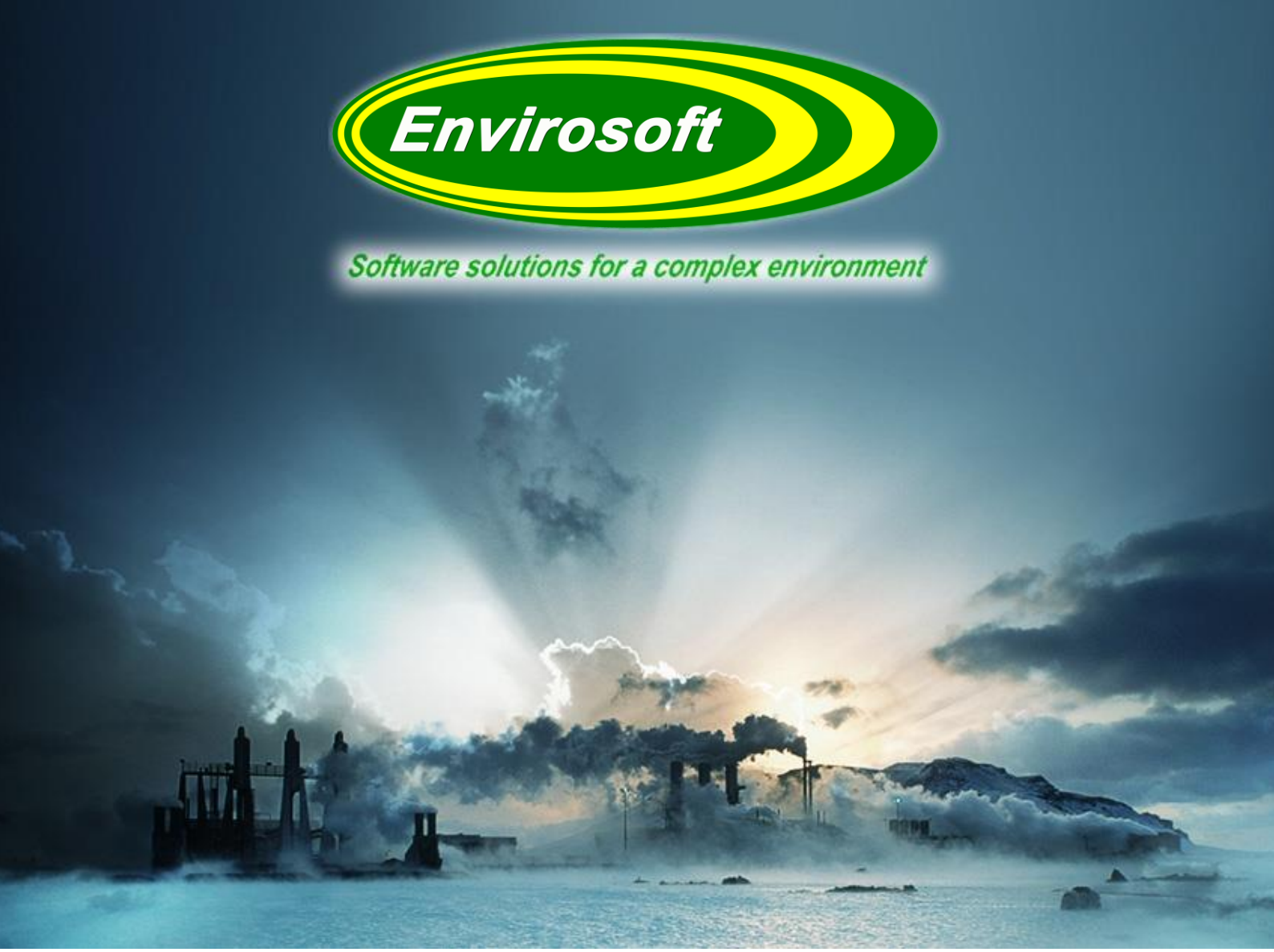

CEMSuite Technical Manual
Ver. 2.02

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1 CONTENTS

2 INTRODUCTION

2.1 CEMSUITE PHILOSOPHY

CEMSuite has been designed to provide all the data processing functions and reports that are required by plant operators to satisfy their legal requirements. These include:

- The Large Combustion Plant Directive (LCPD)
- Waste Incineration Directive (WID)
- Integrated Pollution Prevention and Control (IPPC)
- Integrated Emissions Directive (IED)
- EN 14181 (TGN M20)

2.2 PROGRAMMING OVERVIEW

CEMSuite will consist of a suite of programs that will access and process the data stored by the CEMServer software – this is as detailed in the CEMServer Technical Manual – TM05. In order to provide consistency, each program will access three common code files for the following functions:

- List of Variables (variable.pas).
- Initialisation (initialise.pas).
- Data Processing (library.pas).

The library file above contains the core of all CEMSuite programs and all of the code that accesses and processes the emission data, including:

1. Database Table Access.
2. Measurement Units Conversion (e.g. ppm to mg/m3).
3. Data Averaging (for assessment of required averages).
4. Assessment of Measurement Validity within each average.
5. Assessment of Plant Status (e.g. Avoids plant off periods diluting the measurement).

As the format and reporting of this data differs between applications, each program will use its own unique method of presenting the data. Some of these reports are fixed apart from a few lines of site / operator details (e.g. WID), while others vary considerably between operators and between regions (e.g. LCPD). For plants where there is little guidance in how to report the data (e.g. Glass Plants) a general data reporting package (CEMPort) can be used.

2.3 CEMSUITE PROGRAMS & FUNCTIONS

CEMSuite consists of the following programs:

CEMForm

Typical data analysis (normalization and averaging) to provide real time and historical data analysis. Also acts as the interface to other data export programs to provide outputs from processed data.

CEMPort

Specialist program to summerise emissions data into a format for submission to the authorities or for internal housekeeping or analysis.

CEMQual

Specialist program to analyse and report drift and validity of analyser calibration, based entirely upon the European standard EN14181.

WID Report

Specialist Waste Incineration Directive reporting program that provides the data in a dedicated format suitable for submission to the authortites.

LCPD

Specialist power Generation reporting program that provides the data in a dedicated format suitable for submission to the authorities. Covers reports required under the Large Combustion Plant Directive.

2.4 PURPOSE OF THIS DOCUMENT

The main objectives of this document are to:

1. Provide a broad understanding of the CEMSuite system architecture.
2. Identify the CEMSuite programs and their functions.
3. Identify the relevant documents and test procedures for these programs.
4. Illustrate how the CEMSuite software meets the MCerts requirements.

2.5 RELEVANT DOCUMENTS

CEMS data access and storage are covered by the CEMServer programs, although touched on here; this is detailed more fully in the CEMServer Technical Manual (TM05). All CEMSuite programs have operating manuals that are identified here and may be opened directly while operating each program:

1. CEMForm: User Manual UM10.
2. LCPD: User Manual UM11.
3. CEMPort: User Manual UM12.
4. WID: User Manual UM14.
5. CEMQual: User Manual UM13.

3 CEMSUITE SOFTWARE

3.1 CEMFORM

CEMForm provides the display program for both real time (unique for the CEMSuite programs) and historical data, producing data displays as a spreadsheet-style grid and trend information. It also acts as the interface to other data export programs to provide outputs from processed data. This is the program most operators use to operate their plant and although it doesn't produce any reports, it is an important program in ensuring that plants meet their emission limits as laid down in their relevant guidance notes.

3.1.1 CEMFORM PROGRAMMING SUMMARY

Language: Delphi XE4.

3.1.2 CEMFORM TESTING SUMMARY

Test Program/Data: CEMSimulator.

Test Documents:
Live Data: CEMServer Test Procedure (TP01).
Historic Data: CEMSuite Test Procedure (TP02).

3.2 CEMPORT

CEMPort provides generalised report production, i.e. non-specialist reports to summarise the emission data into daily, weekly, monthly, quarterly and yearly time periods. It also may be used to export the emission data into a spreadsheet compatible format (e.g. comma separated variable - .CSV) and to check on any excursions above alarm levels.

All averages are available, from raw data (every few seconds) to an annual average. Typical statistical analysis including: maxima, minima, standard deviations, percentiles, operating times, mass release etc.

3.2.1 CEMPORT PROGRAMMING SUMMARY

Language: Delphi XE4.

3.2.2 CEMPORT TESTING SUMMARY

Test Program/Data: CEMPort Test Data.

Test Documents: CEMSuite Test Procedure (TM02).

3.3 WID REPORT

This module produces a specialist report that provides the data in a dedicated format suitable for submission to the authorities for process that come under the Waste Incineration Directive. The report provides the daily average and the maximum ½ hourly average in each calendar day and also assesses the availability of these measurements.

3.3.1 WID PROGRAMMING SUMMARY

Language: Delphi XE4.

3.3.2 CEMPORT TESTING SUMMARY

Test Program/Data: WID Report Test Data.

Test Documents: CEMSuite Test Procedure (TP02).

3.4 LCPD

Specialist reports for Power Generation companies that provide the data in a dedicated format suitable for submission directly to the authorities. As these vary considerably between regions and operators, formats may be produced in an excel style grid and then imported into the software and filled with the relevant data.

3.4.1 LCPD PROGRAMMING SUMMARY

Language: Delphi XE4.

3.4.2 LCPD TESTING SUMMARY

Test Program/Data: LCPD Test Data.

Test Documents: CEMSuite Test Procedure (TP02).

3.5 CEMQUAL

CEMQual is a specialist program that enables operators to make all the calculations, graphs and reports to comply with the requirements of the European Standard EN14181. As QAL1 and QAL2 are usually outside of the plant operators scope Envirosoft have concentrated on the QAL3 part of the standard – the ongoing assessment of the quality of these measurement.

3.5.1 CEMQUAL PROGRAMMING SUMMARY

Language: Delphi XE4.

3.5.2 CEMQUAL TESTING SUMMARY

Test Program/Data: CEMQual Test Data.

Test Documents: CEMQual Test Procedure (TP03)

3.6 CEMCFG

The CEMCFG program provides a method of configuring all the CEMSuite programs.

3.6.1 CEMCFG PROGRAMMING SUMMARY

Language: Delphi XE4.

3.6.2 CEMCFG TESTING SUMMARY

Test Program/Data: CEMSuite.

Test Documents: CEMSuite Test Procedure (TP02).

4 DATA STORAGE

4.1 RAW DATA – CEMSERVER

A typical CEMSuite system will consist of one or more Dedicated Storage Units (DSU) that will gather the CEMS data from various sources and store the data to a local database table; this storage is completely independent of the CEMSuite PC. The CEMServer software uploads this data to the CEMSuite PC periodically.

Please refer to the CEMServer Technical Manual (TM05) for more details.

4.2 DATA STORAGE - CEMSUITE

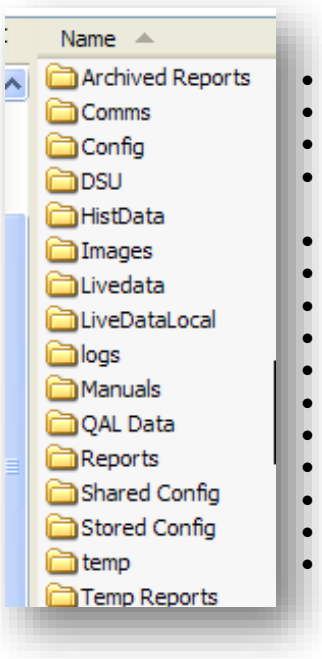
The CEMSuite programs have a maximum capacity of 12 display groups each containing up to 24 channels of data. Normalisation is generally conducted on a group-by-group basis, i.e. each measurement in the same group will share the same normalising parameters. It is possible for a group to contain data channels that have different normalising details; this is detailed in Composite Groups section.

An additional 12 groups of calculated data are available; this data is produced from the existing stored data. Typical examples of calculated pages are backup analysers where the data used for reports or outputs may be determined from one of two analysers, or complex calculations between fuel flows and emission values from large plants – typically oil refineries.

4.3 DATA STORAGE / FILENAMES / FOLDER STRUCTURE

4.3.1 FOLDER STRUCTURE

A typical CEMSuite folder structure is given below:



- Archived Reports: Reports that are significant to the customer.
- Comms: Temporary folder for communications (rarely used).
- Config: Holds all the configuration data.
- DSU: Created manually by Envirosft during commissioning as a backup for the DSU.
- HistData: All archived Data.
- Images: All images for the CEMSuite Programs.
- LiveData: Temporary folder for the live data.
- LiveDataLocal: Folder for raw and processed live data.
- Logs: Holds any error logs for all programs.
- Manuals: Contains manuals for the CEMSuite programs.
- QAL Data: Contains the QAL3 Data and settings.
- Reports: Default report folder for CEMPort.
- Shared Config: Used for multi-PC applications.
- Stored Config: Used for audit purposes.
- Temporary Folders.

Measurement data files are held in two folders off the CEMSuite folder – typically C:\Program Files\Envirosoft\CEMSuite:

1. LiveDataLocal folder: This holds the last 28 hours' worth of data in a rolling table, e.e. the earliest records are deleted as new records are stored; this is used for all real time data processing. Raw data – LiveDataR.db and Processed – Livedata.db. The processing here is only to produce minute averages from the raw data.
2. HistData folder with Year and Month subfolders: This holds the long term data archive. Each day has its own table in the format ddmmyyyy.db for raw and ddmmyyyy.db for the minute average files and ddmmyyyy.db for the processed reportable files.

