



Managing Emissions to New Standards Using PI

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Who are we?



- RWE Power International: brand for services offered by RWE Power (Germany) and RWE npower (UK)
- RWE npower
 - Part of the RWE Group of Companies since May 2002
 - Leading integrated UK energy company
 - Core businesses are energy production, retailing, operations and engineering
 - Own and operate a flexible portfolio of power stations, capable of generating around 10,000MW
 - UK market leaders in cogeneration and renewable energy production

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Emissions Monitoring Legislation

- IPPC: Integrated Pollution Prevention and Control
 - All emissions to air, water and land
 - Best Available Techniques (BAT)
 - Application deadline 31 March 2006 for UK Power stations
 - LCPD is one component

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Emissions Monitoring Legislation

- LCPD: Large Combustion Plant Directive
 - EU wide
 - Applies to all combustion plants >50MWth
 - Monitoring of SO₂, NO_x and Particulates
 - Emission limits (ELVs) and National Plan (NERP)
 - Effective from 1 January 2008

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LCPD in the UK



- A generating unit is a LCP*
- Plants can choose either ELVs or NERP
- Required to provide standard reports of SO₂, NO_x and Particulate emissions, both concentration and mass release

* This approach has been rejected by the EU and is currently being revised to LCP=windshield

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LCPD in the UK



- Standards provided for installation, testing and monitoring of the CEMs
 - QAL1: CEM selection (certification)
 - QAL2: CEM in-situ testing
 - QAL3: Continuous monitoring of CEM calibration

