Managing Emissions to New Standards Using PI

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RWE Power International

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

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

Emissions Monitoring Legislation

- LCPD: Large Combustion Plant Directive
  - EU wide
  - Applies to all combustion plants >50MWth
  - Monitoring of SO_2, NOx and Particulates
  - Emission limits (ELVs) and National Plan (NERP)
  - Effective from 1 January 2008

LCPD in the UK

- A generating unit is a LCP*
- Plants can choose either ELVs or NERP
- Required to provide standard reports of SO_2, NOx 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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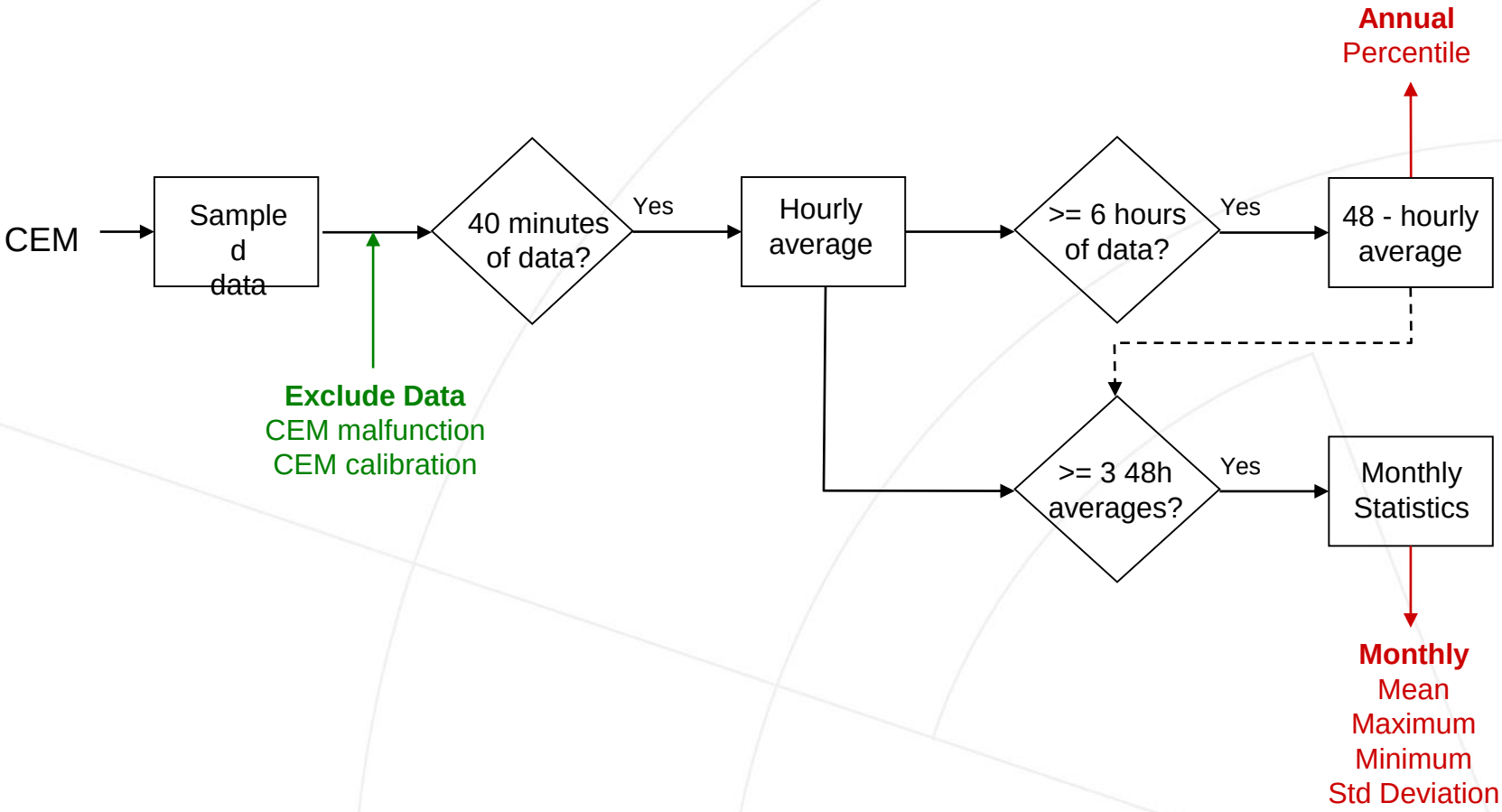
LCPD in the UK