4.3.2 DATA FILE DETAILS

A typical data storage line in the raw and minute processed data tables appears as below:

DataTime	DST	Datastring, G1 = group 1, G2 = group 2 etc
10/09/2008	FALSE	215300000100 7FF8 007FFD 0080 6600 8001 0080 BC00 83E0 00CF D700 8011 007F FF...
...		2153 - coded checksum
...		00 - edit code, should always be 00
		0001 - Fuel type number
		00 - channel 1 validity code
		7FF8 - channel 1 data
		00 - channel 2 validity code
		7FFD - channel 2 data
		00 - channel 3 validity code
		8066 - channel 3 data
		and so on

Note:

1. All values and validities are held as an ASCII string representation of a hexadecimal number.
2. Each line of data has a coded checksum that is checked every time the data is read by any of the CEMSuite programs; the operator is altered should there be discrepancy.
3. For the data values, 7FFF represents 0, FFFF represents the maximum value (+32767) and 0000 represents the minimum value (-32767).
4. The validity byte will be 00 for valid data, FF for no data (e.g. No comms to analyser) and any value in between for invaluid data.
5. As illustrated here, each data point has a fuel number associated with it (as stored by CEMComm) and this value refers to a line in the fuel configuration (calculation factors within CEMCFG program). From here the normalistaion and plant status information are set; examined later, this information is held in the table 'FuelCFG.db'. Also within the fuel information are 12 floating point numbers that are used for additional parameters; these are refferred to as FTV1…FTV12 within the text.

4.4 DATA FILE FORMAT

All emission data will be held in Paradox© database files and will take the form illustrated below:

Field	Data type	Comments
DataTime	TDateTime (float double)	The date (integer part) and time (decimal) of the stored data
DST	Boolean	Unused
G1…Gn	String	Data string

Note: These files are produced from the CEMServer programs. Each Data Storage Unit (DSU) may have up to 8 pages of data but a complete system may have up to 12 pages. Usually a DSU is limited to 3 or 4 pages so that data access may be completed within a reasonable time frame.

4.5 REPORTABLE DATABASE TABLES

At 00:20 each day the CEMForm program will analyse the data for the previous day into a processed data file. This will typically consist of hourly or half hourly averages (LCPD and WID data respectively) and will contain the information that will be used to construct the reports that are submitted to the authorities.

Data here is in IEEE754 format (32 bit precision) and apart from any confidence adjustment, has been corrected for QAL2 factors, normalised and averaged as required. All CEMSuite reporting programs will operate on this data for the compilation of reports. In order to facilitate the removal of bad data, or the inclusion of good data, correction for known errors etc, an editing program, CEMRepair, is available – see below for further details.

4.6 EDITING REPORTABLE DATA

During normal operation of both plant and the continuous emission monitoring, data should not require editing. However, no matter what precautions, service or maintenance procedures are put in place, there will always be instances where the data has been recorded that will either require discounting or modifying before the period is reported to the authorities; these are the typical occasions where editing is used. It provides a secure, recorded and auditable means of adjusting the CEMS data.

Without a means of discounting or modifying their emission data, where problems with the recorded data have occurred, the task of submitting reports to legislative bodies for plant operators can be difficult. CEMRepair provides a protected, recorded and auditable means of accommodating this requirement. Without it, plant operators would have to provide their own methods of data manipulation, which may not be protected and may not provide a clear audit trail.

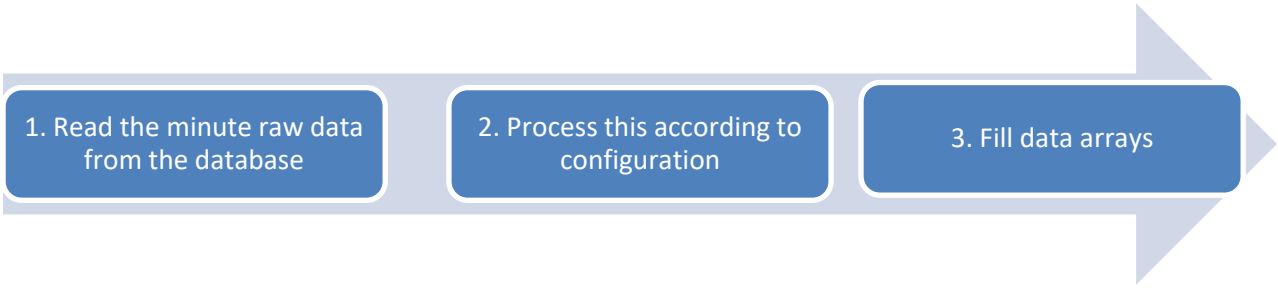
In reality, the processed data files are not actually edited; separate instances are created for each day and it is these files that are available for editing. If the report programs detect their presence, they will use the edited files by default, however, the reporting programs can also be forced to use unedited data. In this way, alongside the recorded edit details, a complete audit trail for the data exists.

5 GETDATA PROCEDURE

A major procedure 'GETDATA' is called to read and process the data within database tables. This entirely controls the processing of the data (normalisation, calculated measurements etc) and is called before another major routine; the average data procedure. Between them, these two procedures define how the data is treated before it is displayed to the plant operator or submitted for reporting to legislative bodies.

5.1 MAIN FUNCTION – DAILY DATA

The three main parts of the GETDATA procedure are as below:



The main aspects of these are detailed below:

5.1.1 DATA READ ROUTINE

After determining the filename of the data required, the data is read for every minute of the selected day (1440 minute values) and processed – see below. The data tables are addressed from the top down (earliest to latest).

5.1.2 DATA PROCESSING

The following processing sequence is adhered to:

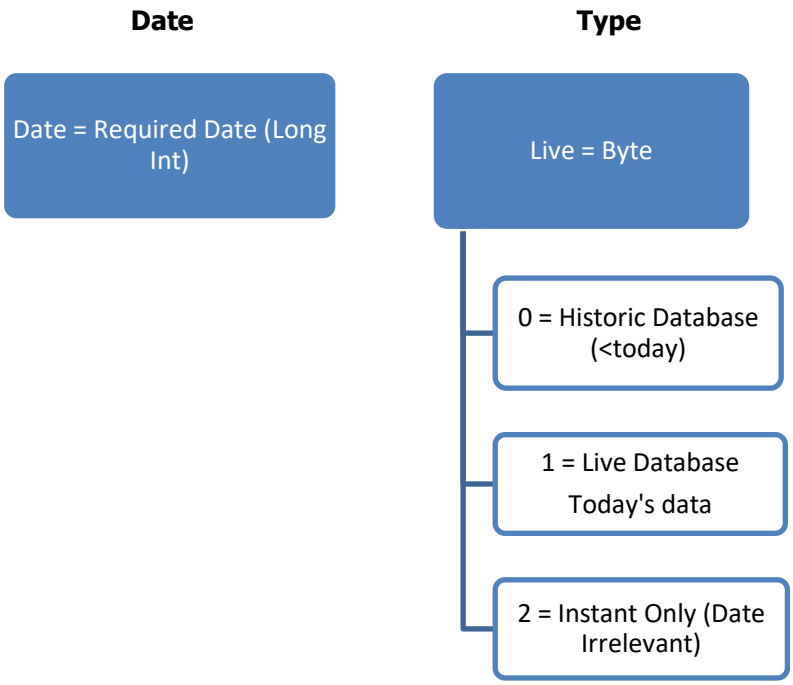
1. Apply the divider to the raw integer value (data now scaled correctly).
2. Correct for QAL2 coefficients (read for each day). This is conducted at an early stage so that the normalisation parameters (particularly oxygen) are corrected before they are used.
3. Depending upon the type of measurement, either adjust for molecular weight (if ppm from a gas analyser) or convert dust from a optical or tribo-electric meter.
4. Correct for appropriate normalisation parameters.
5. Calculate kg/hr if appropriate.

5.1.3 FILL DATA ARRAYS

As the same routine is used for both the rolling live data and the historic data base, once the data has been processed, it is moved to either the live data array (for live trends and live average values) or the historic data array (for historic trends and averages etc).

5.2 CALL METHOD

The procedure is simply called by: **GetData (Date, Type)**. Two parts to the request; date of the data required and the type.



6 CONFIGURATION FILES & DATA PROCESSING OVERVIEW

6.1 EDITING THE CONFIGURATION FILES DIRECTLY

All the CEMSuite programs use the same information to process the data and all data is held within the Config subfolder. There is one .ini file – 'main.ini' and several paradox table files. The main.ini file will open directly from 'Notepad' and this is detailed below.

Below is a summary of the Main.ini file with the 'obvious' lines and those set from the CEMCFG program not shown.

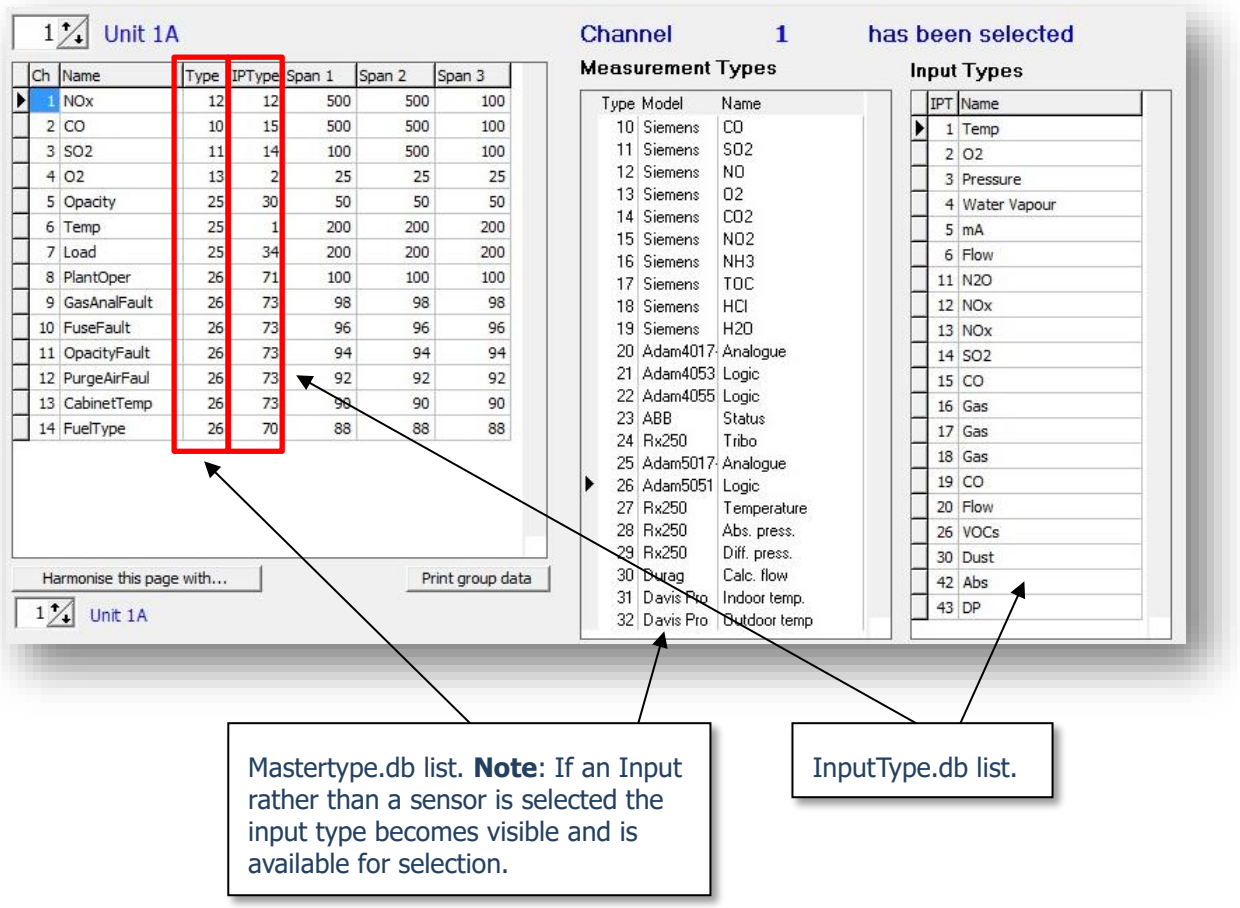
```
[Main]
Davis Group=0          (Set to weather station group if present, else 0)
ThirdParty=1           (Places customer image on CEMForm – 3rdparty.jpg in image folder)
Update=10000           (Update interval of CEMForm)
ABB=1                  (If not set, a 1.53 factor is used to calculate NOx from NO))
GT Display=1           (Uses the predictive display for GT control)
Outputs=1              (This PC will control the analogue outputs, if any are present)
Use TCPIP=1            (In late 2008, this will normally be set)
DSU Address=DSU        (DSU FTP settings – and below)
DSU Port=1024
DSUName=DSU
DSUNo=1

[Options]
NONO2NOX=1             (Add the NO to the NO2 to provide NOx)
WetO2=1                (Oxygen is wet and will be dried by the water vapour channel)
mgdp=1                 (Provide 1 decimal place for all processed measurements)
kgdp=1                 (Provide 1 decimal place for kg/hr calculations)
CommentsYVal=0         (Place the comments at the top of the graph, higher numbers, lower text)
Cover128=0             (Can cover up an error)
CorO2Neg=1             (Allow O2 correction less than 1)
CO2Norm=0              (Set to 1 for CO2 normalisation)
Sound Alarm=2          (Alarm 2 will drive the sound alarm, alternatively alarm 1)
```

6.2 MASTER TYPE AND INPUT TYPE

During the CEMCFG program operation each data channel is configured to achieve the required data processing. However a simple utility program 'DBUtils' resides in the CEMSuite folder and enables each of the configuration tables to be edited directly. After starting this program select the 'Config' folder and examine / edit each table as required.

