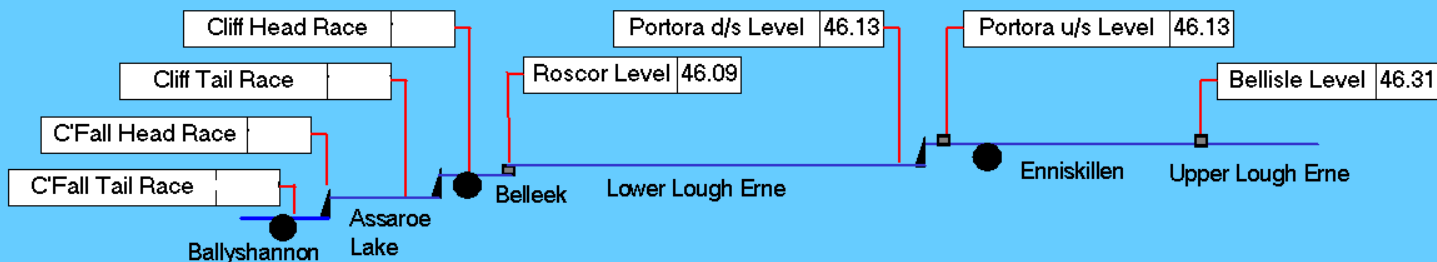**Hydrometric** | **Electrical** | **Clady**

Erne Hydro Stations Overview

County Donegal

LOWER LOUGH ERNE

Enniskillen

Bellisle

Portora Gates

County Fermanagh

Cathaleen's Fall

Belleek

Roscor

Ballyshannon

Assaroe Lake

Cliff Station

Discharges	M3/s	Rainfall	mm	Inflows	M3/s
Portora	72.00	Clones	0.20	Upper L. Erne	57.43
Cliff	65.25	Portora	0.20	Lower L. Erne	85.92
Cathaleen's	64.58	Cathaleen's	0.20	Catchment	74.35

Hydro Efficiency (M3/kWhr)	
Cliff	
Cathaleen's Fall	
Total	

ERNE CATCHMENT LEVELS

Cliff Head Race	
Cliff Tail Race	
C'Fall Head Race	
C'Fall Tail Race	

Portora d/s Level	46.13
Roscor Level	46.09
Portora u/s Level	46.13
Bellisle Level	46.31

Assaroe Lake

Ballyshannon

Belleek

Lower Lough Erne

Enniskillen

Upper Lough Erne

08-Apr-04 15:33:01

Print | Trend

Process Book

Environment | Reports | Manual Entry | What IF? | Plant

Navigation | Overview | SEP Hydro | Availability | Asset Mgmt

ESB

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ESB
Power Generation

Station Name Tarbert
Date:W/E Saturday Week

User Guide

Select a Date

◄ ►

Save Data

Calculate Results

Log Off

Send Email

Help ?

☑ Safe Mode

| | Input Data | Weekly Efficiency Output | Reports and Queries | Weekly Loss Analysis |

	Unit 1	Unit 2	Unit 3	Unit 4	Station
MWHrs Generated					
House Load MWHrs					
Overload MWHrs					
Runhours (Turbine)					
Runhours (Boiler)					
Boiler Recirc Runhours					
Cold Starts					
Warm Starts					
Hot Starts					
Equivalent Starts					
Available Hours					
Average CW Temp					

Calc.

| Unit Data | Fuel Stock | Solid/Gas Fuel Analysis | HFO/LFO Fuel Analysis | Fuel Price / Other Data |

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ESB ESBnet HOME | Efficiency | Availability | Emissions | Fuel | Status | How To ....

Operating Efficiency Trend

Power Generation									
Start: 04-Jan-04 End: 10-Apr-04	Generation		Operating Efficiency			Thermal Efficiency		Costs in €,000	
Station-Unit	GWhrs Gen	GWhrs Exp.	Op Eff Gen	Op Eff Exp	2004 Target Operating Eff	Thermal Eff Gen	Thermal Eff Exp	Tot Fuel Cost	Eff Losses
Poolbeg CG14	282	282	99.88	99.88	100.00	31.83	31.83	13,623	17
Poolbeg CG15	269	269	99.42	99.42	100.00	31.79	31.79	13,025	76
Poolbeg SG16	325	311	96.94	96.25	100.00	27.47	26.36	0	0
POOLBEG CCP	876	862	98.55	98.30	98.20	30.05	29.60	26,648	93

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File   Edit   View   Insert   Tools   Draw   Arrange   Window   Help

Moneypoint
889.50

MP1	282	MP2	305.47	MP3	303.04

Oil MW
622

GI1	0	GI2	-0	GI3	95
PB1	89	PB2	0	PB3	206
MP1	0	MP2	0	MP3	0
TB1	0	TB2	0	TB3	232	TB4	0

Dist MW
68

PB14	0	PB15	0	PB16	0				
MRT	0	MR1	0	MR2	0				
NW1	0	NW2	0	NW3	0	NW4	0	NW5	Freq
AT11	68	AT12	0	AT14	0				

Gas MW
731

AD1	265	AT11	0	AT12	0	AT14	0
PB1	0	PB2	101	PB3	0		
PB14	0	PB15	151	PB16	81		
MRT	104	MR1	29				
NW1		NW2		NW3		NW4		NW5	0 Freq