- 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

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

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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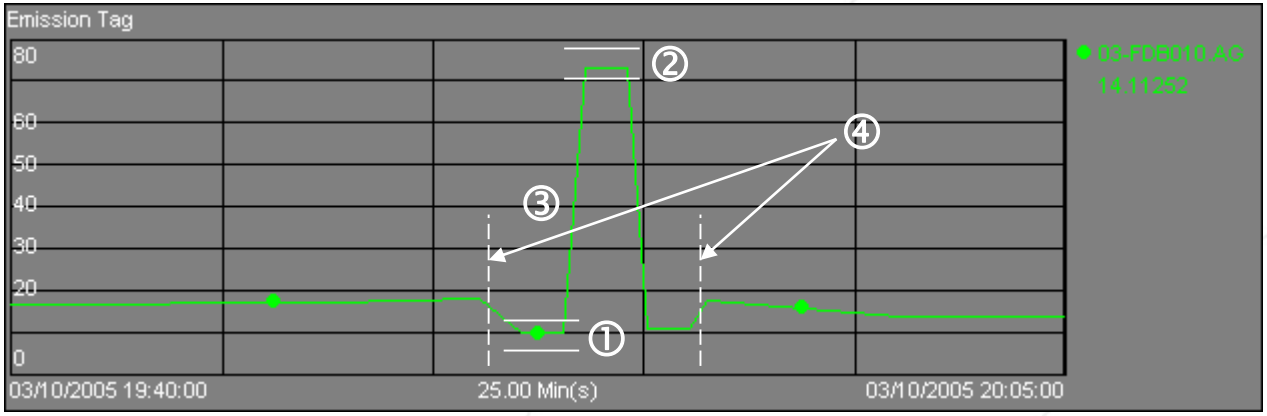
Calculation Modules

- 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)