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MERS Application

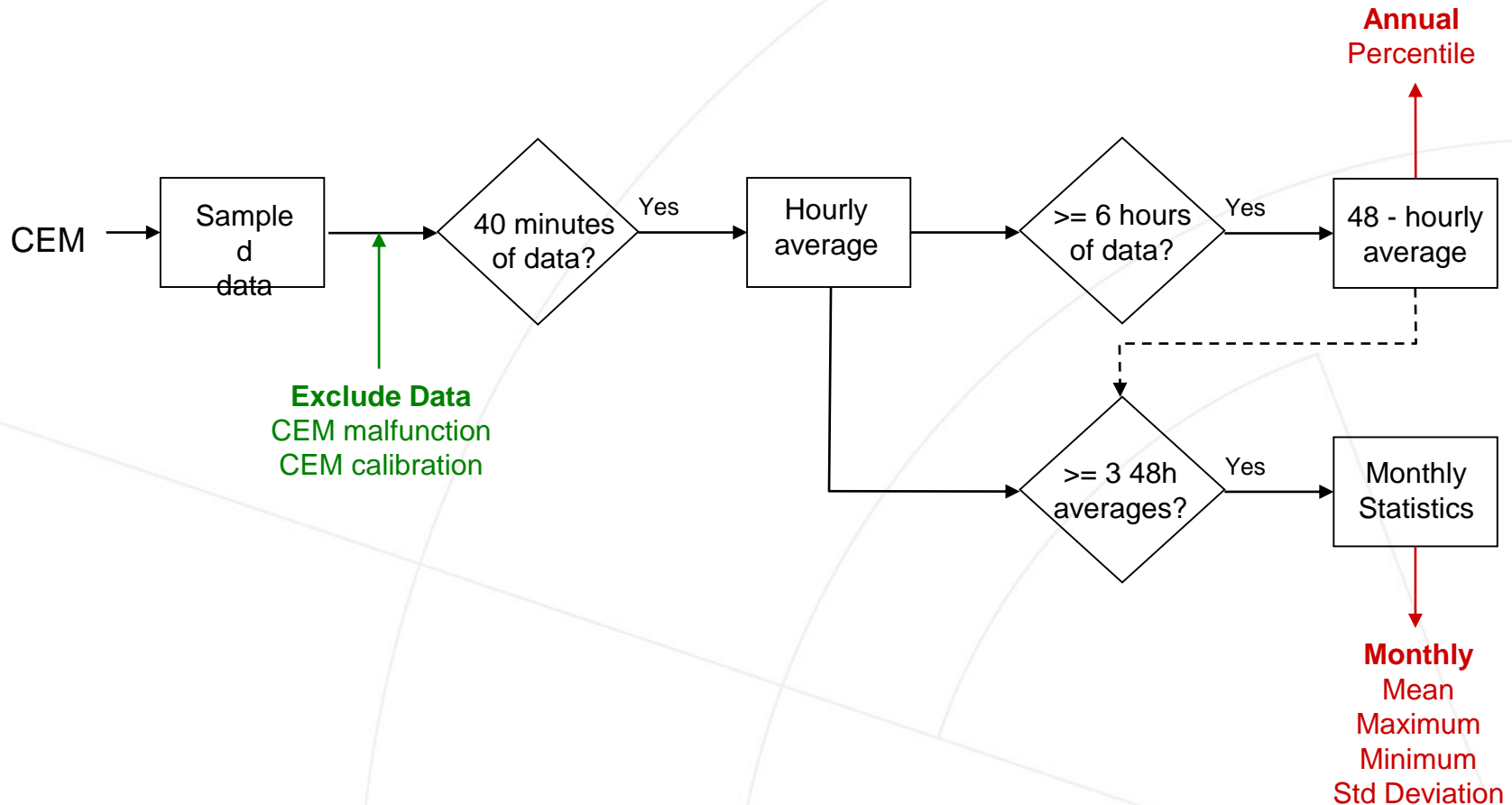


- MERS: Multiple Emissions Reporting System
 - Modular application for collecting, storing and reporting emissions data
 - Toolset initially based on LCPD reporting
 - Excel front-end with Access or SQL server database
 - Uses PI DataLink to retrieve emission data

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LCPD Calculation Path



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MERS Outputs



- Monthly statistics
 - Average, Maximum, Minimum and Standard Deviation
- Hourly averages
- 48hr averages
- Annual percentiles
- CEM reliability
- Calibration drift
- QAL3 charts (CUSUM and Shewart)
- Mass release (future version)

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Calculation Modules



- Exclusions

- Event types: Calibration, Maintenance, Bad Data
- Events generated from PI data (can be edited)
- Bad data events: emission tag failure
- Other events: generated using formula or signature (calibration only)

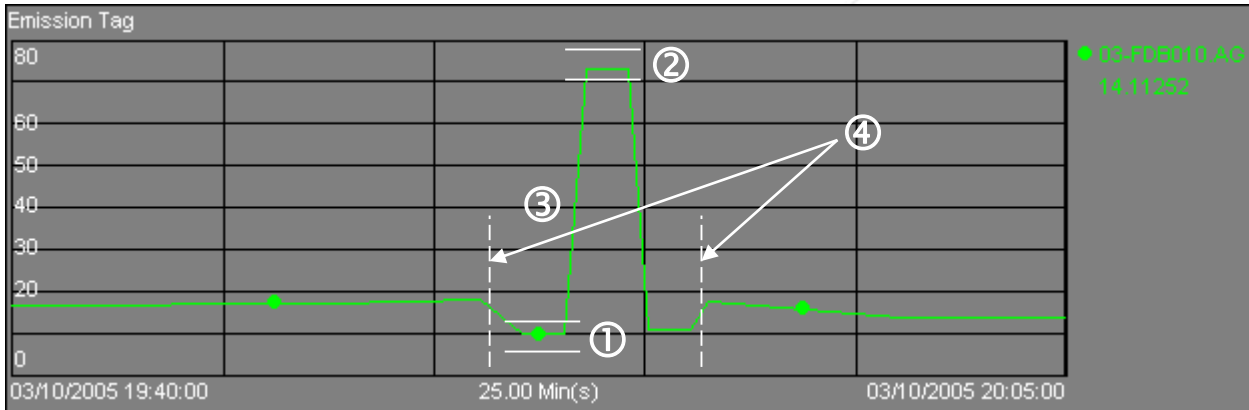
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Calculation Modules: Exclusions