Individual channel settings are held within the MainCFG.db table and this is configured directly from the CEMCFG program. The most pertinent settings for the channel for the CEMSuite programs are tied to either the MasterType or InputType value within the MainCFG table. These are looked up from either the InputType.db or MasterType.db files. The major difference here is that the Type 10…19 from the MasterType table will use the same validity messages, whereas the analogue input settings will use the higher nibble (10, 20, 40 and 80) for A/D errors.



Ch	Name	Type	IPType	Span 1	Span 2	Span 3
1	NOx	12	12	500	500	100
2	CO	10	15	500	500	100
3	SO2	11	14	100	500	100
4	O2	13	2	25	25	25
5	Opacity	25	30	50	50	50
6	Temp	25	1	200	200	200
7	Load	25	34	200	200	200
8	PlantOper	26	71	100	100	100
9	GasAnalFault	26	73	98	98	98
10	FuseFault	26	73	96	96	96
11	OpacityFault	26	73	94	94	94
12	PurgeAirFaul	26	73	92	92	92
13	CabinetTemp	26	73	90	90	90
14	FuelType	26	70	88	88	88

Type	Model	Name
10	Siemens	CO
11	Siemens	SO2
12	Siemens	NO
13	Siemens	O2
14	Siemens	CO2
15	Siemens	NO2
16	Siemens	NH3
17	Siemens	TOC
18	Siemens	HCl
19	Siemens	H2O
20	Adam4017	Analogue
21	Adam4053	Logic
22	Adam4055	Logic
23	ABB	Status
24	Rx250	Tribo
25	Adam5017	Analogue
26	Adam5051	Logic
27	Rx250	Temperature
28	Rx250	Abs. press.
29	Rx250	Diff. press.
30	Durag	Calc. flow
31	Davis Pro	Indoor temp.
32	Davis Pro	Outdoor temp

IPT	Name
1	Temp
2	O2
3	Pressure
4	Water Vapour
5	mA
6	Flow
11	N2O
12	NOx
13	NOx
14	SO2
15	CO
16	Gas
17	Gas
18	Gas
19	CO
20	Flow
26	VOCs
30	Dust
42	Abs
43	DP

6.2.1 MASTER TYPE AND INPUT TYPE TABLE

IPType	Name	MeasBase	Molecular Weight	POZero	Divider	Decimal Places
1	Temp	0	1	False	10	1
2	O2	0	1	False	1000	3
3	Pressure	0	1	False	10	1
4	Water Vapour	0	1	False	10	1
5	CO2	0	1	False	1	1
11	CO	28	1.25	False	10	1
12	NOx	28	2.05	False	10	1
13	NO	28	1.34	False	10	1
14	SO2	28	2.86	False	10	1
15	Gas	28	1	False	10	1
16	Gas	28	1	False	10	1
17	Gas	28	1	False	10	1
18	Gas	28	1	False	10	1
19	Gas	26	1	False	10	1
26	VOCs	1	1	False	1	0

IPType: A number that is cross referenced from the Main CFG table. **Note:** This also applies to the Master Type table where the IPType column is referred to as 'Type'. The same data above exists in both tables.

Name: For information only.

MeasBase: Important – determines how the data is processed.

Molecular Weight: Used for ppm to mg conversion.

POZero: Sets whether the value is displayed during plant shut downs; if true, HELD is displayed.

Divider: The divider to apply to the raw measurement – will match that within the DSU.

Decimal Places: The number of decimal places to display for the raw data. **Note:** There is an overall setting as well.

Ppm, mg/m3, mg/Nm3 and Kg/hr: Labels for the units on CEMForm.

6.2.2 MEASUREMENT BASE (MEASBASE)

This value determines how the data is processed by all the CEMSuite programs. Values are examined below:

Value	Typical Use	Comments
0	Temperature, Oxygen etc.	Any measurement where no processing is required.
1 or 7	Gas ppm	Assumes wet and at STP, usually in-situ. Uses the molecular weight to convert from ppm. **– See EA M2 v5 09/2008, BOX 3.3**
2	Kelvin to Centigrade.	Raw value = Kelvin, Processed = Centigrade.
3	Opacity %	Raw = % Opacity, Processed = mg/m3 using the dust factor and the square by the dust factor 2 in the fuel table.
4	Tribo Output	Raw = % Output, Processed = mg/m3.
5	Flow Input	Raw =m/s (wet), Processed = m3/s.
6	Dust Extinction	Dust is calculated by multiplying the raw data by the dust factor and the square by the dust factor 2 in the fuel table.
8	Gas, ppm or mg	Multiplies the raw data by the molecular weight for the mg/m3 column and then normalises to STP and for water and air dilution. Usually from insitu gas analysers.
9	Gas, ppm or mg	As above but without temperature.
10	Normalisation Ratio	May be used to display the correction from mg to Nmg, fixed to 3 decimal places.
11	Calculated CO2	Uses a stoichimetric CO2 value held in the FuelCFG table, FTV1 to calculate CO2 from the oxygen value.
12	Smoke	Calculates the Ringelmann value from the opacity, just uses 0 to 5 from 0 to 100% opacity.
13	Normalised Flow	Takes a normalised flow reading in Nm3/hr, and converts to m/s and m3/s actual.
15	Visibility	Calculates visibility from the opacity – used for road tunnels.
18	Fuel Input	Converts fuel input to Mj/s using a calorific value held in the FuelCFG table, the FTV number being the same as the channel number.
22	Calculated O2	The reverse of measbase 11.
23	Dust	Determines the dust concentration from the input level x the dust factor, added to the dust factor squared value as an offset (ax + b).
25	Any	Applies an ax2 + bx + c calculation; where x is the raw value and a, b and c are the FTVs held in 10, 11 and 12 respectively. Reading is normalised for units 3.
26	Ppm Dry	Assumes an input of ppm dry @ STP.
27	Any	As 25 but a, b and c are held in the values 123 for channel 1, 456 for channel 2 etc.
28	Mg/m3 Gas	Assumes an mg reading @ STP. Typically used for most sampling analysers. Note that if the ABB=0 is in the Main.ini first section, then for type or input type 12 a correction of 1.53 will also be applied.

Value	Typical Use	Comments
29	mA Input	Converts from a ma input and uses values in the FuelCFG table; value 7 being the offset and value 8 the span (note that the span is without the offset). Typically used for absolute pressure but may be used for anything. Unit 1 is mA, all others are after these calcs.
30	Durag Flow	Calculates the flow from a differential pressure input. Assumes input is in mA and has a 1000 divider. Uses values 1 and 2 of the FuelCFG table, where 1 is the span and 2 is the offset. Corrects for temperature and pressure.
33	Gas mg	As 28 but always assumes a dry measurement.
34	Flow Input	Expects an inputs of m3/hr, and then normalises to STP.
35	O2 from MW	Creates an estimate of oxygen from a MW input, where O2 = MW x FTV5 + FTV6; rarely used.
36	Flow from MW	Calculates an estimate of the flow from a power input. Where Flow = power x FTV2 + FTV3.
37	Fahrenheit to Centigrade	Input is F, all other units are centigrade.
38	Atmospheric Pressure inches Hg to bar	Input is inches Mercury, all other units are bar.
39	Mph to m/s	Input is mph all other units are m/s.
40	Inches to cm	Input is inches all other units are cm.
41	H2O from Wet and Dry Oxygen	Calculates the water vapor from: (Dry – wet) / Dry as a percentage.
42	VOC / TOC	Assumes wet and @ STP input and multiples by the molecular weight.
43	Durag DFL100	mA is stored. Differential span is held in FTV1 (1000 divider, 4-20 mA).
44	COP gas flow calc (Custom Site)	For Philips, Seal Sands.
45	GT flow calc (Custom Site)	For INEOS at Seal Sands.
46	GT flow calc (Custom Site)	For Philips Seal Sands
47	Flow from up to three fuel flows (Custom Site)	Specifically for Didcot.
48	Dry flow from Wet flow	Rarely used.
49	Spare	Spare.
50	Gauge Pressure	Converts to absolute.
51	M3/hr Input	Converts to at STP (mg), dry and O2 (Nmg).
52	Fuel flow to Exhaust Flow Estimate	Enter the conversion in the TV values for the same channel as the flow, to provide: fuel flow, exh. Flow at STP, o2 corrected exh. Flow for units 1, 2, 3 respectively.
53	Flow m3/hr Input	Corrected for O2 and H2O.
54	Flow m3/hr Input	Corrected for just H2O.

6.2.3 MOLECULAR WEIGHTS

The following table illustrates the usual molecular weights used by the CEMSuite programs:

Gas	Molecular Weight*
ppm	mg/Nm3
NO	1.34
NO2/ NOx	2.05
CO	1.25
SO2	2.86
HCl	1.63
HF	0.89
CH4	0.74

*Kaye & Laby - http://www.kayelaby.npl.co.uk/chemistry/3_1/3_1_2.html

6.3 FUEL TYPE INFORMATION (FUELCFG TABLE)

From here the normalisation and plant information are set. This information is held in the table FuelCFG.db. Also within the fuel information are 12 floating point numbers that are used for additional parameters; these are referred to as FTV1…FTV12 within the text.

Information Summary:

Parameter	Type	Comment
Temperature Reference Level (°C)	Integer	Usually set at 0°C.
Oxygen Reference Level (%)	Integer	Varies according to process.
Pressure Reference Level (mbar or kPa)	Integer	Usually set at 1013 mbar.
Water Vapor Ref. Level (%)	Integer	Normally at 0 (dry).
Temperature Status	Bit	True or false for plant status.
Oxygen Status	Bit	"
Pressure Status	Bit	"
Water Vapor Status	Bit	"
Temperature Status Level	Integer	> level plant ON.
Oxygen Status Level	Integer	< level plant ON.
Pressure Status Level	Integer	> level plant ON.
Water Vapor Status Level	Integer	> level plant ON.
Dust Factor	Float	Dust conversion.
Dust Factor2	Float	Dust conversion.
FTV1...FTV12	Float	Various factors for data processing.

6.4 GROUP INFORMATION (CROUPCFG TABLE)

Information pertinent to each group of channels. Data here instructs the programs where to find the necessary data to perform the normalisation and averaging correctly.

Information Summary:

Parameter	Type	Comment
Group Name	String	Identifying string.
Number of Channels	Integer	
Stack Height	Float	Release height – used for CEMPact.
Stack Width	Float	Width of round stack– used for CEMPact.
Use Flow	Boolean	Use measured flow or use a constant.
Duct Area	Float	Used for mass release calcs.
Rolling Average 1..4	Integer	Time in minutes for 1…4 averages.
Rolling Average Strings 1..4	String	String for average.
Estimated Flow	Float	Use this figure if not measured (m3/s).
Temperature Channel	Integer	Defines where to find the temperature data
Oxygen Channel	Integer	Varies according to process.
Pressure Channel	Integer	Usually set at 1013 mbar.
Water Vapor Channel	Integer	Normally at 0% (dry).
Power Channel	Integer	True or false for plant status.
Flow Channel	Integer	"
Pressure Status	Bit	"

6.5 CALIBRATION DATA – QAL2 COEFFICIENTS

All data will be corrected using the coefficients determined during the QAL2 testing. These are present within the CALDATA.DB file, where two real numbers are provided for the A and B coefficients for each measurand. Where no data is available these default to unity with no offset – no correction. All programs will allow the uncorrected data to be displayed, if configured to do so.

A date field determines when this data is to be used from; this will only be checked at the start of each day's analysis (midnight) so effectively a change in QAL2 coefficients may only take place at midnight. The CEMQual program (QAL3 analysis) is used to change these factors under password protection.

Please see the notes in the following section regarding switched analyser systems.

6.6 SWITCHED DATA (REDUNDANCY)

On CEM systems that have redundant, standby analysers that may be switched into a gas stream to provide a backup measurement, CEMSuite can provide a 'calculated page' of data that will either come from the duty analyser (the normal situation) or from the standby analyser when selected. All data from all analysers is always logged; the switch only drives the selection of data for the report and hence usually the control for plant operators.

There are two possible arrangements:

1. Multiple processes (multiple line incinerators or generating units) that use a single standby analyser. In the event of a faulty duty analyser, this may be switched to sample from the same exhust. Main.ini entry: [OPTIONS] Switch QAL2 Data=1.
2. A dedicated redundant analyser that continually makes the same measurements as the duty analyser. Main.ini entry: [OPTIONS] Switch QAL2 Data=0.

These arrangements need to be treated in a slightly different way:

The subtle difference for any CEMS is that for arrangement 1, the standby analyser will use a unique set of QAL2 data for each of the exhausts that it may be switched to. CEMSuite achieves this by using a calculated page for each of the processes and it is here that the QAL2 factors are entered for the switched system.

Arrangement 2 that uses standby systems that are permanently connected to only one process will have a single set of QAL2 factors in the same fashion as the duty analyser. For this arrangement, it is also possible to set CEMSuite to automatically switch over to the standby data in the event of missing data here. The measurement that drives this condition is selectable but note that it must be missing data, not just invalid data that drives this switch. This is to avoid short term calibrations from interfering with this process.

Other Notes:

1. Processed data will always be switched, i.e. the first page of processed data will contain switched data as well as the report page. This is to make the definitions of the reporting page simpler – Unit 1 is page 1 etc.
2. Calculated pages will provide the real time assessment of the data according to the switch.
3. Switched data will be indicated on reports and on the live data and trend pages, either by text indications or by a change to the colour of the data security bar (light blue being used).