Peat MW
0

BK1		BK2			
LA2	0				
SH1	0	SH2	0	SH3	0

Hydro MW
143

AA1	0	AA2	13	AA3	0	AA4	20	Freq	50.01
ER1	9	ER2	8	ER3	20	ER4	20	Freq	50.01
LE1		LE2		LE3					
LI1	-0	LI2	-0	LI4	-0	LI5			
TH1	48	TH2	-0	TH3	-1	TH4	5	Freq	50.02

Current Time: 09-Apr-04 11:14:55

Total MW Generated

2454.19

Display Time

-1day	-15m	Now	+15m	+1Day

Calendar

Copy to Excel

Reports

Main Menu

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Evolution of OIS

- Led by clearly defined Business Requirement

- Operational Performance Metrics to Commercial Performance Control.

- OIS Strategy Underpinned by PI

- One Pillar of ESB Corporate IS Strategy

- Business Critical Applications

- Resilient Technical Architecture

- Supporting Decision Making where and when it counts

Generation Commercial Monitoring

- Market Driven Initiative

- Objective – To Minimise Uninstructed Imbalances as an Aid to Commercial Performance Optimisation

What is a UI???

- Each generating station unit is issued with instructions by NCC on the level of production for any given time. This is done via the EDIL system, and is called a *Dispatch Instruction*.

- For the purposes of settlement, the trading day is broken up into 48 half hour periods. So for every half hour period each unit will be expected to produce a specific quantity of electricity.

- Failure of the Unit to comply with an instruction will result in an *Uninstructed Imbalance (UI)*

- UIs are incurred when a generating unit's metered MWhr output does not match the instructed MWhrs from NCC in any settlement period.

- GCM is a tool to help identify when a unit is generating Uninstructed Imbalances.
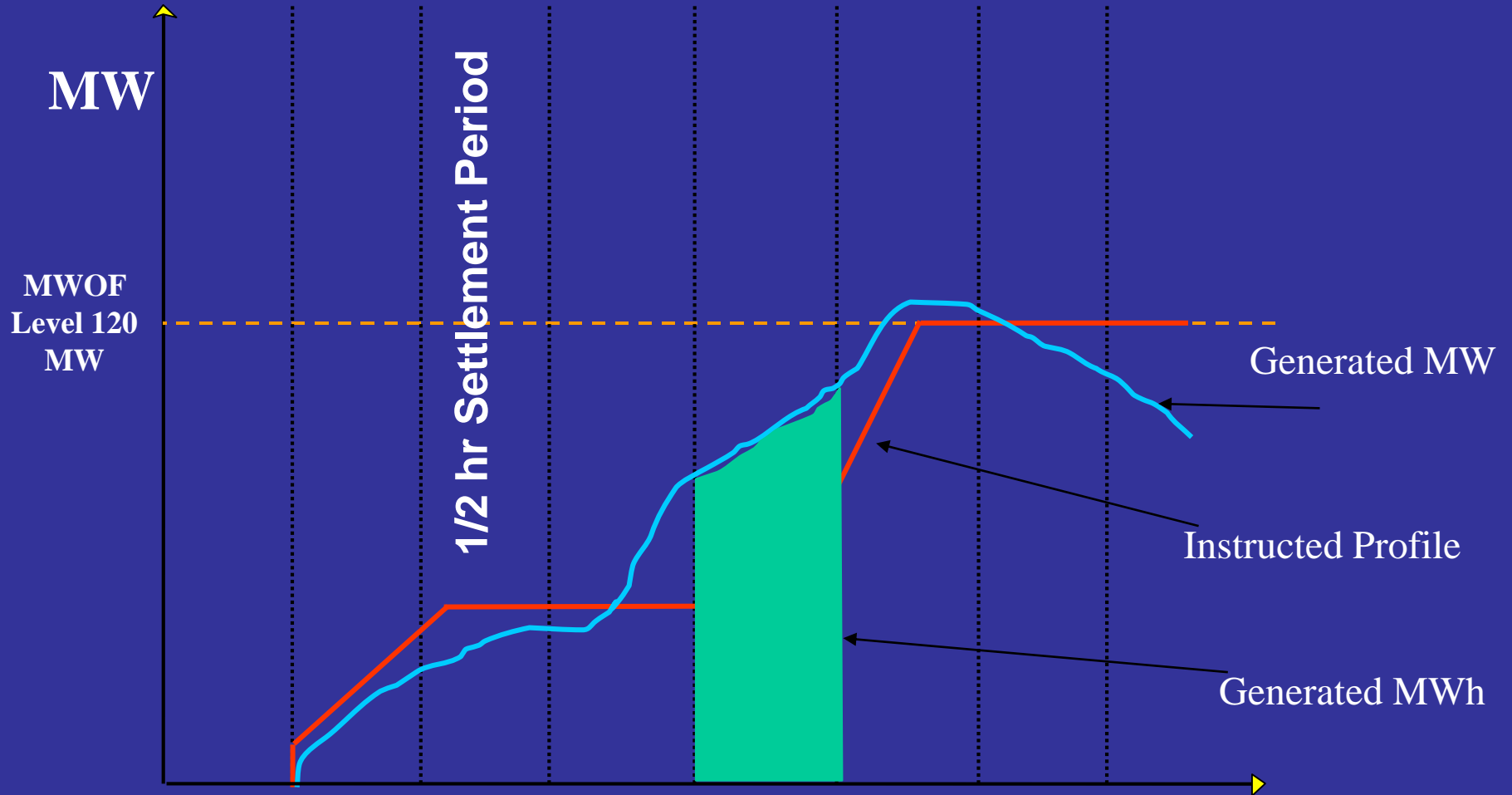
Instructed MWs