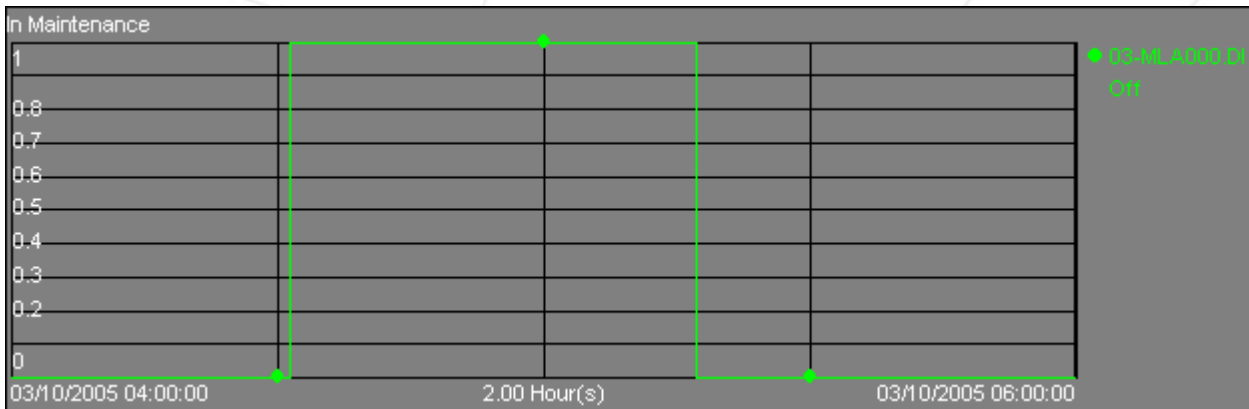


Signature event detection



1. Zero in tolerance
2. Span in tolerance
3. Transition time within specification
4. Event times: detect edges (or use default times)

Formula event detection



1. Event start: equation False (0) → True (1)
2. Event end: equation True (1) → False (0)

Formula: (IF TagBad('03-MLA000.di', '*') THEN "Er" ELSE '03-MLA000.di'="On")

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Calculation Modules: Exclusions



Exclusion Management - Particulate Exclusions

Unit Selection: Select Unit **Unit 1**

Show Exclusions: From **27-Sep-05** To **06-Oct-05** Category **All Categories** **Show**

ID	Start Time	End Time	Category	Source	Auto/Manual	Edited By	Comment
816	03-Oct-05 15:52:00	03-Oct-05 15:55:00	Calibration	Calibration Signature	Automatic	npuk\nunnd	
817	03-Oct-05 17:52:10	03-Oct-05 17:54:50	Calibration	Calibration Signature	Automatic	npuk\nunnd	
818	03-Oct-05 19:52:00	03-Oct-05 19:55:00	Calibration	Calibration Signature	Automatic	npuk\nunnd	
819	03-Oct-05 21:52:00	03-Oct-05 21:57:00	Calibration	Calibration Signature	Automatic (Edited)	npuk\nunnd	Changed
836	03-Oct-05 22:00:00	03-Oct-05 22:10:00	Maintenance	Manual Entry	Manual	npuk\nunnd	Fixed it
820	03-Oct-05 23:52:00	03-Oct-05 23:54:50	Calibration	Calibration Signature	Automatic	npuk\nunnd	
808	04-Oct-05 00:37:10	04-Oct-05 00:52:00	Bad Data	Emission Tag	Automatic	npuk\nunnd	
839	04-Oct-05 01:52:00	04-Oct-05 01:55:00	Calibration	Calibration Signature	Automatic	npuk\nunnd	
840	04-Oct-05 03:52:10	04-Oct-05 03:54:50	Calibration	Calibration Signature	Automatic	npuk\nunnd	
837	04-Oct-05 04:01:30	04-Oct-05 04:03:30	Bad Data	Emission Tag	Automatic	npuk\nunnd	
841	04-Oct-05 05:52:10	04-Oct-05 05:54:50	Calibration	Calibration Signature	Automatic	npuk\nunnd	

Add Entry **Edit Entry** **Delete Entry**

ID: From: **10-Mar-06 00:00:00** To: **10-Mar-06 00:00:00** Category: Auto/Manual:

Comment: **OK** **Cancel**

Exclusion Timeline:

Close

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Calculation Modules

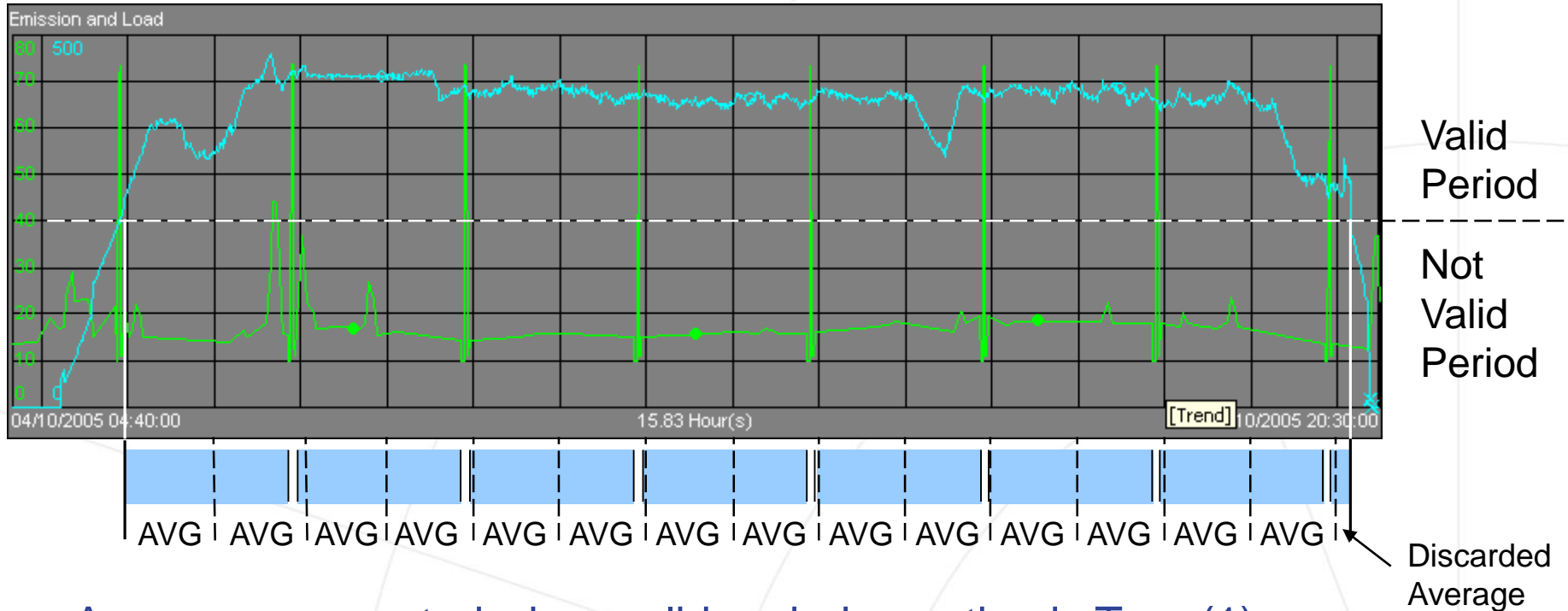


- Concentration
 - Calculates hourly averages from sampled PI data
 - Valid period defined by formula (e.g. Load > 150MW and FGD in service)
 - Link to exclusion module to get excluded times
 - Also calculates:
 - 48 hourly averages
 - Percentiles
 - CEM Reliability

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Calculation Modules: Concentration



- Averages generated when valid period equation is True (1)
 - In above case equation: $\text{Load} \geq 250\text{MW}$
- Values during calibration, maintenance and bad data events excluded
- Averages less than minimum time length (40 mins) are discarded

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Calculation Modules

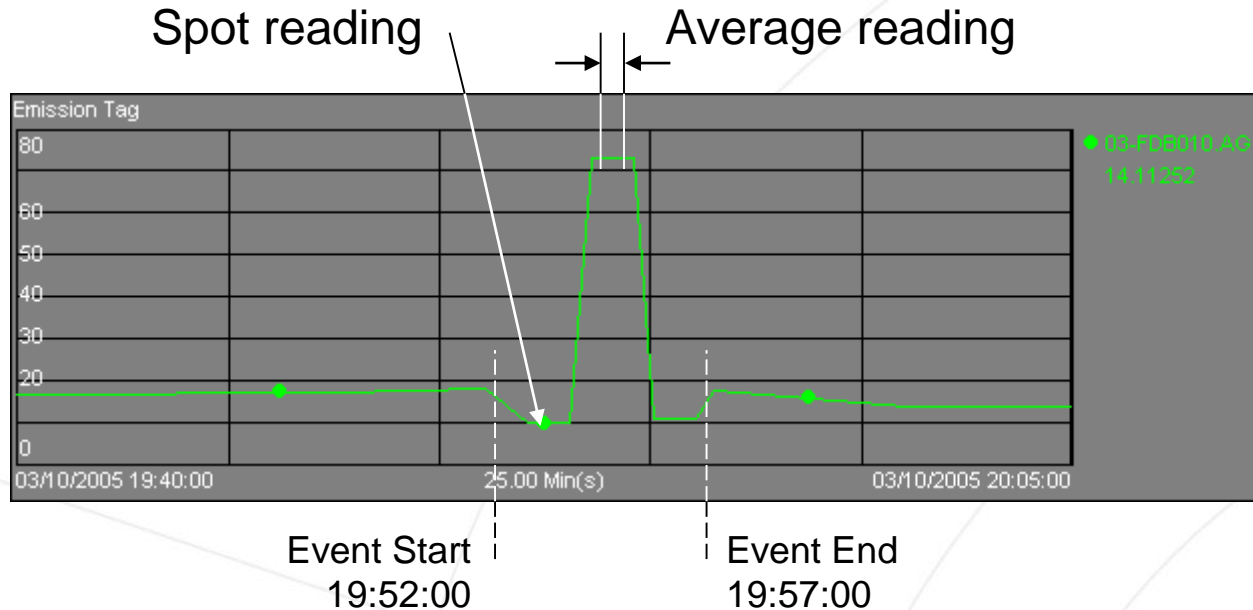


- QAL3
 - Calibration times sourced from exclusion module
 - Can take spot, average, maximum or minimum reading for zero/span within calibration event
 - Calibration drift calculated using reference value
 - Calibration drifts can be edited