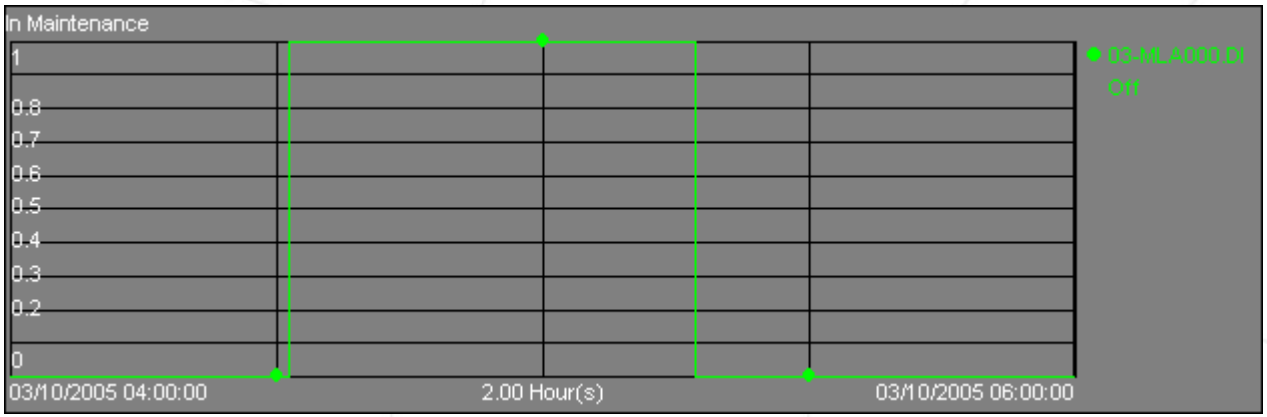
Calculation Modules: Exclusions

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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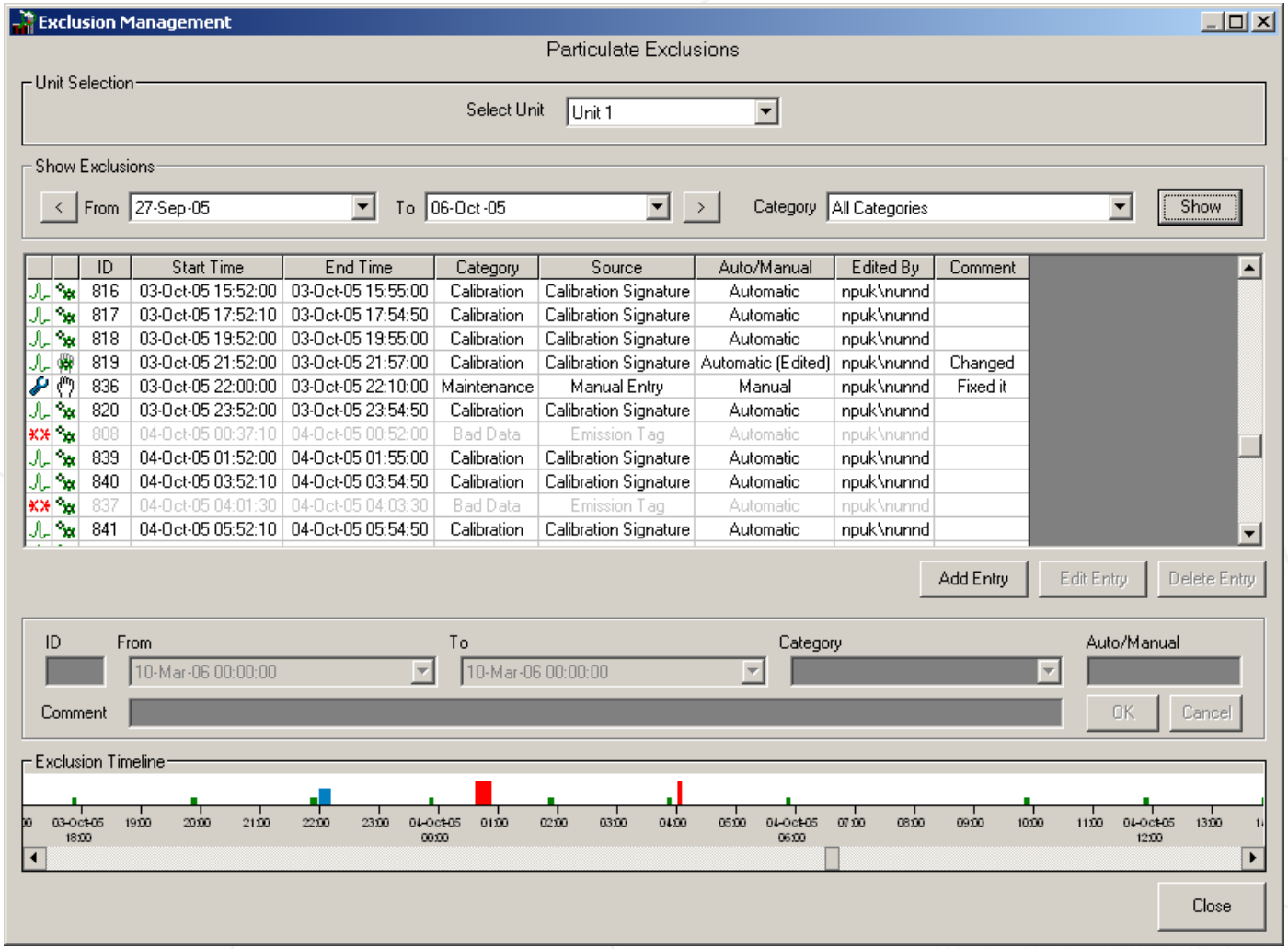
Calculation Modules: Exclusions



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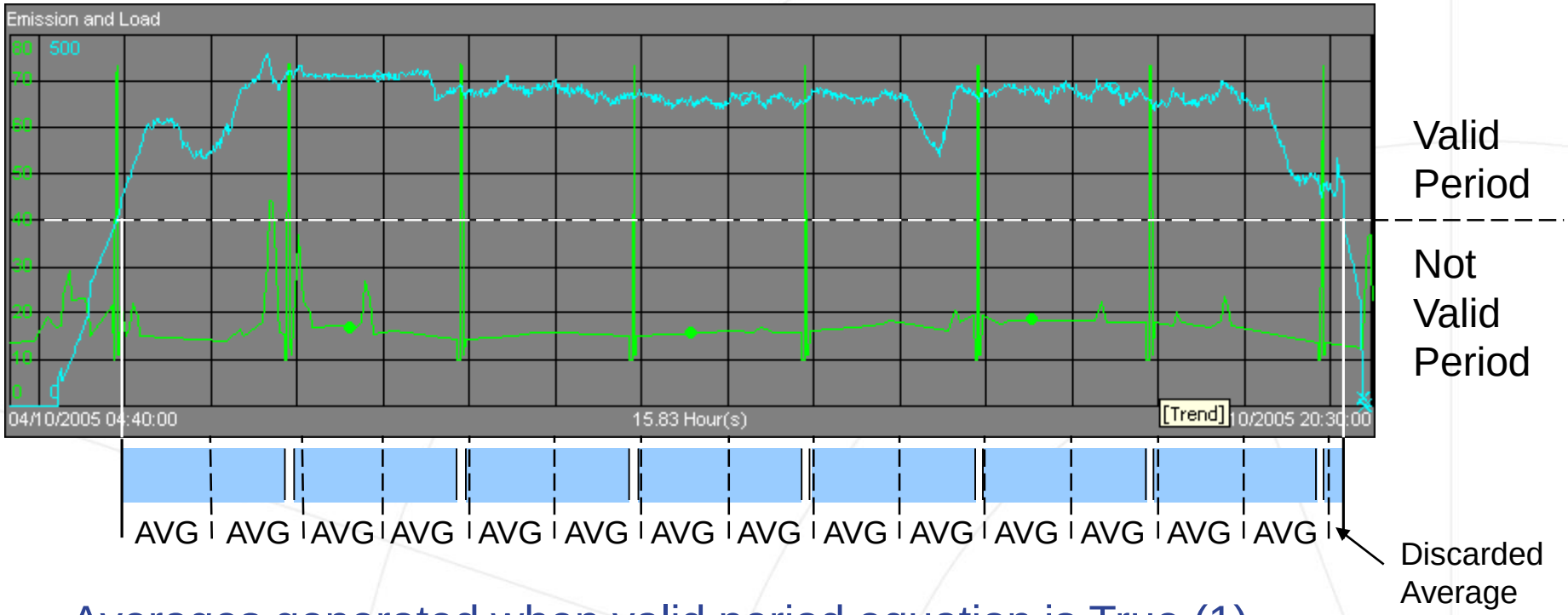
Calculation Modules