- Operational Characteristics held in Module Database

- Updated Daily via File Transfer
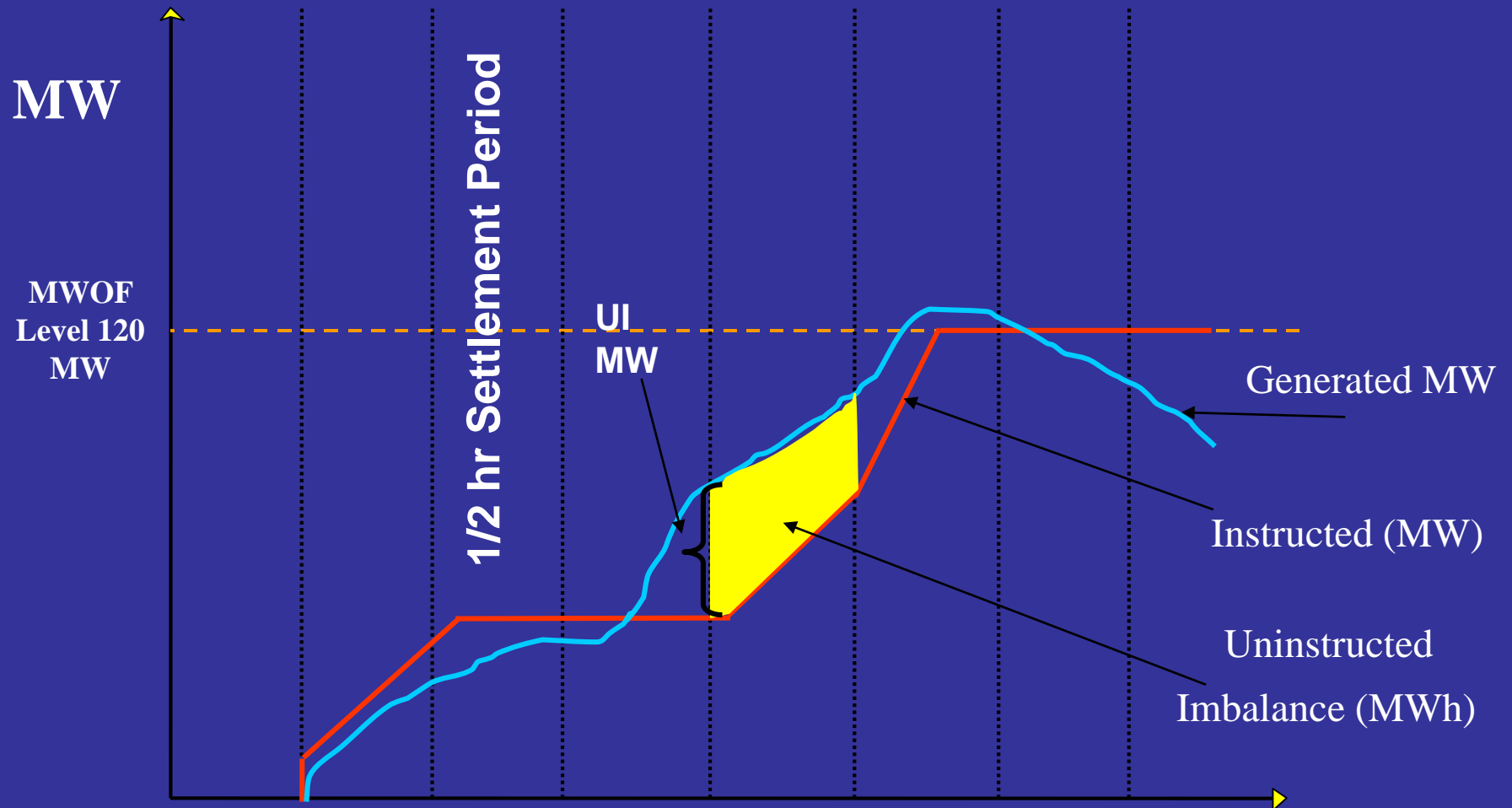
- Used to Plot Instruction Profile