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Calculation Modules: QAL3



- Reading times are calculated from event times
 - Zero: spot reading at 60 seconds from event start
 - Span: average reading between 240 and 180 seconds from event end

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Calculation Modules: QAL3



QAL3 Calibration Management Particulates QAL3

Unit Selection: Select Unit

Show Calibrations: From To Status

Ex ID	Start Time	End Time	Zero Method	Zero Drift	Span Method	Span Drift	
891	06-Oct-05 07:50:30	06-Oct-05 07:53:30	Average	11.8335525512695	Spot	-54.5995971679688	np
892	06-Oct-05 13:50:30	06-Oct-05 13:54:00	Average	11.8123924255371	Spot	-59.5104835510254	np
893	06-Oct-05 15:50:40	06-Oct-05 15:53:00	Average	11.9434181213379	Spot	-2.01330871582032	np
894	06-Oct-05 17:50:30	06-Oct-05 17:54:00	Average	11.7891986846924	Spot	-51.9891975402832	np
895	06-Oct-05 19:50:30	06-Oct-05 19:54:00	Average	11.9434181213379	Spot	-51.9891975402832	np
896	06-Oct-05 21:50:40	06-Oct-05 21:53:00	Average	11.9129001617432	Spot	-1.83202514648438	np
936	06-Oct-05 22:00:00	06-Oct-05 22:06:00	Manual	13.456	Not Set	Not Set	np
897	06-Oct-05 23:50:40	06-Oct-05 23:53:00	Average	11.8897064208984	Spot	-1.88196716308595	np
911	07-Oct-05 01:50:40	07-Oct-05 01:53:00	Average	12.0191047668457	Spot	-1.94188842773438	np
912	07-Oct-05 03:50:40	07-Oct-05 03:53:00	Average	13.1519519805908	Spot	-2.07556457519532	np
913	07-Oct-05 05:50:40	07-Oct-05 05:53:00	Average	13.0634479522705	Spot	-1.92691040039063	np
914	07-Oct-05 07:51:10	07-Oct-05 07:54:00	Average	11.9434181213379	Spot	-54.5776245117188	np
915	07-Oct-05 09:51:10	07-Oct-05 09:54:00	Average	11.8335525512695	Spot	-54.6398826599121	np

Alarm limit breached
 Warning limit breached

Exclusion ID:
 Zero Drift:
 Span Drift:
 Zero Ref. Level:
 Span Ref. Level:

Comment:

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Exclusions Sharing



- Enables Concentration and QAL3 modules to use the events from Exclusions modules
- Several modules can be dependant on one Exclusions module
- Minimises amount of collected data and event editing

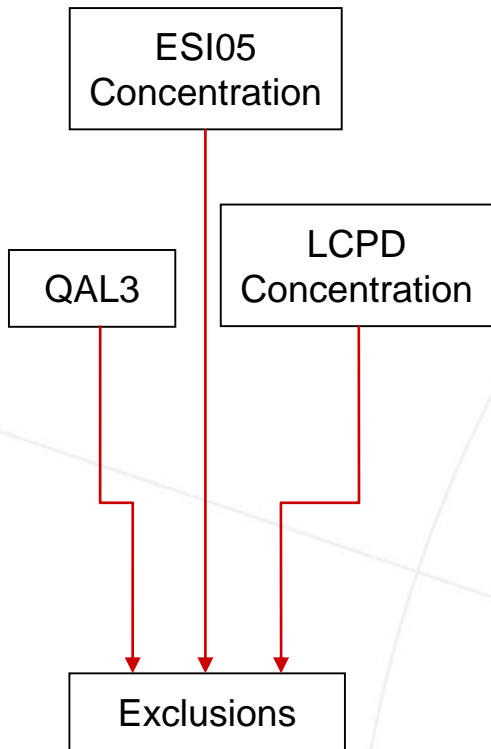
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Exclusions Sharing Examples