- 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

Calculation Modules: Concentration



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

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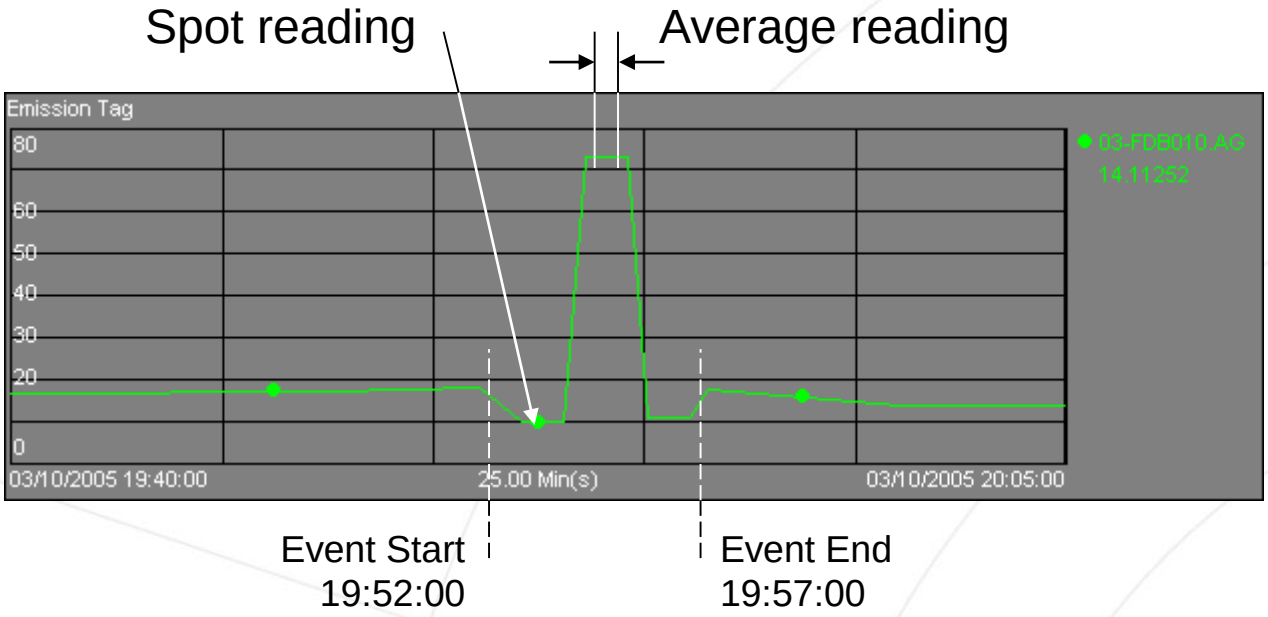
Calculation Modules