- **The instructed profile gives us the MW values to be achieved at particular times**
- **The area under this profile gives us the MWh targets (Instructed Quantities) for any time period t.**
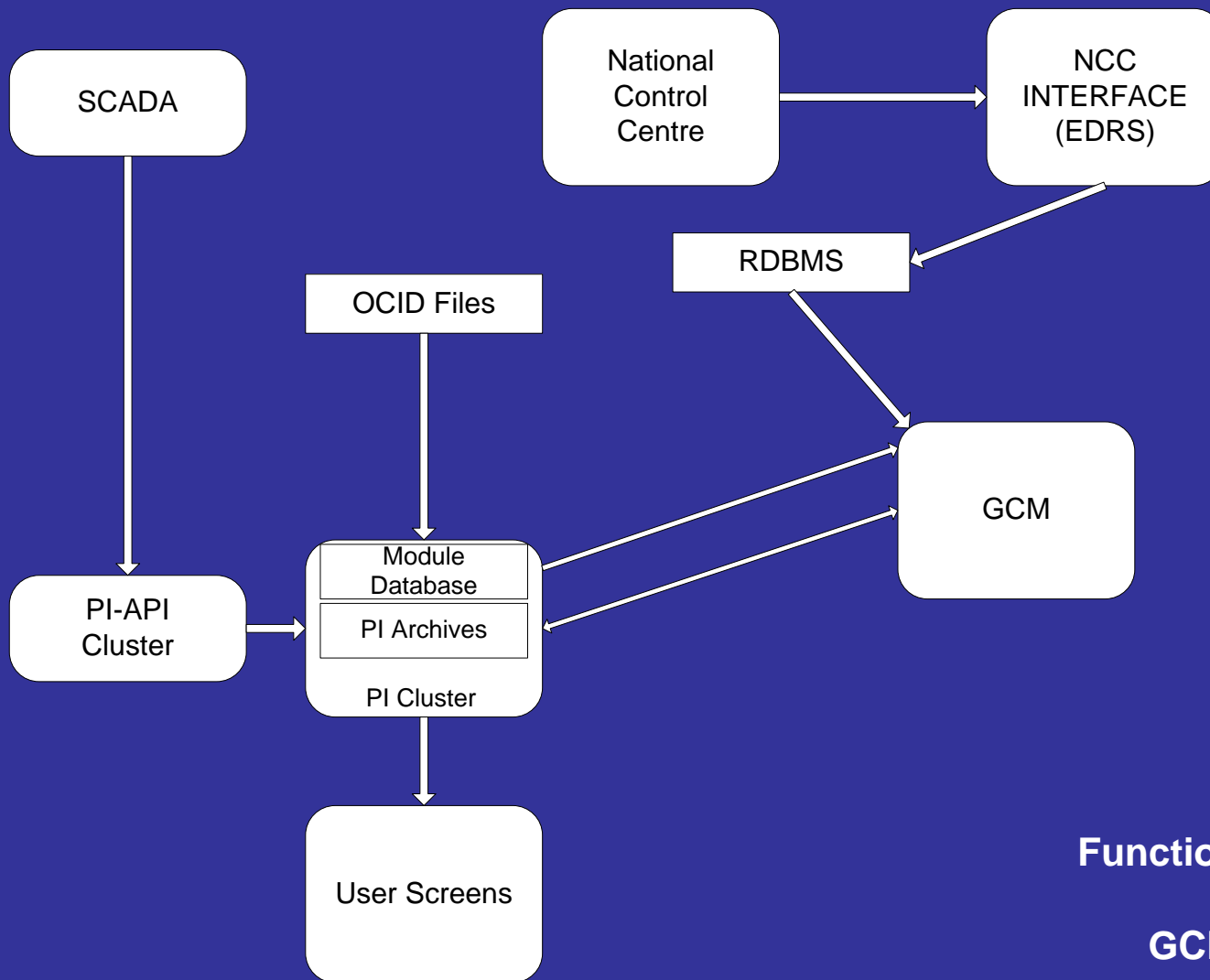
MWOF Level 120 MW

1/2 hr Settlement Period

Achieved Status

Instructed Profile (OCID derived)