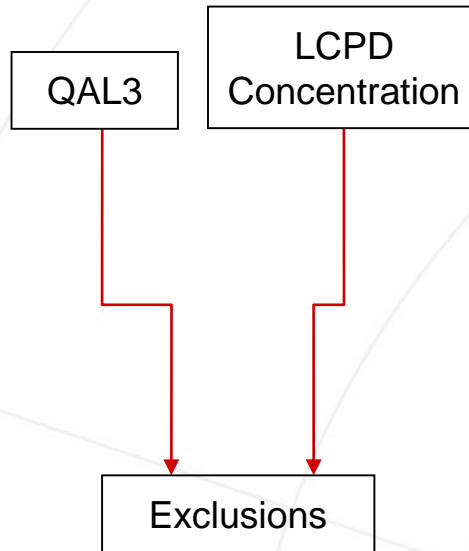


Particulates



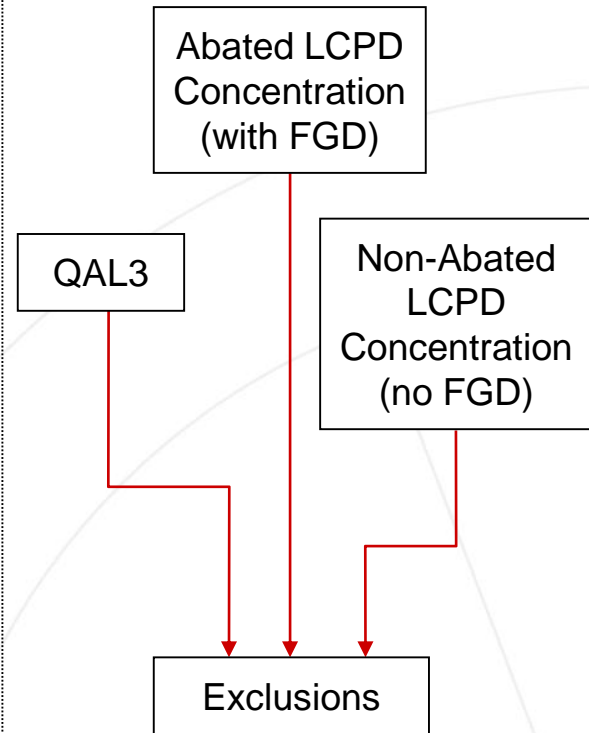
Per CEM

NOx



Per CEM

SO₂



Per CEM

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Example Reports: Statutory



Multiple Emissions Reporting System - ESI 111

File Emissions Reports System Window Help Select Period Oct 2005 Start Date 01-Oct-05 End Date 31-Oct-05 PI

Q26 fx

	A	B	C	E	G	I	K	M
1	RELEASES TO AIR							
2	LCPD REPORTING							
3	QUARTERLY RETURN OF CONCENTRATION STATISTICS							
4								
5	Operator:							
6	Location: Example Power Stn							
7	Permit/Variation Number							
8								
9	From: 01-Oct-05		Unit 1			Unit 2		
10	To: 31-Oct-05		(mg/m3)			(mg/m3)		
11	Month	Hourly Means	SOx	NOx	Dust	SOx	NOx	Dust
12	Month 1	Monthly Mean			22.17			24.16
13		Maximum			48.23			49.12
14		Date/Time of Max			10-Oct-05 09:00:00			03-Oct-05 09:00:00
15		Minimum			12.35			16.68
16		Std. Deviation			5.29			4.89
17		% Data Capture			99.40			99.40
18	Month 2	Monthly Mean						
19		Maximum						
20		Date/Time of Max						
21		Minimum						
22		Std. Deviation						
23		% Data Capture						
24	Month 3	Monthly Mean						
25		Maximum						
26		Date/Time of Max						
27		Minimum						
28		Std. Deviation						
29		% Data Capture						
30								