6.6.1 CONFIGURATION NOTES – CALCULATED PAGES

The page structures of typical systems may appear as below:

Arrangement 1

Page	Data
1	Unit 1 Duty
2	Unit 2 Duty
3	Unit 3 Duty
4	Miscellaneous
5	Standby Analyser
6	Unit 1 Report
7	Unit 2 Report
8	Unit 3 Report

Arrangement 2

Page	Data
1	Unit 1 Duty
2	Unit 2 Duty
3	Unit 3 Duty
4	Miscellaneous
5	Unit 1 Standby
6	Unit 2 Standby
7	Unit 3 Standby
8	Unit 1 Report
9	Unit 2 Report
10	Unit 3 Report

From CEMCFG, increase the number of groups to accommodate the 3 report groups at the end but set a new line in the Main.ini: [MAIN] NumDataGroups=n, where n is the number of data pages that contain analyser data (i.e. the number of pages are transmitted from the DSUs).

From CEMCFG again, in the 'Calculated Pages' section, define each of the new groups as type 8 – A switched group.

Now we have the empty pages, they need to be filled with data. CEMSuite will assume that the first page after the last real data page is the report page for the first process and will by default, copy the duty first page into it. The same applies for the remaining report pages (second after the end is page 2s data etc). In order for the data to be switched in from the standby group, additions need to be made to the Main.ini, note there are settings to accommodate GAS, DUST and a CUSTOM DEFINED set of data:

```
[SWITCH DATA]
Gas 1=0301140100                -     GAS SWITCHING INFO FOR PAGE 1
      03                        -     SOURCE PAGE OF THE STANDBY DATA 0=OFF
        01                      -     PAGE OF THE SWITCH
          14                    -     CHANNEL OF THE SWITCH (DECIMAL)
            01                  -     VALUE TO ACTIVATE THE SWITCH
              00                -     SPARE
Gas Duty Name=Gas - Duty        -     DUTY NAME STRING
Gas Stby Name=Gas - Stby        -     STBY NAME STRING
Gas Missing Chanel=1            -     SET TO 0 TO TURN OFF THE AUTOMATIC
                                      SWITCH ON MISSING DATA, NON ZERO WILL
                                      SET THE MEASUREMENT CHANNEL THAT DRIVES
                                      THIS FEATURE
Dust 1=0301140100               -     DUST SWITCHING INFO FOR PAGE 1
       03                       -     SOURCE PAGE OF THE STANDBY
         01                     -     PAGE OF THE SWITCH
           14                   -     CHANNEL OF THE SWITCH (DECIMAL)
             01                 -     VALUE TO ACTIVATE THE SWITCH
               00               -     SPARE
Gas Duty Name=Gas - Duty        -     DUTY NAME STRING
```

```
[SWITCH DATA] Continued…

Gas Stby Name=Gas - Stby        -     STBY NAME STRING
Dust Missing Chanel=1           -     SET TO 0 TO TURN OFF THE AUTOMATIC
                                      SWITCH ON MISSING DATA, NON ZERO WILL
                                      SET THE MEASUREMENT CHANNEL THAT DRIVES
                                      THIS
```

CUSTOM switch is the same (change DUST for CUSTOM) but define the type to switch by adding:

```
CUSTOM SWITCH TYPE=nn, where nn is the type to use.
```

Notes:

1. Using DBUtils, set the DISPCHAN column for the switched data to match the channel number of where the data is to come from. For gases this is normally the same as the channel number, but for dust or custom data to be switched, a single page may contain several standby data sources.
2. GAS will be switched if their TYPE is between 10 and 19 or type 71(NOx). **Note:** MASTERTYPE, not INPUTYPE.
3. DUST will be switched if their type number is 22.
4. CUSTOM switch type is as defined above.

7 ADVANCED CONFIGURATION

7.1 CEMSUITE CONFIGURATION – STEP BY STEP

7.1.1 DSU

1. Ensure that the latest versions of CEMComm, DSUCFG, DBUtils and Watchdog are located in C:\Program Files\Envirosoft\CEMSuite.
2. Open DSUCFG, login and navigate to the 'communications' tab.
3. Check the relevant boxes of the devices CEMComm will be communicating with under the 'Use?' column and configure the corresponding port / baud / parity / data bits / stop bits for each selected device.
4. Select the 'Lead?' box next to the first device selected. New options should appear on the right hand side of the window.
    a. If **ADAM** is selected perfom the following steps:
        i. Double-click the first row under the 'Address' column and select the corresponding address of the first ADAM device, typically 16 (leftmost slot of ADAM 5000)
        ii. Double-click the first row under the 'Type' column and select the corresponding type of the first ADAM device.
        iii. Continue the steps above in the subsequent rows for any additional ADAM devices.
        iv. Click 'Save'.
    b. If **ABB** is selected perform the following steps:
        i. In the box next to 'Num.addrs' enter the number of analysers CEMComm is to communicate with in the Modbus loop (i.e. if there are 2 ACFNTs and 2 Durag DRX250s enter '4') and click 'Save'. The numbers that appear in the leftmost blue column (#1, #2, #3, etc) correspond to the analyser Modbus address, so confim that this matches the Modbus address configured at the analyser.
        ii. Under 'No.chans' enter the number of channels to be implemented into the CEMSuite system per analysers.
        iii. Under 'Start reg.' enter the register the required analysers data begins from in the Modbus map (varies depending on analyser type).
        iv. Under 'Stat reg.' enter the register the required status data ('01' – Fault, '02' – Maintenance, etc) begins from in the Modbus map (varies depending on analyser type).
        v. Under 'Num. reg' enter the number of bits to be read from the status register.
        vi. Under 'Num rds' enter the number of reads to be requested from the analyser (1st Read – Channel data, 2nd Read – Analyser status, 3rd Read – Analogue inputs, 4th Read – digital inputs).
        vii. Under 'Start DI' enter the register the required digital input data begins from in the Modbus map.
        viii. Perfom steps ii-vii for each listed analyser.
        ix. Check the box next to 'GCA?' if analyser is an ACX (leave unchecked for all other types).
    c. If **LAND** is selected perform the following steps:
        i. Follow steps i-vi above.
        ii. Under 'Address' enter the Modbus address of the analyser.
        iii. Under 'Even' check the box if an even numbered read is expected (typically left unchecked).
        iv. Perform the above steps for each listed analyser.

d. If **PI** is selected perform the following steps:
    i. First ensure that the PI Data Link software has been installed on the DSU and that 'piapi32.dll', 'pilog32.dll' and 'sdkreg.dll' are located in C:\Program Files\Envirosoft\CEMSuite.
    ii. In the box to the right of 'Uname' enter the username required to log on to the PI server.
    iii. In the box to the right of 'Pword' enter the password required to log on to the PI server.
    iv. In the box to the right of 'Sname' enter the Hostname or IP address of the PI server.
    v. In the box to the right of 'Num Tags' enter the number of channels to be requested from the PI server and click 'Save'. Tag numbers will appear in the leftmost blue column, corresponding to the channel number (e.g. Tag#1 – Channel 1).
    vi. In the box next to the tag number enter the Point ID (or PID) associated with the channel data requested from the PI server (the requested channels will need to have been asigned Point IDs by a site operator).

e. If **AdamTCP** is selected perform the following steps:
    i. In the box to the right of 'Num Ads' enter the number of Adam devices CEMComm is to communicate with (e.g. if a single Adam 5000 TCP is connected to the system with a 5017, 5051 and 5069 in the first three slots enter '3'). Then click 'Save'. IP numbers will appear in the leftmost blue colomn, corresponding to the address number of the Adam device (e.g. using the example above, IP1 would represent the 5017 on address 1).
    ii. In the box next to IP number enter the IP address of the Adam 5000 TCP (this IP address should be repeated next to each separate IP number corresponding to each Adam device). If data is being read from an Anybus Unit enter the associated IP address next to the subsequent IP number and repeat for as many Modbus addresses are associated with the device.

5. Under 'Read interval (ms)' at the bottom left of the window enter the time you wish a communications loop (full read) to be completed in milliseconds.
6. Under 'Reads before hard save' enter the number of full reads (loops) you wish to be completed before data is saved to the hard disk (this can be ignored – only used on older versions of CEMComm).
7. Under 'DSU Number' enter the number you wish to assign to the DSU (single DSU systems will always be set to 1).
8. Navigate to the 'Group \ Measurand information' tab.
9. In the box next to 'No. of groups' enter the number of raw data groups to be set up on that specfic DSU.
10. In the box to 'Select group to edit' enter the number of the group you wish to edit and in the box next to 'No of channels' enter the number of channels you wish that specific group to contain (maximum of 24). Name the specific group under 'Group Name'.
11. In the main grid you will see a list of channels, the amount of which should correspond to the number of channels you stated in step 10. Under the 'Name' column enter the name of each measurand in the required position \ channel number. If a channel is to be calculated (such as NOx) then be sure to add it to the list in the location required.
12. Under the 'Type' column enter the type number for each individual measurand according to the type info table to the right of the window (if blank, 'typeinfo.txt' is missing from the config folder)
13. Under the 'Ad' column enter the address where the corresponding measurand is located (e.g. if the measurand is from an Adam 5017, enter the number you assigned it on the communications tab).

14. Under the 'IP Ch' column enter the channel where the corresponding measurand is located (e.g. if the measurand is from an Adam 5017, enter the number corresponding to which contacts the measurand is connected to on the front of the module, i.e. 1st and 2nd contacts would be channel 1).
15. Under the 'Base' column enter the base number of the scale used if the measurand is being brought into the system via analogue input (typically set to 4 for 4-20mA scale). Can be left at zero if measurand is being brought in via Modbus.
16. Under the 'I/P Span' column enter the number represented by full scale (typically 20mA) if the measurand is being brought into the system via analogue input. This column is redundant for Modbus inputs.
17. Under the 'I/P Zero' column enter the number represented by base mA (typically 4mA) if the measurand is being brought into the system via analogue input. This function is used for measurands that are required to either display values below zero or values that have a high base value e.g. pressure in mbar.
18. Under the 'Multiplyer' column enter the factor by which the measurand is to be multiplied before the data is sent to the CEMs PC (typically set to 10 for measurands that require just one decimal place and 100 for those that require two i.e. O2 & H2O).
19. Follow steps 11-18 for each separate group. If you require the next group to be identical select 'copy configuration to next group'.
20. Navigate to the 'Validity' tab (if channel validity is to be controlled by digital input).
21. In the upper left of the window enter the number of the group you wish to edit. The name of the group should be displayed to the right. In the main grid you will see a list of channel numbers and measurands corresponding to what was entered in the specific group on the previous tab along with their addresses and input channels.
22. Find the measurands that require the validity of which to be controlled by digital inputs. Under the 'ValidAd' column enter the address of the digital input module holding the required logic inputs (this will be the number you assigned to it on the communications tab).
23. The next four columns (Bit1, Bit2, Bit3, Bit4) represent the lower nibble of the status byte associated with Adam analogue inputs (the upper nibble is reserved for range errors etc). Therefore in order to assign a logic input (e.g. calibration flag) to the validity of a chosen measurand, select which bit you wish to assign to the validity of that measurand and enter the number of the channel corresponding to where that particular logic input is connected to at the input module (e.g. if a dust calibration flag is wired in to the digital input module at channel 3, and you wish the measurand to be invalidated with a '08' flag when in state, find the dust measurand in the list and enter the number '3' in the 'Bit4' column).
24. Once you are happy with the configuration, close DSUCFG.
25. Navigate to C:\Program Files\Envirosoft\CEMSuite\Config and open 'Watchdog.ini'. Ensure that 'CEMComm.exe' is listed (being aware that the program name is case sensitive).
26. Navigate to C:\Documents and Settings\All Users\Start Menu\Programs\Startup and ensure that shorcuts to 'CEMComm.exe' and 'Watchdog.exe' are located in the folder.
27. Restart the DSU and ensure CEMComm and Watchdog are automatically executed without issue on OS start.

7.1.2 CEMS PC

Install the Borland Database Engine (BDE) by following the steps below:
Locate the file 'BDEInst.dll' and place in the root of C:\.
Execute the command prompt (Run – 'cmd') and type 'regsvr32.exe C:\BDEInst.dll' (or alternatively run an associated BAT file if available).
Follow the onscreen instructions.
Locate a backup of a similar CEMSuite configuration and copy the entire folder (minus the historical data) to C:\Program Files\Envirosoft\.
Ensure that CEMForm, CEMPort, CEMCFG, CEMSync, CEMSocket (if a multi DSU system), CEMQual, LCPD (if a power station), WID (if a WID site), DBUtils are updated to their latest versions.
Open CEMCFG, log in and navigate to the 'Group Information' tab.
In the groups section, in the box next to 'No. of groups' enter the total number of groups.
In the box next to 'Select group to edit' select the group you wish edit and enter a relevant name under 'Group Name'.
In the channels section, under 'No of channels' enter the number of channels you wish the selected group to contain (must conform to corresponding group on DSU).
In the flow details section, under 'Flow ?' enter either 'true' or 'false' depending on whether the flow is to be used to calculate the mass release.
Under 'Duct Area' enter the stack size in m^2 (if known).
Under 'Flow Multiplier' enter the factor that is to be applied to the calculation in order to produce kg/hr data.
Under 'Flow Units' enter the units you wish the mass release data to use (typially kg/hr).
Under 'Est. Flow' enter a fixed flow value if the mass release data is to be calculated using an estimate of the flow (leave at '1' on systems with an actual or calculated flow value).
In the Averaging Details section you will find four averages that may be configured for the Live Data page in CEMForm. Under 'Avg Caption' enter the title to be displayed above the corresponding column in CEMForm (e.g. '30mins' if entering 30 minute average), and under 'Avg Time (mins)' enter the average time in minutes to be calculated according to what was entered under 'Avg Caption'. All averages are on a rolling basis by default but if you wish to configure one of the columns as a block average then navigate to the Main.ini file and under the 'Options' section enter 'average to start reset=n' (where 'n' represents the number of the column to be configured as a block average – typically either 3 or 4).
Click 'Save'.
Navigate to the 'Channels' tab.
Select the number of the group you wish to edit. The name of the group should appear to the left.
Below the group number / name you will find the list of channels, the number of which should correspond to what was entered on the 'Group Information' tab. Under the 'Name' column enter the name of each measurand in the required position / channel number according to the corresponding group previously configured in DSUCFG on the DSU.
Under the 'Type' column enter the mastertype of the associated measurand (refer to the type list to the right of the main grid or alternatively navigate to the MasterType.ini file located in C:\Program Files\Envirosoft\CEMSuite\Config using the DBUtils program).
Under the 'IP Type' column enter the input type of the associated measurand (refer to the InputType.ini file located in C:\Program Files\Envirosoft\CEMSuite\Config using the DBUtils program).