Instructed Quantities

Synch time
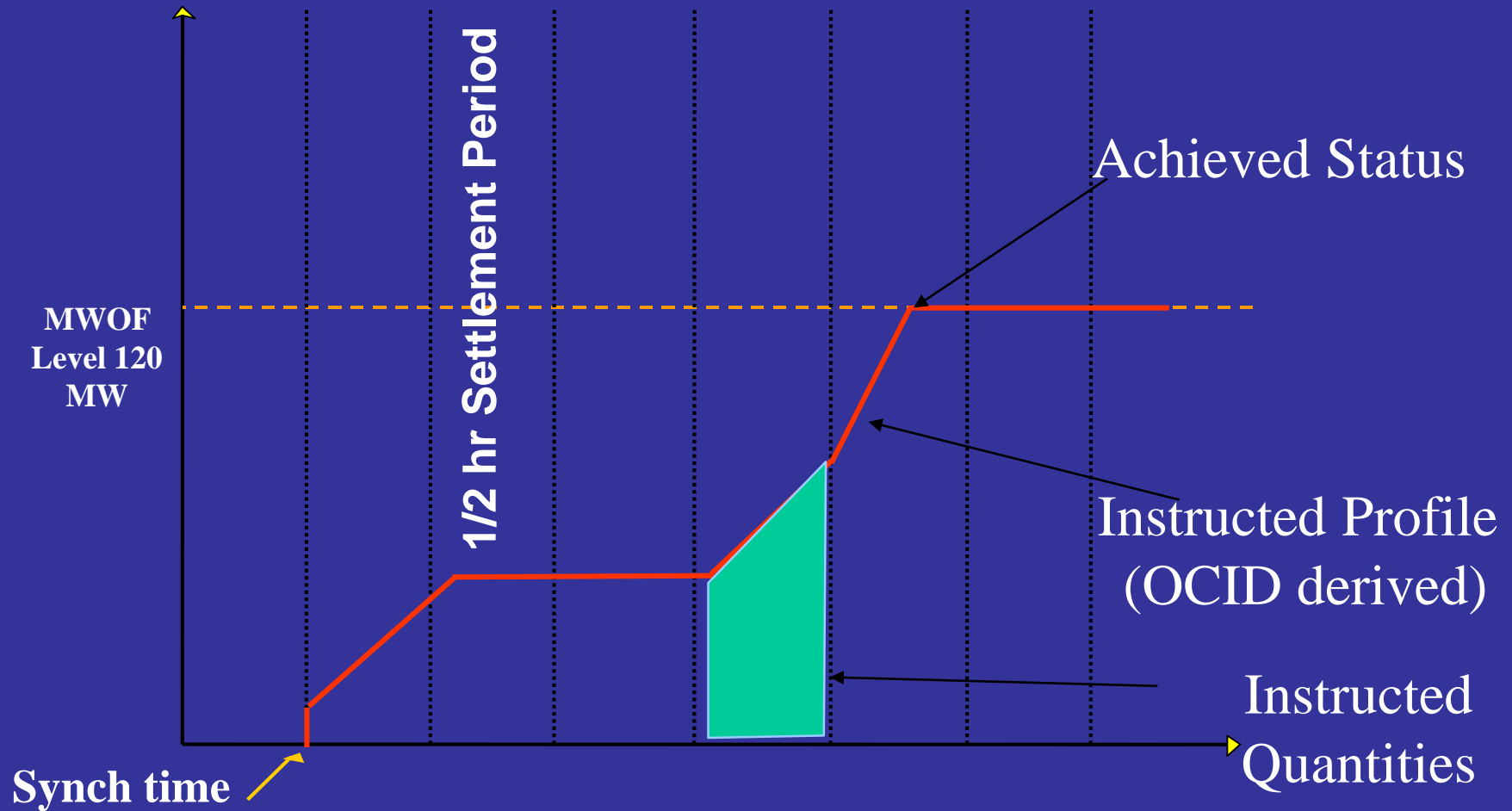
• **The area under the actual generated (MW) gives us the Actual Generation in MWh**

MW

MWOF
Level 120
MW

1/2 hr Settlement Period

Generated MW

Instructed Profile

Generated MWh

•Uninstructed Imbalance is the variance between Generated MWh and Target MWh

MW

MWOF
Level 120
MW

1/2 hr Settlement Period

UI
MW

Generated MW

Instructed (MW)

Uninstructed
Imbalance (MWh)

SCADA

National
Control
Centre

NCC
INTERFACE
(EDRS)

RDBMS

OCID Files

GCM

PI-API
Cluster

Module
Database

PI Archives

PI Cluster

User Screens

**Functional Overview
of
GCM System**

www.esb.ie

File Edit View Insert Tools Draw Arrange Window Help

MONEYPOINT View   Portfolio View   **SPEED   2997 RPM   FREQUENCY 49.94 HZ   TIME 10:42**