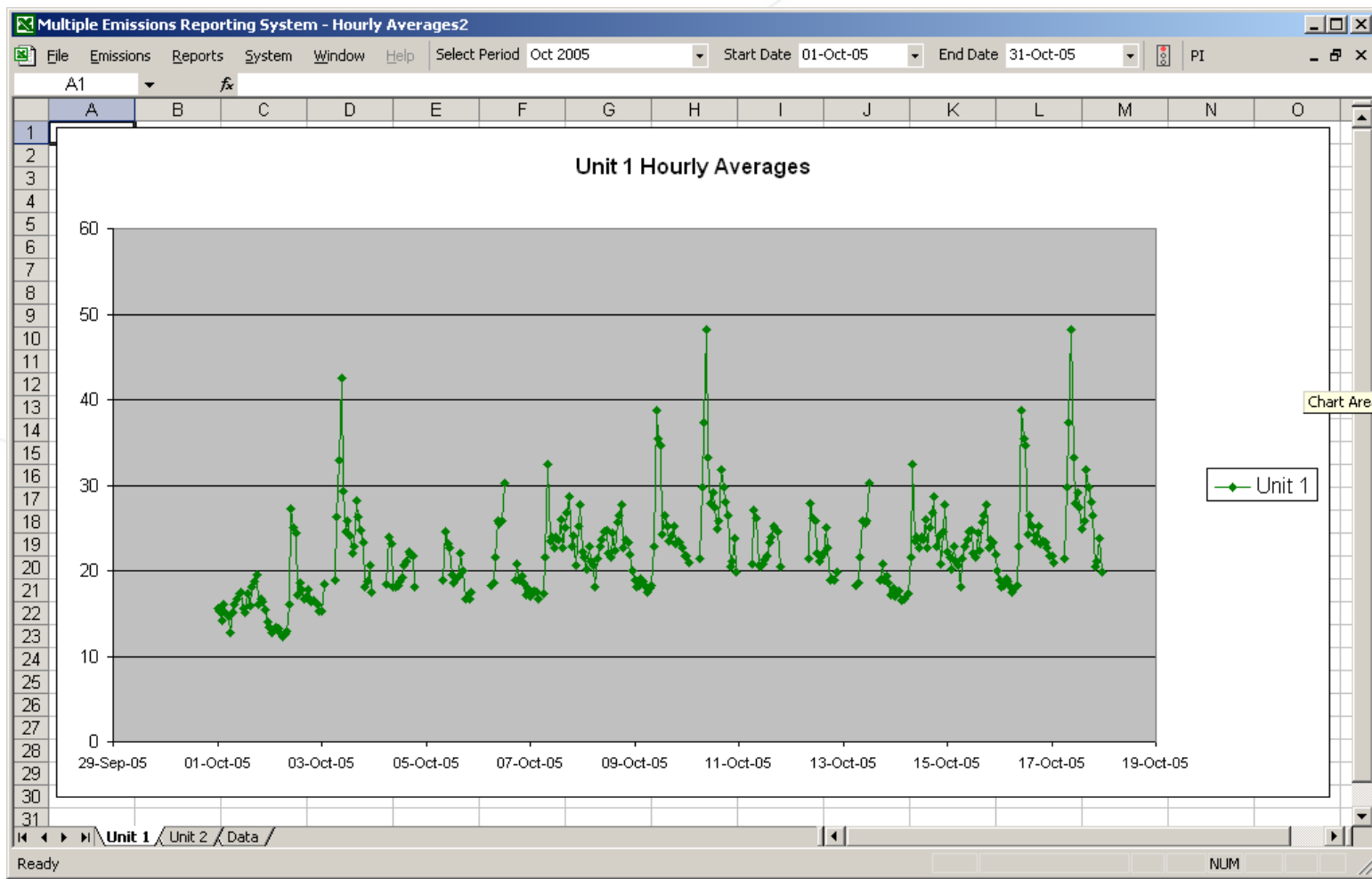
ESI 11 / NUM

Ready

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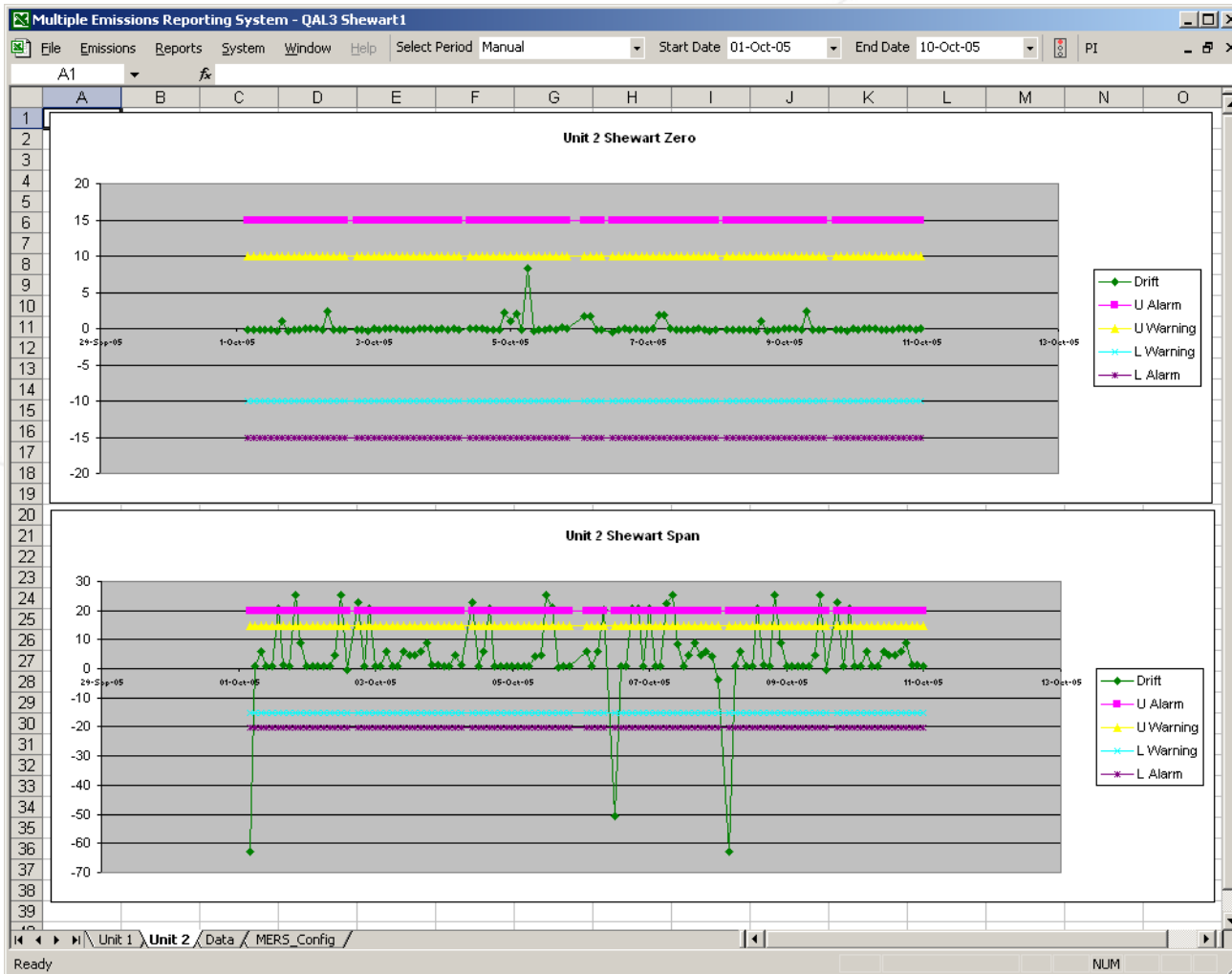
Example Reports: Ad-hoc Chart



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Example Reports: QAL3 Chart



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Technical Challenges



- Automation of PI DataLink
- Daylight-saving time
- Time changes
- Minimising data collection time
- Formulas

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Automating PI DataLink



- Calculate the number of rows required (add extra for time changes)
- Enter formula as formula array
- Calculate the cells
- Excel add-ins have hidden sheet – used for PI DataLink formula

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Daylight-Saving Time



- Dates/times used throughout system
- Decision made to use and store all timestamps in standard (not daylight-saving) time
- Retrieve the time change times from the Windows time-zone settings
- PI DataLink only retrieves local time, convert all timestamps to standard time
- For autumn time change need special measures...

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Time Changes



- Autumn time change: one hour of duplicate (ambiguous) overlapping timestamps
- PI DataLink retrieval starting/ending in this period returns first occurrence of timestamp
- Solution: expand data collection to start before and end after the time change – guarantees detection of the actual timestamp during the ambiguous period

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Minimising Data Collection Time



- Could have a system configured with 300+ tags
- Collecting this data can take a LONG time
- Solution
 - MERS calculation modules request data from a central collection process
 - Requests are collated and those that overlap with the same tag and sample interval are collected once
 - Collected data is then distributed back to modules
 - Has reduced the collection requirement by about 50%

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Formulas

- System uses PI DataLink expression calculation (PIExpDat) to evaluate formulas
- Limitations:
 - Maximum equation length: 255 characters
 - When using operators (>,<,<=>,>=<=>) if tag has bad value the equation returns False (0)
- Solutions:
 - No solution to length
 - Created formula builder that adds to equation: tests tags for bad value and forces equation to fail

MERS Benefits



- Common solution
 - Independent of unit or CEM layout
 - Uses PI as standard interface layer to DCS
 - Central repository for emission data
- Scalable
 - Single module CCGT to multi-unit coal-fired
- Configurable
 - ‘Unlimited’ emissions
 - Customised reports

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Thanks for your time
Any questions?

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