Under the 'Span 1' enter the ppm span of the associated measurand.
Under the 'Span 2' enter the mg/m³ span of the associated measurand.
Under the 'Span 3' enter the mg/Nm³(-C) span of the associated measurand.
Perform steps a-g for each separate group. If you require the next group to be identical to the current group select the number of the group you wish to be idenitcal to in the bottom lefthand corner of the channels tab and select 'Harminse this page with…'
Navigate to the 'Channel Info' Tab.
Select the number of the group you wish to edit.
In the main grid you will find a list of channels as configured on the previous tab for the group selected.
Under the 'Confidence %' column enter the confidence interval for the associated measurand in percent (refer to the relevant EA legislation for current confidence interval values).
Under the 'ELV Short term' column enter the short term ELV (Emissions Limit value) of the corresponding measurand (the term depends on the directive the site is operating under, i.e. a WID site would have a short term period of 30 miniutes).
Under the 'ELV Daily' column enter the daily ELV of the corresponding measurand (ELVs can be found in the sites operational permit).
Under the 'Origin' column enter the base value of the corresponding measurand if higher or lower than zero (e.g. pressure in milibar will typically have a base of 800).
Under the 'Overall Position' column enter the numerical position you wish the corresponding measurand to be located at in the Overview on the Live data tab in CEMForm ('1' would be at the top).
Under the 'Composite' column enter details if there are more than one oxygen or tempreture to be used to normalise the data.
Navigate to the 'Group Channels' tab.
Select the number of the group you wish to edit.
In the box adjacent to 'Temperature Channel' enter the number of the channel to be used for the temperature normalisation.
In the box adjacent to 'Oxygen Channel' enter the number of the channel to be used for the oxygen normalisation.
In the box adjacent to 'Pressure Channel' enter the number of the channel to be used for the oxygen normalisation.
In the box adjacent to 'H20 Channel' eneter the number of the channel to be used for the H20 normalisation.
In the box adjacent to 'Flow Channel' enter the number of the channel to be used to calculate the mass release.
In the box adjacent to 'Plant Status 1' enter the number of the digital channel to be used for the plant status.
In the box adjacent to 'Plant Status 2' enter the number of an additional digital channel to be used for the plant status.
Navigate to the 'Calc Factors' tab.
Select the number of the group you wish to edit.
Ensure the correct parameter set is selected (typically the same number as the group).
Under the 'Normalisation' section enter 'true' next to all the channels to be used in the normalisation process along with their corresponding reference values, e.g. Temperature – 0°C, Pressure – 1013 millibar (Oxygen reference level dependant on process).
Under the 'Plant Status' section enter 'true' next to all channels to be used for the report status along with their corresponding levels (channels will be either 1 or 0 dependant on logic).
Navigate to the 'General/Data Comms' tab and then to the 'FTP/MultiDSU/CemBus' tab.
Enter the number of the DSUs connected to the Envirosoft system along with the total number of groups over all connected DSUs.
Under 'Select Share or FTP Mode' ensure that 'Network Share' is selected.
In the box next to 'Number of groups to transmit to CemForm', enter the number of groups to be brought in to CemForm (typically the same as total number of groups)
In the box next to 'DSU No.' enter the number of the DSU you wish to edit.

In the box next to 'No. Groups' enter the number of groups that have been configured on the selected DSU.
FTP Port and Socket Port are typically set to '21' and '1024' respectively.
In the box next to 'Hostname' enter either the hostname or the IP address of the selected DSU.
Username and password are typically set to 'administrator' and 'ems' respectively (password is left blank on older 671 DSUs).
In the box next to 'Live Data Start Dir.' enter the folder path in which the live database files are to be stored on the CEMs PC (typically left at 'LiveDataLocal' on single DSU systems and 'DSUx/LiveDataLocal' on multi DSU systems – where 'x' is the number of the DSU).
In the box next to 'Hist Data Start Dir.' use the same rule as above but type the word 'HistData'.
In the box next to 'Share Drive Letter' enter the drive letter to be mapped to the CEMSuite folder of the selected DSU. Also ensure the box next to 'Create Drive' is checked in order for it to be listed on the CEMs PC.
If the time synchronisation function is to be used then ensure the box next to 'Send Time Sync to this DSU' is checked.
In the box next to 'Group No.' enter the number of ther group you wish to edit.
In the box next to 'No. Channels' enter the number of channels in the selected group.
In the box next to 'Channel Types' enter the letters associated with the channel types in their respective positions (A – Analogue\Measurand Channel, D – Digital\Logic Channel).
Follow steps 'm-o' for each group of the selected DSU.
Follow steps 'd-o' for each DSU connected to the system.
Close CEMCFG.
Navigate to C:\Program Files\Envirosoft\CEMSuite\Config and open 'FTPSync.ini'.
Under the [Main] section ensure that 'CemFormPort=1023'. Also ensure that all lines of instruction conform to the CEMCFG config. Save and close file.
Open 'Main.ini'.
Under the [Main] section ensure that 'DSU Address=127.0.0.1' and 'DSU Port=1023'.
Under the [Main] section enter 'Look back day count=x' where x is the desired amount of previous days to process counting back from the current day. Save and close the file.
Navigate to C:\Program Files\Envirosoft\CEMSuite and open 'ExeStarter.exe' (if 'Exestarter.dat' is also located in this folder delete this file before opening).
In the ExeStarter window enter the filenames you wish to run in the desired order along with their extensions and the time delay in seconds (**Note:** The delay resets after the execution of the previous program). Close the window and save the configuration.
Restart the PC and ensure that CEMSocket, CEMSync and CEMForm execute automatically and check all running programs for any issues.

7.2 NOX CONFIGURATION

7.2.1 NO/NO2/NOX – LAND SYSTEMS (RAW UNITS = PPM)

1. Under the 'Group/Measurand Information' tab in DSUCFG create an additional channel for the NOx with a multiplier of 10. Address and input channel are unimportant.
2. Under the 'Channels' tab in CEMCFG set the NO Mastertype to 12, NO2 to 15 and the NOx to 71. Inputtype is unimportant.
3. Navigate to the 'Reports' tab and then the 'General' sub-tab. Ensure that 'NONO2NOx' is selected.
4. Open DBUtils and naviagate to 'Mastertype.db' in the config folder. Ensure that the molecular weight for NO (12) is set to 1.34, NO2 (15) is set to 2.05 and NOx (71) is set to 1.53.
5. Ensure the measbase for the above measurands are set at '7' in DBUtils.
6. Open the Main.ini file in \CEMSuite\Config. Under the '[Main]' section ensure that 'ABB=' is set to '0'.

7.2.2 NO/NO2/NOX – ABB SYSTEMS (RAW UNITS = MG/M^3)

1. Follow steps 1-4 above in 7.2.1.
2. Ensure the measbase for NO, NO2 and NOx are set at '28' in DBUtils.
3. Open the Main.ini file in \CEMSuite\Config. Under the '[Main]' section ensure that 'ABB=' is set to '1'.

7.2.3 NO ---> NOX

1. Under the 'Group/Measurand Information' tab in DSUCFG configure the NO(x) type according to analyser (e.g. type 90 for Siemens, type 10 for ABB, etc) and configure the address and channel accordingly.
2. Under the 'Channels' tab in CEMCFG set the NOx Mastertype to 12 and the Inputtype to 12.
3. Open DBUtils and navigate to 'Mastertype.db' in the config folder. Ensure that the molecular weight for NOx (12) is set to 2.05.
4. Still in DBUtils navigate to 'Inputtype.db' in the config folder. Ensure that the molecular weight for NOx (12) is set to 2.05.
5. Open the Main.ini file in \CEMSuite\Config. Under the '[Main]' section ensure that 'ABB=' is set to '0'.

7.3 SAMS CALCULATION

To use QAL3 control charts effectively a realistic standard deviation value (Sams) is required. This value plays a key role in determining whether an analyser measurement is in control; if it's too high a fault may not be detected and if too low a false error will be reported.

The Environment Agency's Technical Guidance Note for Emissions, M20, gives operators some freedom to decide upon a sensible value for the Sams. It mentions the French (AFNOR) method for determining Sams, which is based on a fraction of the uncertainty specified in the applicable directive. This is seen as a simpler approach, rather than combining all the uncertainties for each measurement. In the same section of M20 operators are informed that they can determine the limits for control charts based on experience.

In order to provide consistency when calculating the Sams, the Sams for each gas will initially be set at a percentage of the span gas or the reference value. This avoids potentially ridiculous limits (either too large or too small) when there are large differences between the Emission Limit Values and the measuring ranges of the analysers.

The following will be adopted for all pollutant gases:

- Sams Span = 2.5% of Span Gas Value.*
- Sams Zero = 0.5% of Span Gas Value* or 2, whichever is the greater.

And for O2 / CO2 measurements:

- Sams ZERO and SPAN fixed at 0.53%.

Notes:

1. To avoid regular changes to Sams, it is necessary to use reasonably constant concentrations for the reference material.
2. *Round the reference values according to the table below:

Span Gas Value	Use
<= 100	Round to the nearest 10
100 < SGV <= 500	Round to the nearest 50
500 < SVG <= 2500	Round to the nearest 100
2500 < SVG	Round to the nearest 500

Examples:

- Span Gas = 130, round to 150; Sams SPAN = 3.75 and Sams ZERO = 2.
- Span Gas = 3800, round to 4000; Sams SPAN = 100 and Sams ZERO = 20.

3. No units of measurement are provided here but the basic measurement of the analyser – unsually mg/m3 will automatically be used.

7.4 CEMCAL TRIGGER FROM CEMCOMM

Operators will not always be at the computer to start to a QAL3 calibration from the CEMQual program, or be able to make the remote VNC connection into the DSU if it's operating from there. Consequently, a method of starting a calibration from an Adam input location is required. From CEMComm 3.26 and CEMCal 2.05 a contact into a logic input will be received by CEMComm and a command sent to the CEMCal program. CEMCal will receive this command and then start the selected calibration sequence.

Notes (CEMComm.ini):

Five QAL3 sequences are allowed, sequence 6 is reserved as an abandon calibration function, an example of a setup is given below.

[CEMCal Ops]
Address=17 Address of the I/P card receiving the signals

Position 1=10 Start of the byte to interpret
Bit 1=1 Bit to use for calibration

Position 2=10 Second calibration…
Bit 2=2

Position 3=10 Third calibration…
Bit 3=3

Position 6=10 6^{th} = Special, abandon the current sequence (all relays off).
Bit 6=4

Notes:

1. The position is the start of the two characters that represent the byte (usually 10). This is a bit fiddly but will allow us to accommodate all Adam serial input types (4000 and 5000 series), 232/485.
2. The bit should be made negative to invert the logic, i.e. contact broken to start a cal. (Bit 1 = -1, bit 2 = 02, bit 3 = 04 etc).
3. No settings are required for CEMCal. However, it should be set up so that the number of calibrations matches the above. Should a calibration be requeted whilst a calibration is in progress it will be ignored.

7.5 GENERATING LOCAL OUTPUTS (CEMCOMM)

There are occasions when analogue outputs may be required directly from CEMComm without being processed by the PC. Typically however, the PC route is preferable as the DSU and CEMComm know little about QAL2 or normalisation.

Up to 4 analogue output cards may be used for this purpose, each with 4 analogue outputs. All settings are in the CEMComm.ini:

Notes (CEMComm.ini):

[Local Outputs]
Use = 1 //If not set, CEMForm will control the outputs.
Ignore valid for outputs=1 //Will update, no matter the validity, or hold.

//Group channel and span info for each Op Module (card) and each output.
Group data – Output module 1 Op Number 1=1
Channel data - Output module 1 Op Number 1=3
Span data - Output module 1 Op Number 1=2000
Group data - Output module 1 Op Number 2=1
Channel data - Output module 1 Op Number 2=2
Span data - Output module 1 Op Number 2=25
Group data - Output module 1 Op Number 3=1
Channel data - Output module 1 Op Number 3=1
Span data - Output module 1 Op Number 3=500
…and so on for each output module.

//Switched group – see notes below, if not present set as above.
Group data 2 – Output module 1 Op Number 1=2
Group data 2 - Output module 1 Op Number 2=2
Group data 2 - Output module 1 Op Number 3=2
Group data 2 - Output module 1 Op Number 4=2

[Local OP switch] //Controls the switched group above.
Address=17 – Address of the I/P card receiving the signal.
Position=10 – Start of the byte to interpret.
Bit=1 – Bit to use switch to second group.