OUTSIDE INSIDE PREDICTED
TOLERANCE TOLERANCE IMBALANCE

UNINSTRUCTED IMBALANCES

○ LOW FREQ

○ HIGH FREQ

	MP1		MP2		MP3
	1.0 2.3		0.2 0.7		-0.6 -1.8

MP1   **MP2**   **MP3**

32   24   31

RANKING
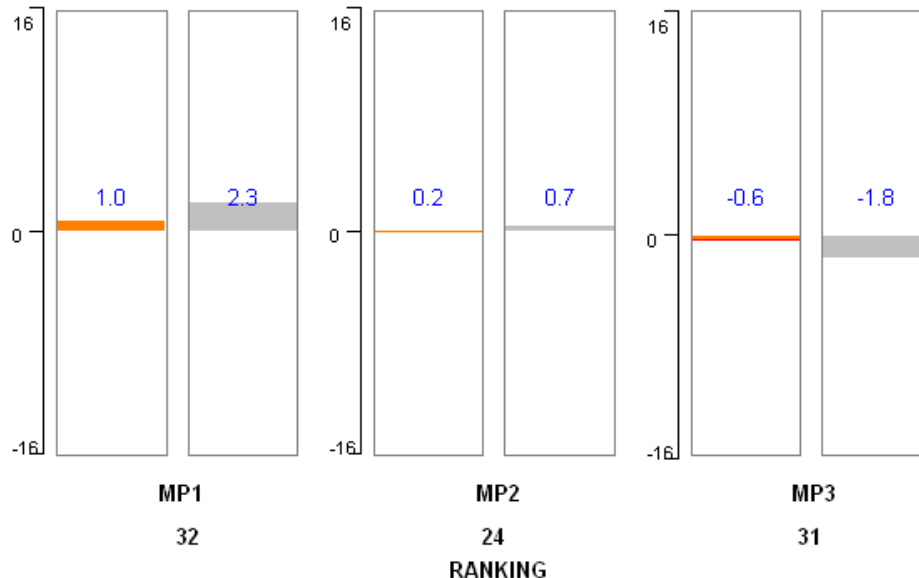
Unit View

Station Aggregate Panel
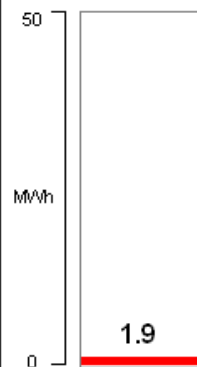
MONEYPOINT CURRENT	
TARGET MWh	181.0
ACTUAL MWh	181.6
IMBALANCE	1.9

1.9

CURRENT PERIOD	22
CURRENT MINUTE	12
STATION	**MONEYPOINT**
TARGET MW	905.0
CURRENT MW	906.2

EDIL Interface Status	OK
CALCULATION ENGINE	OK

LAST FIVE INSTRUCTIONS

MP3, MWMD, 305 MW, 08-Apr-04 09:27
MP3, MWMD, 295 MW, 08-Apr-04 08:13
MP3, MWMD, 280 MW, 08-Apr-04 06:54
MP3, MWMD, 305 MW, 07-Apr-04 22:02
MP1, MWMD, 295 MW, 07-Apr-04 20:59

LAST FIVE DECLARATIONS

MP3, MDMW, MIX, 305 MW, 08-Apr-04 09:26
MP3, MDMW, MIX, 295 MW, 08-Apr-04 08:10
MP3, FUEL, MIX, 08-Apr-04 06:50
MP3, MDMW, COAL, 230 MW, 08-Apr-04 06:50
MP3, MDMW, MIX, 280 MW, 08-Apr-04 06:50

Report

Ready   NUM

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PORTFOLIO VIEW - MAIN UNITS

SPEED 3000 RPM   FREQUENCY   49.99 HZ   TIME 10:09

| MAIN UNITS | PEAT UNITS | HYDRO UNITS |

UNINSTRUCTED IMBALANCES   MWh VIEW

CURRENT
IMBALANCE

| View | View | View | View | View | View | View |

	27		15		6		50		12		32		50
	9.7		3.0		0.1		1.1		0.0		0.3		1.5
	AGHADA		NORTHWALL		MARINA		POOLBEG		GREAT_ISLAND		TARBERT		MONEYPOINT
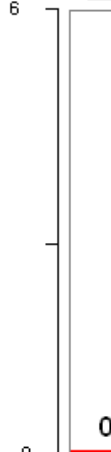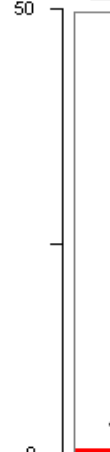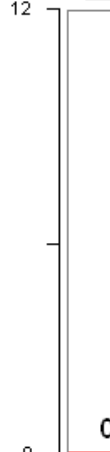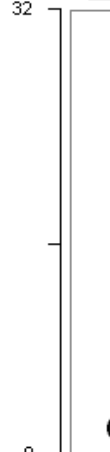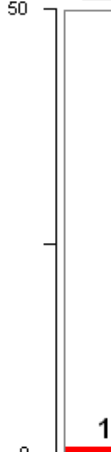
MWh

CURRENT PERIOD   21

| MWh | % |

190				
	PORTFOLIO CURRENT		**TEN WORST UIs**	
	TARGET MWh 363.7		AT14	-10.5
			NW5	-3.0
	ACTUAL MWh 353.0		PB3	0.8
			MP3	-0.7
	IMBALANCE 15.8		MP2	0.6
			MP1	0.5
			PBC	0.4
	Aggregate Panel		AD1	0.3
15.8 MWh			TB3	0.3
0			MRT	-0.1