- 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

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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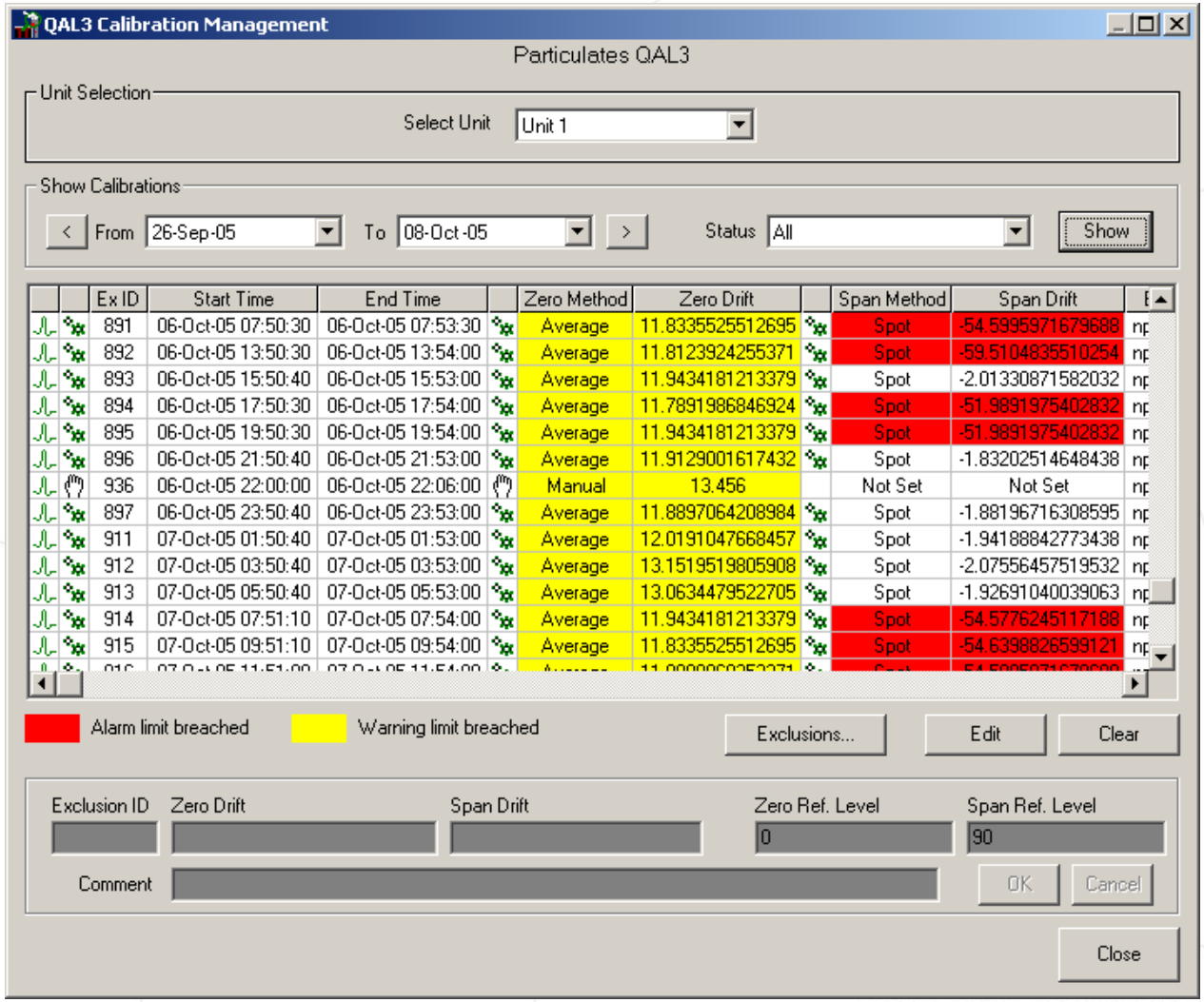
Calculation Modules: QAL3