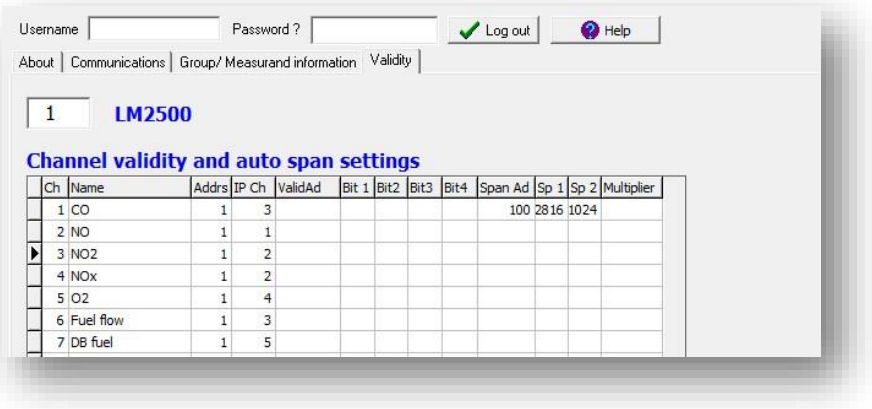
Notes:

1. The position is the start of the two characters that represent the byte (usually 10). This is a bit fiddly but will allow us to accommodate all Adam serial input cards (4000 and 5000 series), 232/485.
2. The bit should be made negative to invert the logic, i.e. contact broken to switch group (Bit 1 = 01, Bit 2 = 02, Bit 3 = 04 etc).
3. Outputs are always 4-20 mA.
4. Dividers are taken of, enter the real numbers (integers only for span, minimum setting = 1).

7.6 EXTRA INVALIDITY

CEMComm can invalidate the measurement for one or more digital inputs. Invalidations required are a failure (code $01) and a maintenance request ($04). Although single inputs can generate the desired effect, the customer here has a selection of conditions from the external sampling that will also invalidate the measurement (e.g. pump failure, sample line temperature).

To facilitate the above, the configuration area of the span changing relay input area used for analogue input signals (rarely used) may be set for this purpose. The CEMComm program (4.06 and above) will be instructed to use this as follows, from DSUCfg.exe, as below:



Ch	Name	Addrs	IP Ch	ValidAd	Bit 1	Bit2	Bit3	Bit4	Span Ad	Sp 1	Sp 2	Multiplier
1	CO	1	3						100	2816	1024	
2	NO	1	1									
3	NO2	1	2									
4	NOx	1	2									
5	O2	1	4									
6	Fuel flow	1	3									
7	DB fuel	1	5									

Set a non-zero Span Ad. **Notes:**

1…99: the address of the serial Adam 4050 or 5051 cards (all 16 bits usable – 1 WORD).

100…164: Ethernet Adam 5000 (digital read always used):
100 = 1st TCP Ethernet Adam, 1st slot
101 = 1st TCP Ethernet Adam, 2nd slot 1, up until…
107 = 1st TCP Ethernet Adam, 8th slot, then:
108 = 2nd Ethernet Adam, 1st slot, etc., etc.

The SP1 and SP2 are a mask for the whole word returned at the location above that will invalidate the measurement, so in the above example:

2816:= h0B00 = 0000 1011 0000 0000 Inputs 9, 10 and 12 will trigger
1024:= h0400 = 0000 0100 0000 0000 Input 11 will trigger

SP1 will drive the analyser failure condition ($01) and SP2 the maintenance request ($04).

It is recommended that the inputs are tested fully during commissioning to ensure that the desired effect is achieved from all input conditions.

Currently only implemented for the ABB analysers, but has been written to extend easily to all if required. Not made universal as the bits to change may differ depending upon the type of analyser.

7.7 SWITCHING DATA FROM STANDBY ANALYSERS

For sites where any data loss is unacceptable, the CEMSuite programs have the ability to switch data from a standby analyser into the reported information. Data for the processed data files and the calculated pages are those switched. A simple logic input will instruct CEMSuite to use the standby data. The stages to set this up are:

1. Increase the number of groups using CEMCfg to accommodate the switched groups, fill these with an identical structure as the duty analyser page.
2. Instruct CEMSuite that the additonal groups are calculated and not real from CEMCfg. See below for an example:

   [Main]
   Numgroups=9 (Actual data pages + switched groups)
   NumDatagroups=7 (Actual Data)

3. From CEMCfg, set the extra group types (the calculated pages) as type 8 – switched data.
4. If the order of the channels has to be different between the duty and standby pages (often the case for dust) then use DBUtils to edit the MainCFG.db and change the DispChan column to reflect the channel number that the switched data exsits in within the standby page – see embedded examples below.
5. There are three types of data to switch, change the types as below. Note that each set of data requires a separate input to receive the switch logic (discussed later).
   a. Gas Analyser Data (TYPE = 10…19)
   b. Dust Analyser Data (TYPE = 22)
   c. Custom Data (TYPE = as selected – see below)
6. See the embedded files below for examples of the MAINCfg files. Copy those to a folder and examine with DBUtils:

The basic framework of the data switching is now complete. The next stage is to configure which logics will switch the information. These are usually a single logic channel, but could also be from a logic WORD (type 28). They can exist on any page within the system, not necessarily from the duty or standby data pages.

It is configured by setting the Main.ini as below, e.g. for GAS:

[Switch Data]
Gas 1=0401150200 (Group 1 switch info to see below – switch information)
Gas 2=0502150200 (Group 2 Info)
Gas Duty Name=Gas – A (Names to identify the standby analyser. Replace with dust or custom)
Gas Stby Name=Gas – B
Custom Switch Type=27 (Data type for custom switch)

These settings are now examined.

7.7.1 SWITCH INFORMATION DETAIL

In the example shown the following would occur for the gas data (all types 10…19) on the group 1 page (Gas 1 = Gas data on group 1), all entries are decimal. Configuration is different if the switch exists within a logic word rather than a single bit.

SINGLE LOGIC BIT
Gas 1=0401150100

04	- Group of the standby data to use.
01	- Group of the logic signal.
15	- Channel of the logic signal.
01	- Value to switch (either 00 or 01 {NO/NC}).
00	- Spare.

WORD LOGIC BITS (x16 – Type 28)
Gas 1=0401150201

04	- Group of the standby data to use.
01	- Group of the logic signal.
15	- Channel of the logic signal.
02	- Bit to test (0 to 15)
01	- 00 = Normally Open / 01 = Normally closed.

In identical fashion the Dust and Custom switches may also be configured (Dust 1, Dust 2 and Custom 1 etc.)

Note that the data security bar will change to Aqua if the switch has been requested. To ensure that this appears on the calculated page, repeat the above for the calculated page as well, i.e. Gas n=0401150100, where n is the switched page number.

7.7.2 WHICH DATA IS SWITCHED

If the data is switched as above, note the following:

Processed Data from the duty pages will always contain switched data even in the duty data pages; this is to simplify configuration of the reports, i.e. Group 1 processed data will always contain the switched data for that process.

Data within the calculated pages will ***always*** contain switched data. This is to enable live trends and averages etc. being used for realistic alarms in the event of the data being switched.

7.7.3 QAL2 SETTINGS

Should the standby(s) be permanently connected to the same flue(s) and not switchable, they will have their own QAL2 factors and should be set up from CEMQual in the normal fashion. However, if the standby analyser may be switched between two or more flues, a different set of QAL2 data is required for each flue. In this situation, the QAL2 data should be entered as if associated with the switched, calculated pages, not the standby source page.

Set from the Maini.ini, options section:

[Options]
Switched QAL2 Data=1 (1 = Switch from calc pages, 0 = From standby page).

Notes:

If selected ON as above auto switching (below) is prohibited for the gas data. This is because the standby data for these situations will probably not contain relevant data and so should not be used.

7.7.4 AUTO SWITCHING

In the first case above (permanently connected standby gas or dust analysers) the system may be set to automatically switch to the standby data if required. This would be in the event of a complete failure within the duty page resulting from, for example, analyser failure, communications failure or data storage failure. Effectively it has to be the NO DATA condition, simple analyser calibrations or maintenance will not trigger the swap.

To enable this feature, set the following in the Main.ini:

[Switch Data]
Gas missing channel=1

NO DATA on channel 1 will automatically switch in the standby gas data. Set to 0 to switch off this feature and replace Gas with Dust for dust auto switching.

7.8 PLANT AND REPORT STATUS SETTINGS

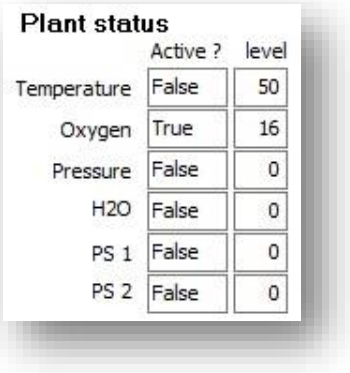
In order for the CEMSuite programs to report only the data from times when the process is on and the conditions are as defined for reporting, four conditions are available:

1. Plant Off – NO Combustion, NO Reporting.
2. Plant On but report parameters not met – See below.
3. Plant On and report parameters met.
4. Plant On but delayed.

These are now examined in more detail.

7.8.1 PLANT ON AND OFF SWITCH

This should be set up from CEMCfg Calc. factors page. Each of the four normalisation parameters (temperature, oxygen, pressure and water vapour) and two additional inputs may be used – Plant Status 1 and 2 (PS 1 and PS 2).



The data may be used even if there is no temperature or pressure data etc. Just make sure that the channels are defined in the group channels page.

Notes:

1. CEMSuite will always record the data, no matter what the status. Settings here will prevent the data from being reported or generating alarms.
2. Set the channel numbers from the Group Channels page.
3. All thresholds are greater than the level to switch ON, except oxygen, this is less than the level and <= or >= are always used for the switch.
4. For logic signals set the level to either 0 or 1 depending upon whether NO or NC. Note that this will also depend on the CEMComm setup.
5. For a WORD channel (16 bits – Type 28) set the level to the bit required (0…15) and make negative to reverse the logic (don't use channel 0 if reverse required).
6. There are two conditions; plant OFF by default and any signal will turn the plant ON; plant ON by default and any signal will turn the plant OFF. This is a subtle difference but an important one for processes with multiple plant status inputs. Configure from the Main.ini.

[Options]
PlantOnFlag=1 (or 0) // 1= signal(s) turn plant ON / 0 = signal(s) turn plant OFF.

7. The system can ignore invalid data to switch the plant off, Main.ini:

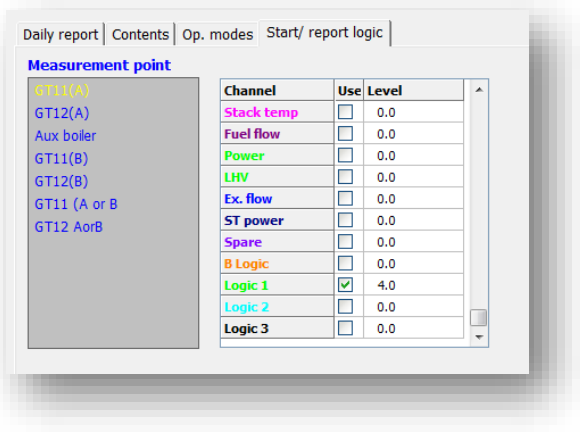
   [Options]
   Valid for plant off=1 (or 0) // 1 = Must be valid data before it is used for plant status.

8. Normally the CEMSuite programs will use only VALID, Plant On and Reportable data for the concentration (mg) reporting. For the mass reporting however it is normal practice (and so for CEMSuite) to use all data except plant off data for the mass release of any period.

7.8.2 REPORT PARAMETERS NOT MET

A simple situation here is for an incinerator that uses a WASTE BURN signal to indicate that waste is being burnt. This may be setup by defining a Logic BIT channel as type 74. This is a special type that will always set the reporting status according to a digital input. Watch for NO/NC condition and adjust from CEMComm to be as required. Single logic bits only at the moment.

A more complex situation may arise for LCPD sites where multiple conditions are used. From the LCPD program, 'Start/ report logic' page:



From here multiple channels may be used to define one or more conditions that must be met, e.g. FAN ON, >50 MW etc.

Notes:

1. Data values must be always be GREATER than the levels defined above to indicate ON.
2. If logic channels are defined, Level is either 0 or 1.
3. For a WORD channel (16 bits – Type 28) set the level to the bit required (0…15) and make negative to reverse the logic (don't use channel 0 if reverse required).

7.8.3 DELAYS

For simple systems where a minimum of data exists, a delay in reporting may be set to allow for the plant to stabilise before being counted in the reports. This should only be used where agreement has been reached with local inspectors.

To set up, edit the Maini.ini to include a new section:

[Delays]
Group 1 ON=120
Group 1 OFF=30

The above settings will delay group 1 data by 120 minutes during a start-up and 30 minutes during a shutdown. The time will start when the plant status changes between ON and OFF or vice versa.