LAST FIVE INSTRUCTIONS

MP3, MWMD, 305 MW, 08-Apr-04 09:27
MP3, MWMD, 295 MW, 08-Apr-04 08:13
AT14, MWOF, 70 MW, 08-Apr-04 07:56
AT12, MWOF, 70 MW, 08-Apr-04 07:40
AT11, MWOF, 70 MW, 08-Apr-04 07:35

LAST FIVE DECLARATIONS

MP3, MDMW, MIX, 305 MW, 08-Apr-04 09:26
MP3, MDMW, MIX, 295 MW, 08-Apr-04 08:10
AT11, FUEL, GAS, 08-Apr-04 07:17
AT14, FUEL, DIST, 08-Apr-04 07:09
AT11, FUEL, DIST, 08-Apr-04 07:07

| EDIL Interface Status   OK |

| CALCULATION ENGINE   Fault | | Report |

Ready   NUM

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File   Edit   View   Insert   Tools   Draw   Arrange   Window   Help

PORTFOLIO VIEW - MAIN UNITS

SPEED 2998 RPM   FREQUENCY   49.96 HZ   TIME 10:41

MAIN UNITS | PEAT UNITS | HYDRO UNITS

UNINSTRUCTED IMBALANCES   PERCENTAGE VIEW
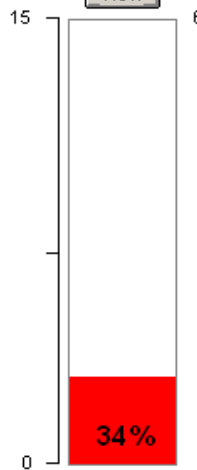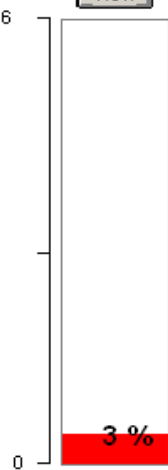
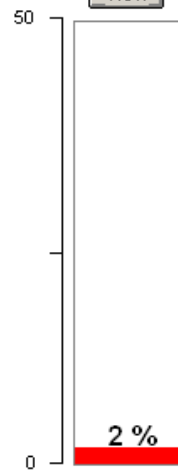CURRENT IMBALANCE

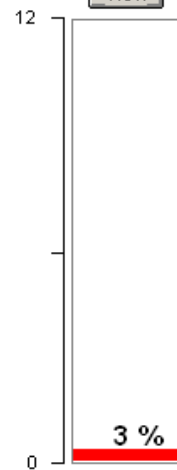| View	View	View	View	View	View	View
27	15	6	50	12	32	50
22%	**34%**	**3 %**	**2 %**	**3 %**	**1 %**	**1 %**
AGHADA	NORTHWALL	MARINA	POOLBEG	GREAT_ISLAND	TARBERT	MONEYPOINT
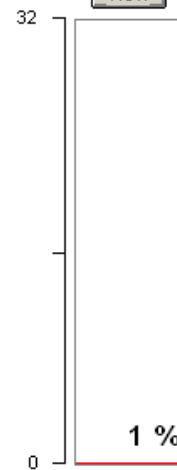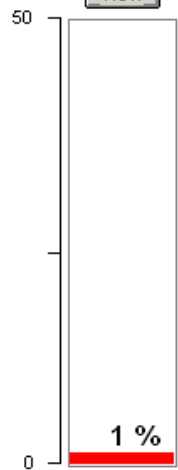
MWh

CURRENT PERIOD   22
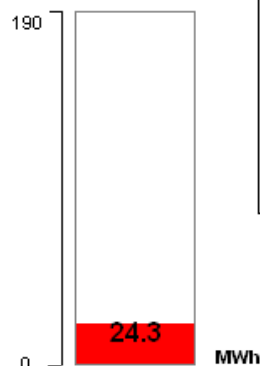
MWh | %

PORTFOLIO CURRENT		TEN WORST UIs	
TARGET MWh	**448.7**	AT14	-12.8
		AT12	-3.3
ACTUAL MWh	**433.7**	NW5	-3.0
		PB3	1.5
IMBALANCE	**24.3**	AT11	-1.0
		MP1	0.9
		MP3	-0.5
Aggregate Panel		PBC	0.5
		MRT	0.4
24.3 MWh		PB2	0.4