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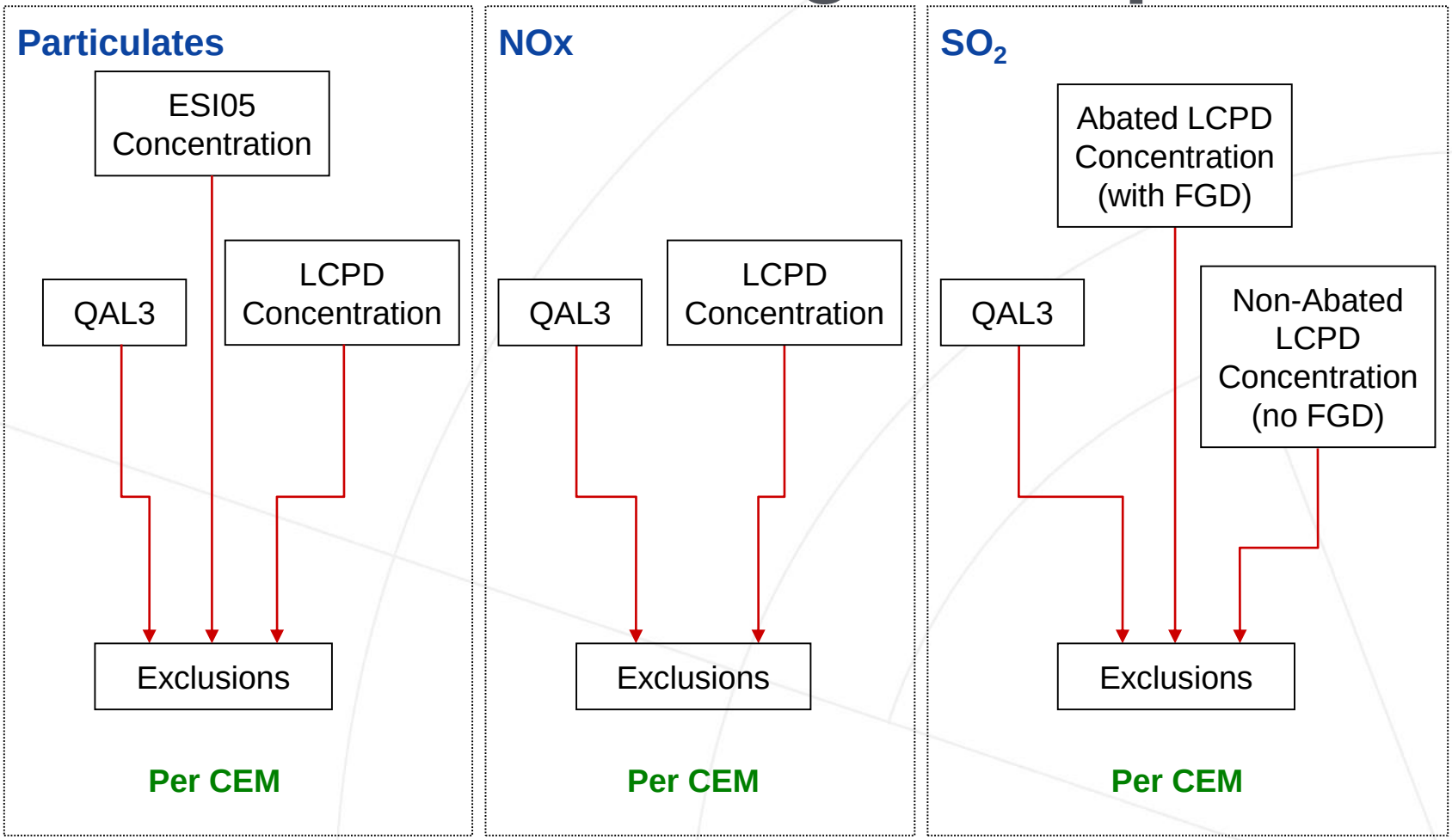
Exclusions Sharing

- 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

Exclusions Sharing Examples



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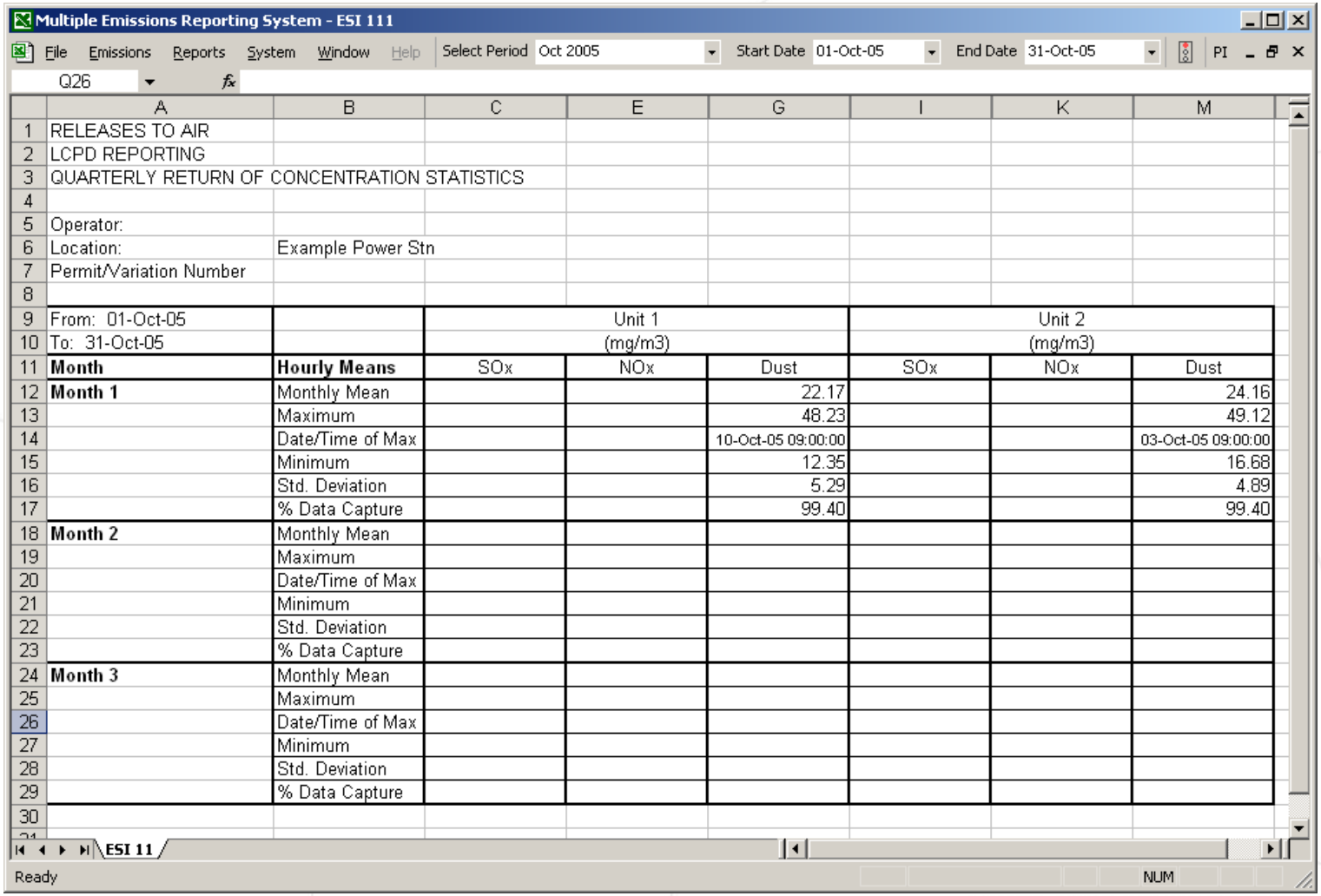
Example Reports: Statutory