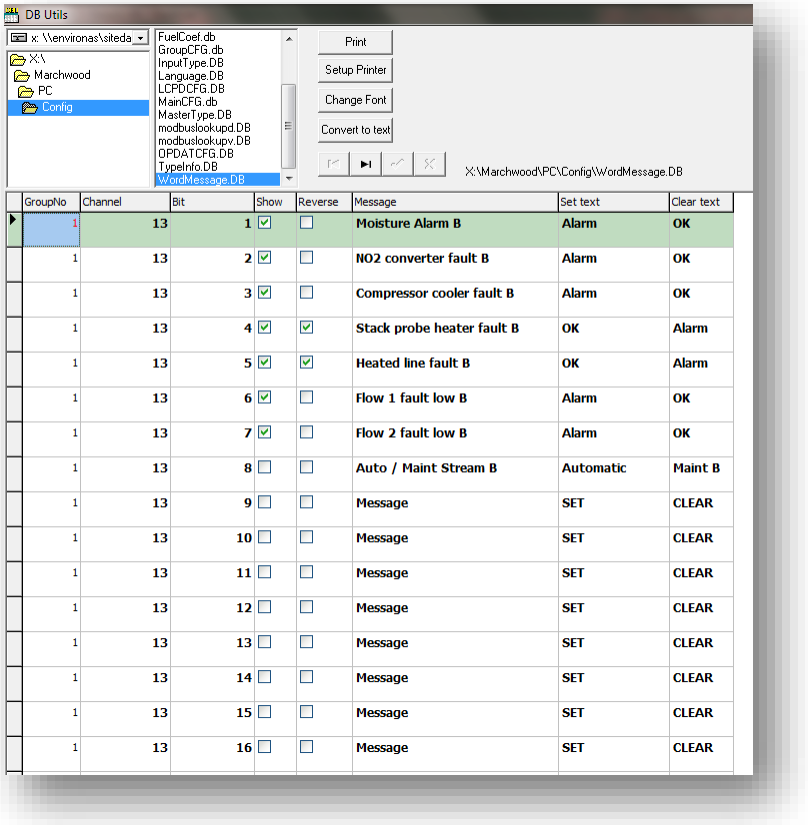
7.9 SETTING UP A LOGIC WORD FOR DISPLAY

Where a system contains multiple logic signals that will clutter a display and use up valuable screen space and data storage, CEMSuite may be setup to store and display all 16 Bits (1 WORD) from a Digital input device (4051, 5051 etc). To set this up conduct the following:

CEMComm: Set up as if a normal, single-bit, logic input but then modify the channel number to 1 and the base to 100.

CEMSync: Define the channel type in the FTPSync.ini to F (not A or D). This will prevent the program from averaging the data for the minute database files.

CEMForm: Set as Type 28 and then using DBUtils setup the bit definitions within the WordMessage.db file; an example is embedded below and the DBUtils screen shown:



GroupNo	Channel	Bit	Show	Reverse	Message	Set text	Clear text
1	13	1	☑	☐	Moisture Alarm B	Alarm	OK
1	13	2	☑	☐	NO2 converter fault B	Alarm	OK
1	13	3	☑	☐	Compressor cooler fault B	Alarm	OK
1	13	4	☑	☑	Stack probe heater fault B	OK	Alarm
1	13	5	☑	☑	Heated line fault B	OK	Alarm
1	13	6	☑	☐	Flow 1 fault low B	Alarm	OK
1	13	7	☑	☐	Flow 2 fault low B	Alarm	OK
1	13	8	☐	☐	Auto / Maint Stream B	Automatic	Maint B
1	13	9	☐	☐	Message	SET	CLEAR
1	13	10	☐	☐	Message	SET	CLEAR
1	13	11	☐	☐	Message	SET	CLEAR
1	13	12	☐	☐	Message	SET	CLEAR
1	13	13	☐	☐	Message	SET	CLEAR
1	13	14	☐	☐	Message	SET	CLEAR
1	13	15	☐	☐	Message	SET	CLEAR
1	13	16	☐	☐	Message	SET	CLEAR

Notes:

1. 16 Lines required for each logic channel.
2. The '***Show***' field will select whether to include this info on the alarm page and the '***Reverse***' field will reverse the logic of the alarm; normally when SET.
3. The trends will reval a solid, coloured bar (as single bit logic) but with a BLACK TICK if the state of any bit changes. Holding the mouse over the bar will reval the '***Message***' and the current condition (the SET or CLEAR text) of each bit.
4. The logics within this may be used for plant status or data switching if required.
5. Lines with the '***Message***' coloum defined as "Message" will not be shown.

7.10 CALCULATING WATER VAPOUR % FROM WET AND DRY 02

It is possible to use wet and dry oxygen measurements to provide an estimate of the water vapour. The math is pretty simple:

H20 = (Dry – Wet) / Dry

But looks a little more complicated in percentages:

H20% = 100 x (Dry O2% - Wet O2%) / Dry O2%

This technique cans suffer from gross inaccuracies, particularly when the O2 levels are low. Experience suggests that small errors of the wet or dry O2 analyser calibrations can result in poor estimates. To prevent this data from being used, minimum and maximum clamps are available; this will prevent the potential knock on effect to other readings if the water is used in other calculations.

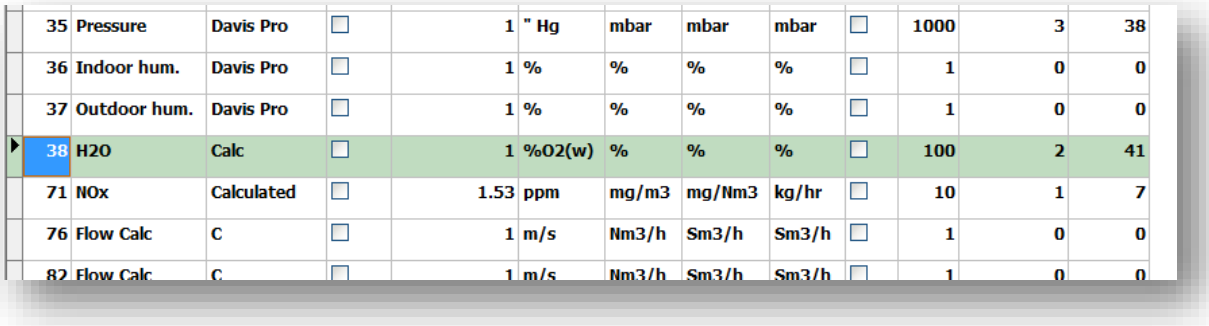
To setup conduct the following:

CEMComm: Define the Dry and Wet oxygen channels in the normal fashion, depending upon the source of the data.

CEMForm: Set the Wet O2 channel to Measurement Base 41. This will provide the following for different unit selections; ppm = wet O2, mg and kg = % H20.

Notes:

1. Validity will follow the dry O2 validity. The dry O2 must be defined as the oxygen channel from the Group Channels page.
2. May be clamped to prevent unrealistic readings by setting TV5 to a minimum and TV6 to a maximum allowable H2O measurement. If TV5 and 6 are the same values the data will not be clamped. The kg/hr data selection will always show the unclamped water calculation.
3. QAL2 data for the water esitmate is applied after the calculations above; this is to prevent complex calculations on the wet and dry O2 data.
4. Example of the Master or Input type entry:



35	Pressure	Davis Pro	☐	1	" Hg	mbar	mbar	mbar	☐	1000	3	38
36	Indoor hum.	Davis Pro	☐	1	%	%	%	%	☐	1	0	0
37	Outdoor hum.	Davis Pro	☐	1	%	%	%	%	☐	1	0	0
38	H2O	Calc	☐	1	%02(w)	%	%	%	☐	100	2	41
71	NOx	Calculated	☐	1.53	ppm	mg/m3	mg/Nm3	kg/hr	☐	10	1	7
76	Flow Calc	C	☐	1	m/s	Nm3/h	Sm3/h	Sm3/h	☐	1	0	0
82	Flow Calc	C	☐	1	m/s	Nm3/h	Sm3/h	Sm3/h	☐	1	0	0

7.11 PRODUCING AN AVERAGED MEASUREMENT FROM 2 OR MORE MEASUREMENTS

This may be used for applications that make multiple measurements of the same parameter – such as a number of identical wet oxygen readings and wish to use an average of these to calculate another parameter – such as water vapor in the example here.

Note: This feature is only available with CEMForm and CEMPort v4.13 and above.

To set this up, insert an entry of 170 into the MasterType.db file and configure as required for the averaged measurement. In the MainCFG file, set the averaged channel to the next measurement after the channels that are to be used in the average – make it type 170. The Molecular Weight setting should hold the number of channels that should be averaged, i.e. if 3 is entered here; this measurement will be the average of the preceding 3 measurements. This averaging will be conducted at the raw measurement units, and if calculations are conducted on this measurement base, these will be conducted as normal.

Notes:

1. If no valid data is found validity will be set to $FF – No data, with a value of 0.
2. Only valid data is used for the average.
3. The channel to hold the average must be immediatly after the measurments to average and these must be continuous.
4. If the number of measurements defined tries to use < channel 1, the program will trap this error and not produce an average. That is, the value of the molecular weight must be less than the channel number – 1.

7.12 CONFIGURING CEMCOMM TO DRIVE ANALOGUE AND RELAY OUTPUTS DIRECTLY

CEMComm may be configured to drive local analogue outputs and relay outputs without any influence from other CEMSuite programs; CEMForm has no effect. CEMComm 4.5 and above is required.

Edit the CEMCOM.ini file directly.

7.12.1 ANALOGUE OUTPUT DETAILS

If normalisation to oxygen is required (Set the channel to 0 to remove):

[Main]
Oxygen Channel=7
Oxygen reference=6

[Local Outputs]
Use=1
//If set to ON as shown, CEMComm will ignore the data from CEMSuite and use the settings here.

Ignore valid for outputs=1
//If set as shown, the outputs will only be adjusted if the data is valid; this is the safer, less confusing setting if invalid data is experienced, especially during commissioning.

Then for up to four modules and four analogue channels within each the details may be configured.

Group data – Output module 1 Op Number 1=1
Channel data – Output module 1 Op number 1=1
Span data – Output module 1 Op number 1=100
Span 2 data – Output module 1 Op Number 1=100
Group 2 data – output module 1 Op number 1=1

The span 2 and group 2 settings are only relevant for switched range and redundant systems, see further settings. The settings for the next three channels of module 1 are now as below;

Group data – Output module 1 Op Number 2=1
Channel data – Output module 1 Op Number 2=1
Span data – Output module 1 Op Number 2=100
Span 2 data – Output module 1 Op Number 2=100
Group 2 data – Output module 1 Op Number 2=1

Group data – Output module 1 Op Number 3=1
Channel data – Output module 1 Op Number 3=1
Span data – Output module 1 Op Number 3=100
Span 2 data – Output module 1 Op Number 3=100
Group 2 data – Output module 1 Op Number 3=1

Group data – Output module 1 Op Number 4=1
Channel data – Output module 1 Op Number 4=1
Span data – Output module 1 Op Number 4=100
Span 2 – Output module 1 Op Number 4=100
Group 2 data – Output module 1 Op Number 4=1

The next output modules (2-4) are now configured in a similar fashion.

7.12.2 REDENDANT SWITCH TO SECOND ANALYSER

Use the following settings to use the group 2 setting instead of the primary group for each of the analogue outputs. This is only possible for RS485 Adam units and for two groups within the DSU.

[Local output switch]
Address=0
Position=0
Bit=0

Address: Address of the Adam 5000 unit to receive the digital input.
Position: Position of the first character of the byte containing the bit.
Bit: The bit to test for in the byte above – make negative to swap from normally open to normally closed.

7.12.3 RELAY OUTPUT CONFIGURATION

The relay outputs for up to 8 modules and for 8 outputs in each may now be configured as below:

Group – Relay module 1 Op Number 1=1
Channel – Relay module 1 Op Number 1=1
Alarm – Relay module 1 Op Number 1=100
Type – Relay module 1 Op Number 1=1
Mask – Relay module 1 Op Number 1=1

And for the second output:
Group – Relay module 1 Op Number 2=1
Channel – Relay module Op Number 2=1 etc.

And for the next module:
Group – Relay module 2 Op Number 1=1
Channel – Relay module 2 Op Number 1=1 etc.

The type has 5 settings:

1. An alarm level is exceeded or equalled (for logics). The level is equal to or above the alarm level.
2. Invalid data, only activates if the relevant bits in the mask (the next setting) is active.
3. No communication with the measurement device.
4. A range switch. Will operate if the measurement is above 95% of span 1 to instruct the DCS or other equipment that the range has switched.
5. Main timer pulse. Will operate at the pulse of the data storage, may be used for DSU health checking.

7.13 USING MULTIPLE DSUS WITH A SINGLE SOURCE

In situations where there is more than one DSU and each has its own analogue and/or relay outputs that require driving from the PC, CEMComm needs to be told to ignore the first n outputs, forcing the second DSU to use the next relay data to drive its first relay card. For example, if two DSUs are used and both have two analogue output cards, the second DSU should be set to move the analogue outputs down two, so that the output data from CEMForm for modules 3 and 4 are really for cards 1 and 2.

To move it down two cards set the following in the CEMComm.ini file:

```
[Main]
Move analogue outputs=2          //Note that this number cannot be greater than 2.
```

In a similar fashion, CEMComm may be instructed to use a different relay card:

```
[Main]
Move relay outputs=2             //Set these both to zero (the default entries) to stop this effect.
```

7.14 ADAM TCP TO OUTPUT FROM PC

Set up the IP address of the Adam TCP unit. (See chapter 5 of the Adam 5000 TCP manual or Adam 6000 manual).

Make sure the Adam and the PC are on the same network.

Get the start addresses of all the modules you wish to talk to (this can be found in the Adam/Apax.net utility. Password is: 00000000.

Set up the outputs as normal in CEMCfg but unselect 'enable outputs' in the outputs tab (unless you want to also output them to a serial Adam connected to the DSU).