190

LAST FIVE INSTRUCTIONS

AT11, MWMD, 90 MW, 08-Apr-04 10:25
MP3, MWMD, 305 MW, 08-Apr-04 09:27
MP3, MWMD, 295 MW, 08-Apr-04 08:13
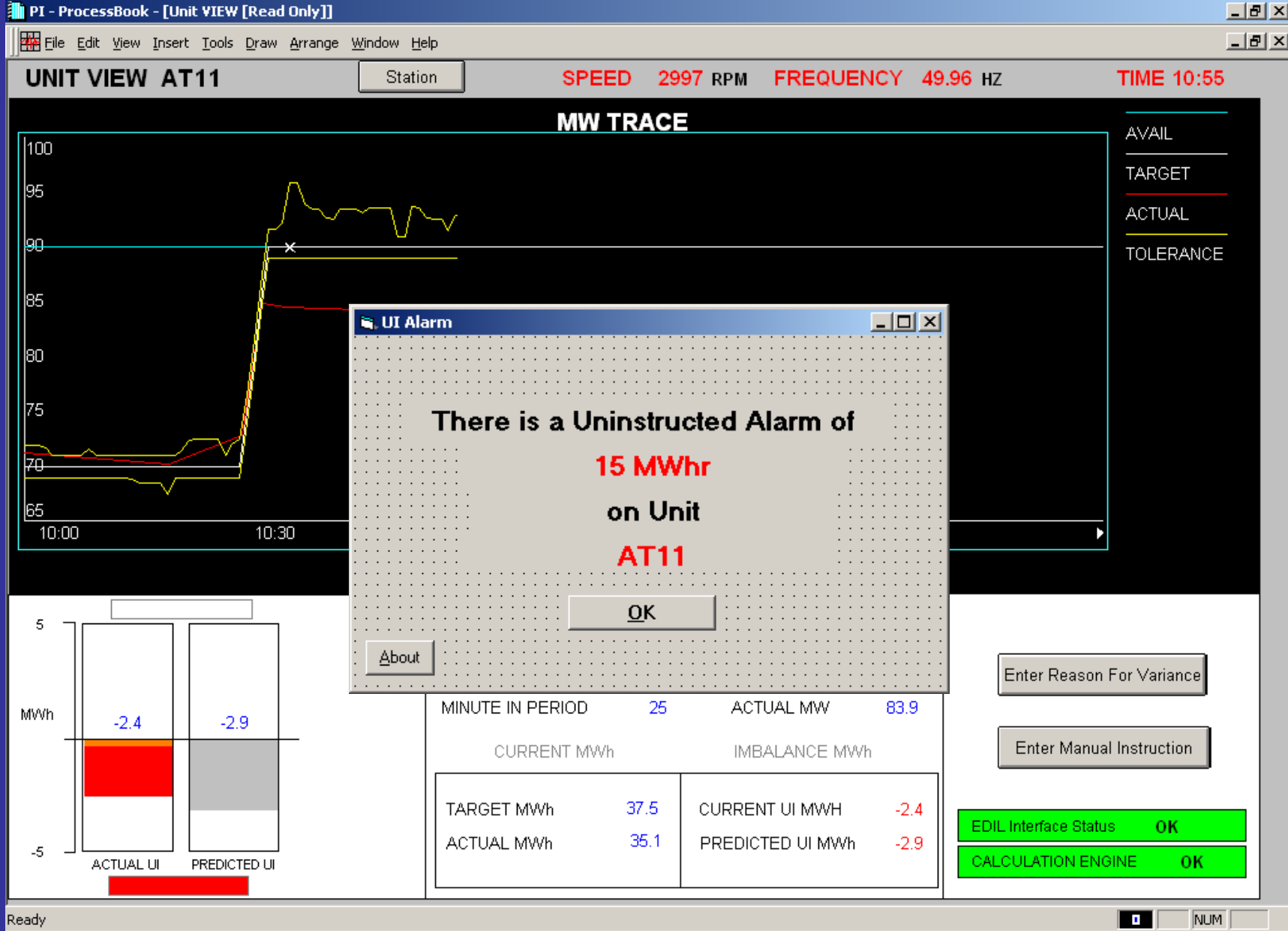AT14, MWOF, 70 MW, 08-Apr-04 07:56
AT12, MWOF, 70 MW, 08-Apr-04 07:40

LAST FIVE DECLARATIONS

MP3, MDMW, MIX, 305 MW, 08-Apr-04 09:26
MP3, MDMW, MIX, 295 MW, 08-Apr-04 08:10
AT11, FUEL, GAS, 08-Apr-04 07:17
AT14, FUEL, DIST, 08-Apr-04 07:09
AT11, FUEL, DIST, 08-Apr-04 07:07

EDIL Interface Status   OK

CALCULATION ENGINE   Fault

Report

Ready   NUM

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GCM Provides Operators :

- Visualisation of the current operational state
- On-screen, real-time verification of their actions
- Predictive output for the trading period
- Visual Alarms on screen
- Optional Alarm into DCS/SCADA system

Challenges Overcome

- Real time B2B Integration across physical and commercial boundaries

- Compressed Timescale (Are we there yet….)

- Fluid specification in some areas due to changing Regulatory Environment.

Where do we go from here..

- Increased use of Pi ICE and ProcessBook.
- Development of KPIs in Pi ACE
- Further Reinforcement of Technical Architecture

- Increased Focus on Key Benefits Delivery

Acknowledgements

- MDC Technology Ltd.
- Process Informatics Ltd.
- TQS Integration Ltd.

Questions ?