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

	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

Ready NUM

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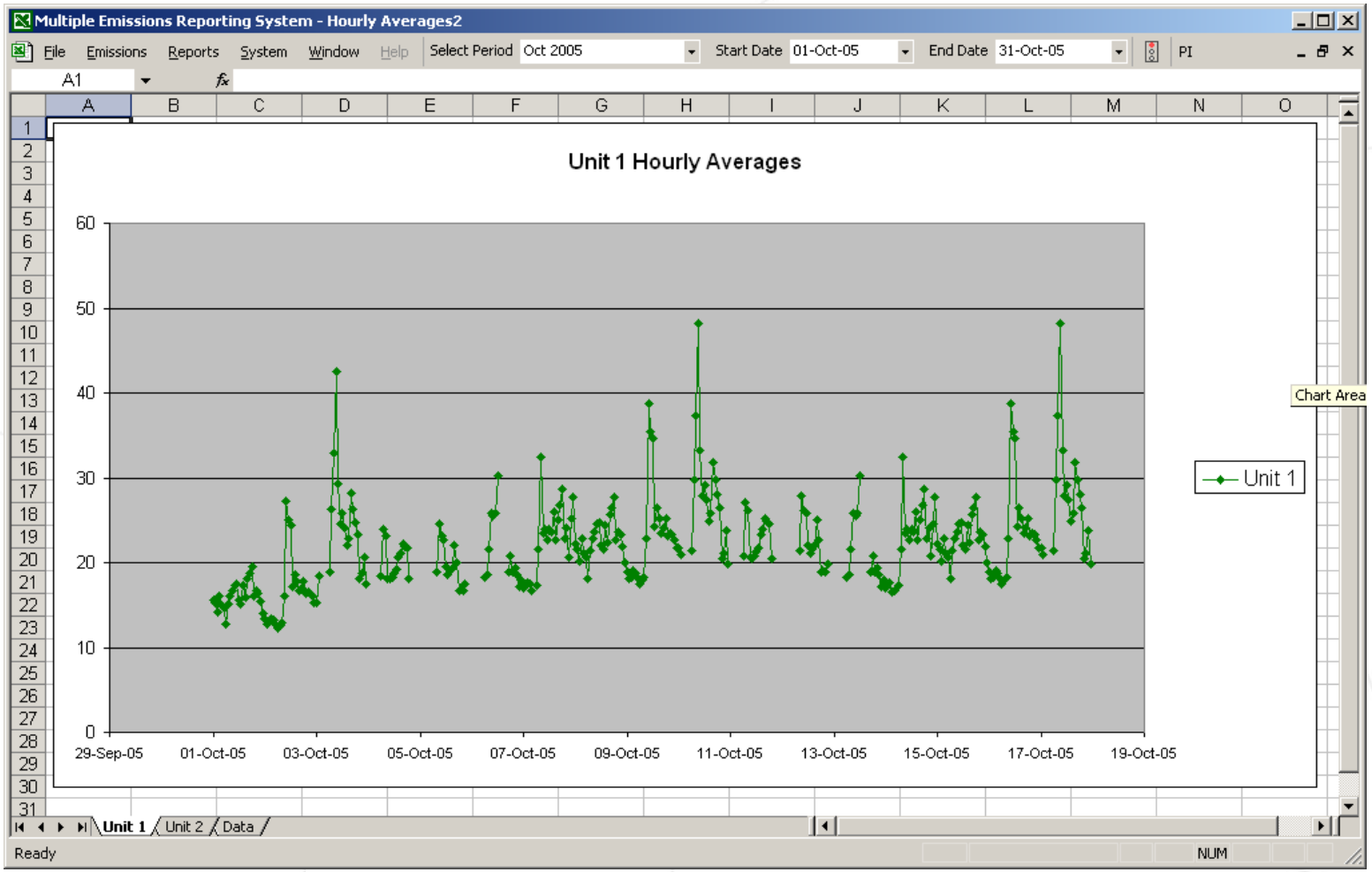
Example Reports: Ad-hoc Chart



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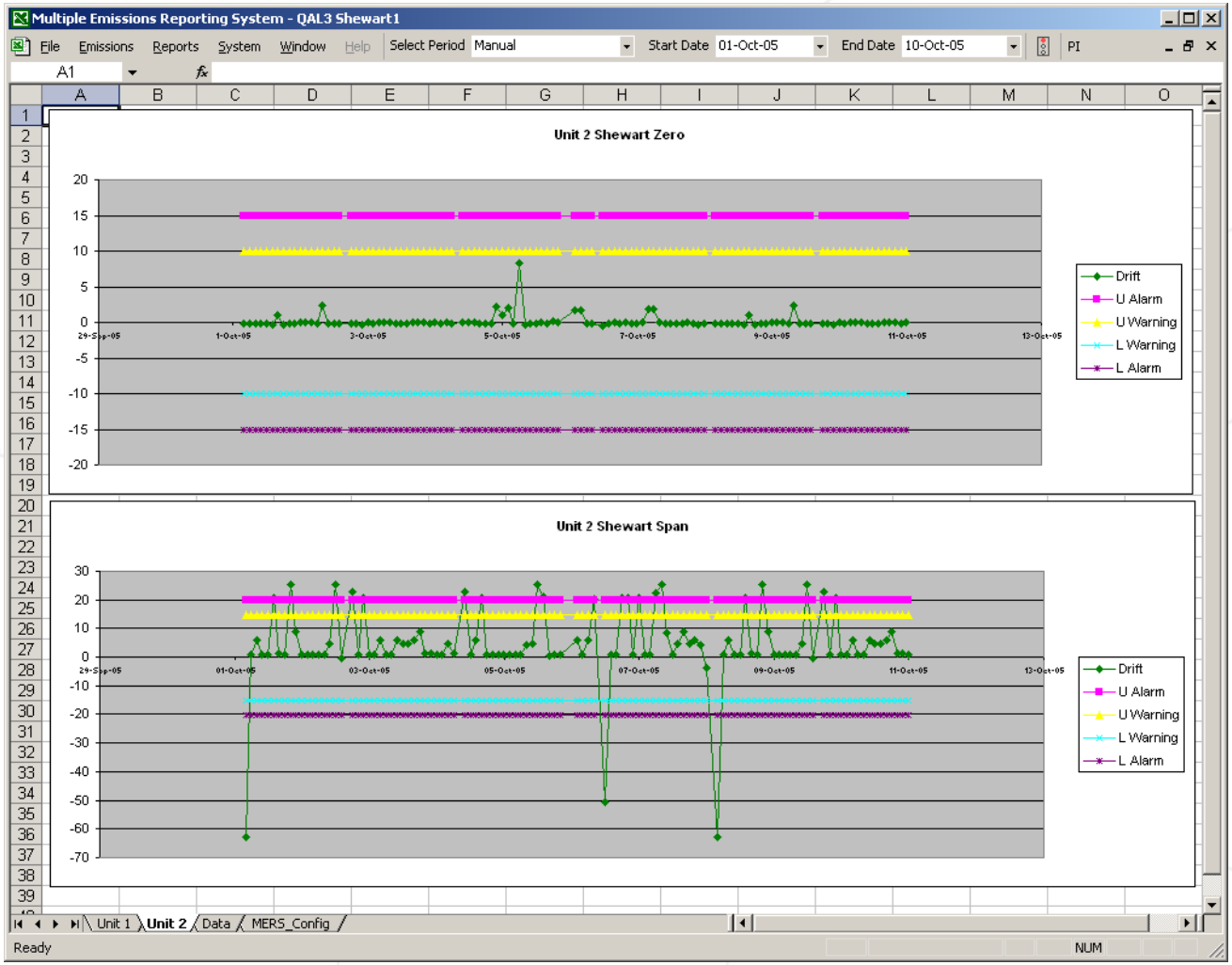
Example Reports: QAL3 Chart



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Technical Challenges

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

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

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…

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

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%

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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