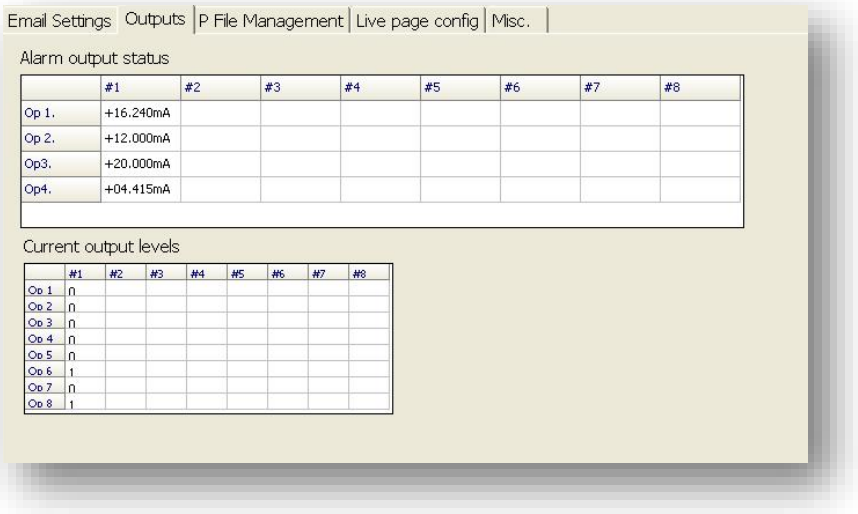
Below is a description of all the ftpsync.ini entries required:

```
[AdamTCP]
No Adam TCPs=2                    // This is the number of units on the system
Adam 1 Host=192.168.0.101         // IP address of the first unit
Adam 2 Host=192.168.0.100         // IP address of the second unit
Use=1                             // Switches on the function
Adam ASlotAd 1=0                  // Start address of the first analogue card
Adam DSlotAd 1=16                 // Start address of the first digital card
Adam DSlotAd 2=16                 // Start address of the second digital card
Adam Analogue 1 Unit No=1         // Which Adam unit the first card is in
Adam Digital 1 Unit No=1          // Which Adam unit he first digital card is in
Adam Digital 2 Unit No=2          // Which Adam unit the second digital card is in
Output DSU Fail Unit=0            // Which digital card to use for the DSU fail logics (0 for none)
DSU fail Rev Logic=1              // Reverse the logics on the DSU fail outputs
```

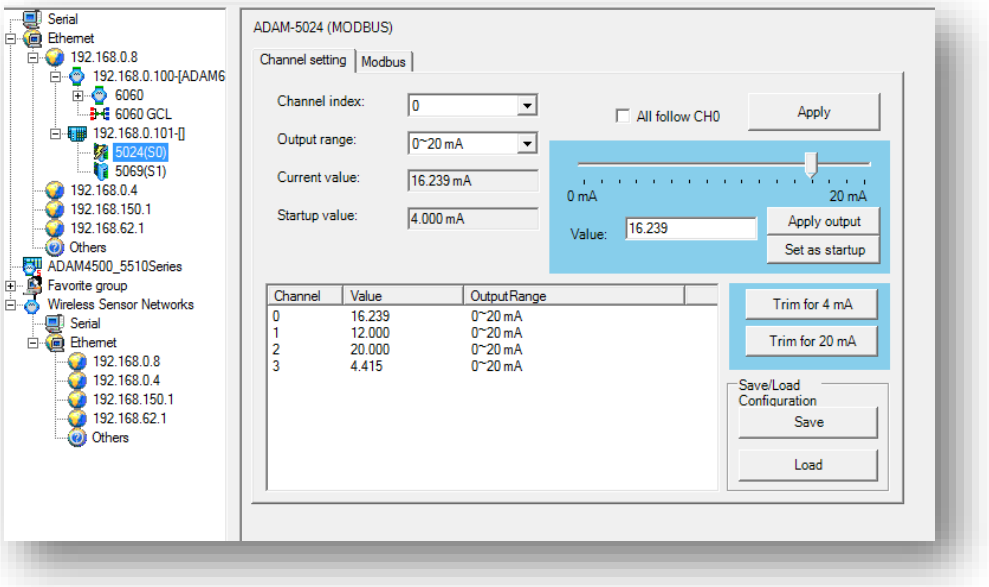
Notes: CEMForm v4.06 or later and CEMSocket v4.03 or later required.

To test either run the Adam/Apex.net utility to see the outputs or use a multimeter to measure the analogue and digital outputs and compare then with the outputs seen on the Configuration tab of CEMForm. See below:

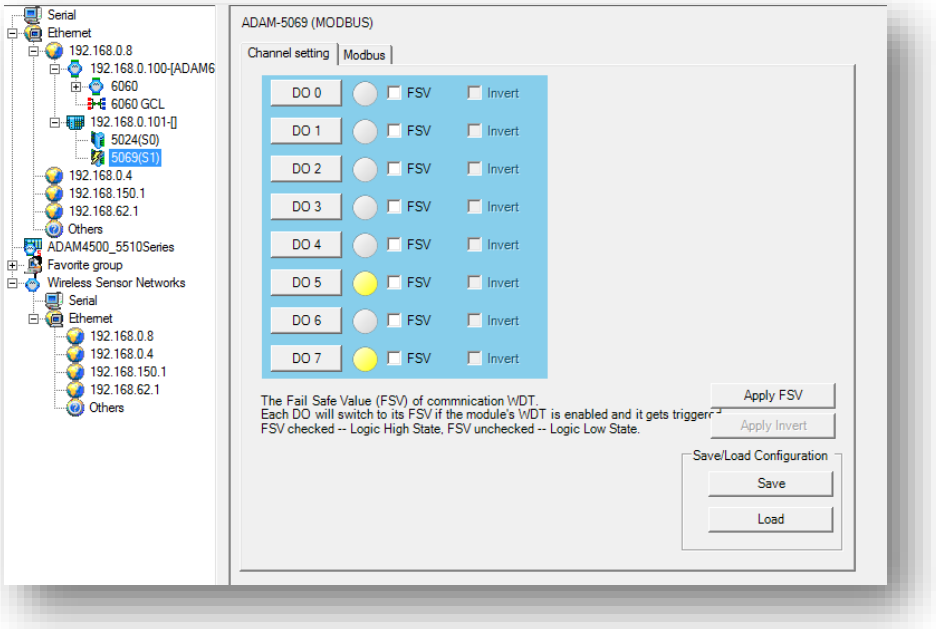
CEMForm:



Adam/Apex.net utility and analogue outputs:



Adam/Apex.net utility and Digital outputs:



CEMForm sends the command: **OUTPADM01020304050607080000000000000000**

OUTPADM is the identification for the command.
The first 8 bytes are the 8 possible digital output modules.
The rest is the analogue outputs in a block of four of two bytes per analogue output.
The range of each analogue outputs in from 0000 to 0FFF.

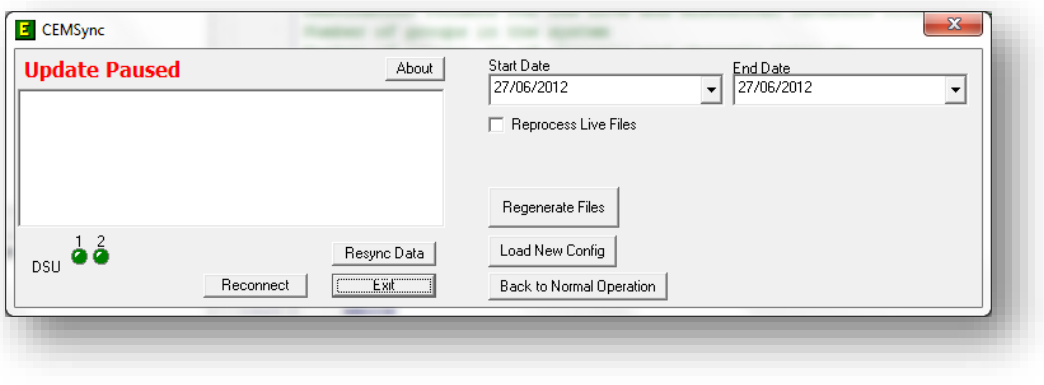
The command is processed by CEMSocket, then the outputs are sent to the Adam via a Modbus TCP command.

7.15 CEMSYNC DATA RESYNC

To start this mode you both add the entry below in ftpsync.ini and then restart the program (this is the best method if you are not running this on the CEMS PC).

[Main]
eng=1

Or double click the time indication and then you should see the screen below:



If you are using a modified ftpsync.ini file then click 'Load New Config' and select your new .ini file.

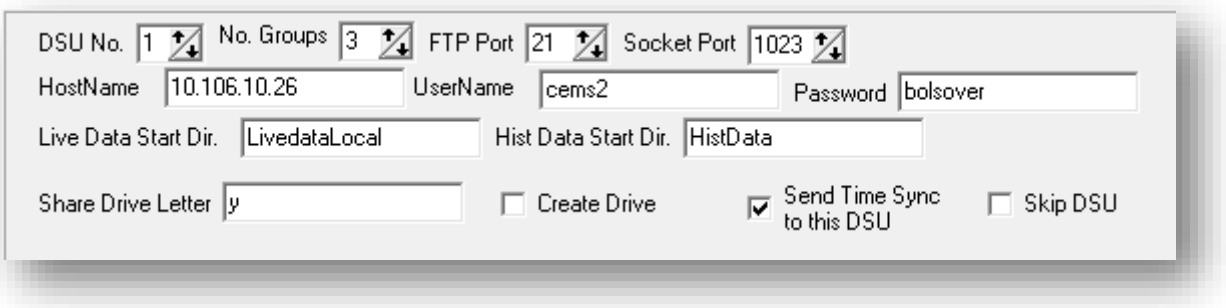
Then select the start and end dates you wish to reprocess and select if you require the livedata files to be reprocessed and clock regenerate files.

After a short delay the files should be reprocessed to match the selected config file.
If you added an 'eng=1' entry to ftpsync.ini then delete it and save the file.

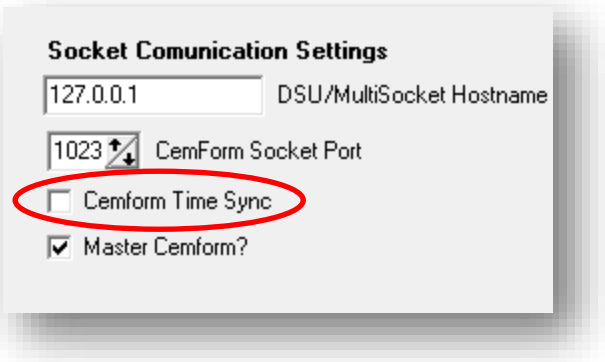
You can now click 'Back to Normal Operation' for the system to go back to normal (you will get a few error messages for the first couple of minutes, these can be safely ignored). Alternatively you can exit the program and restart it.

7.16 DSU TIME SYNCHRONISATION

It is important to keep the time of the DSU(s) in sync with the time of the CEMs PC in order to keep an accurate record of all data collected. If there is no time synchronization solution already in place CEMSync can be configured to adjust the date/time of the DSU(s) to that of the CEMs PC. To do this you must select 'Send Time Sync to this DSU' on each of the DSUs in CEMCFG.

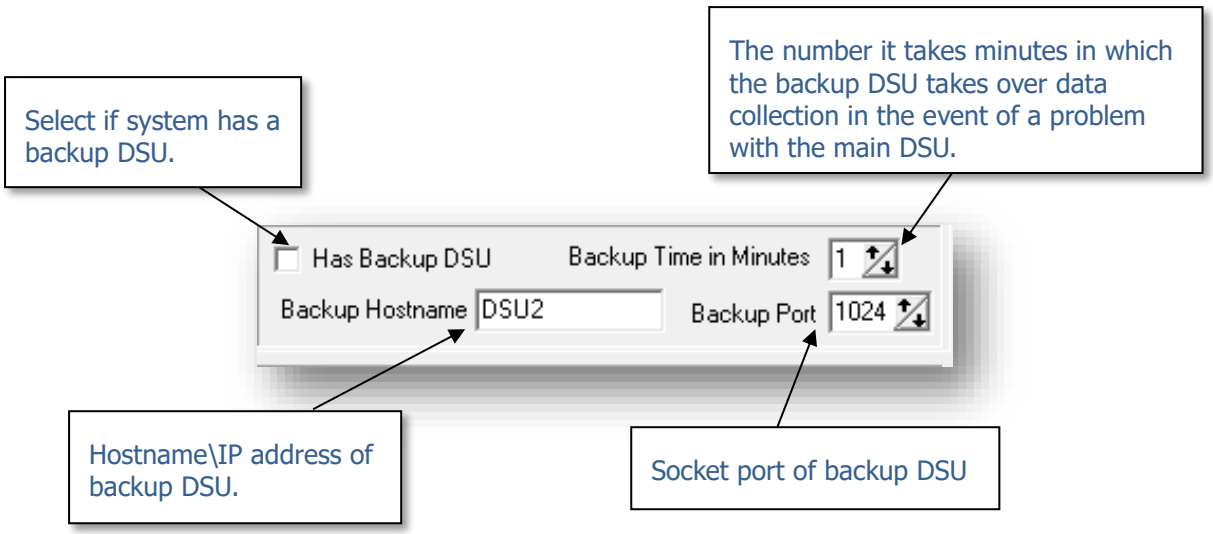


CEMForm must also be configured as the time master in order for the DSU(s) to conform. This is done by selecting 'CEMForm Time Sync' on page 1 of the 'CEMForm' tab in CEMCFG (As shown below).



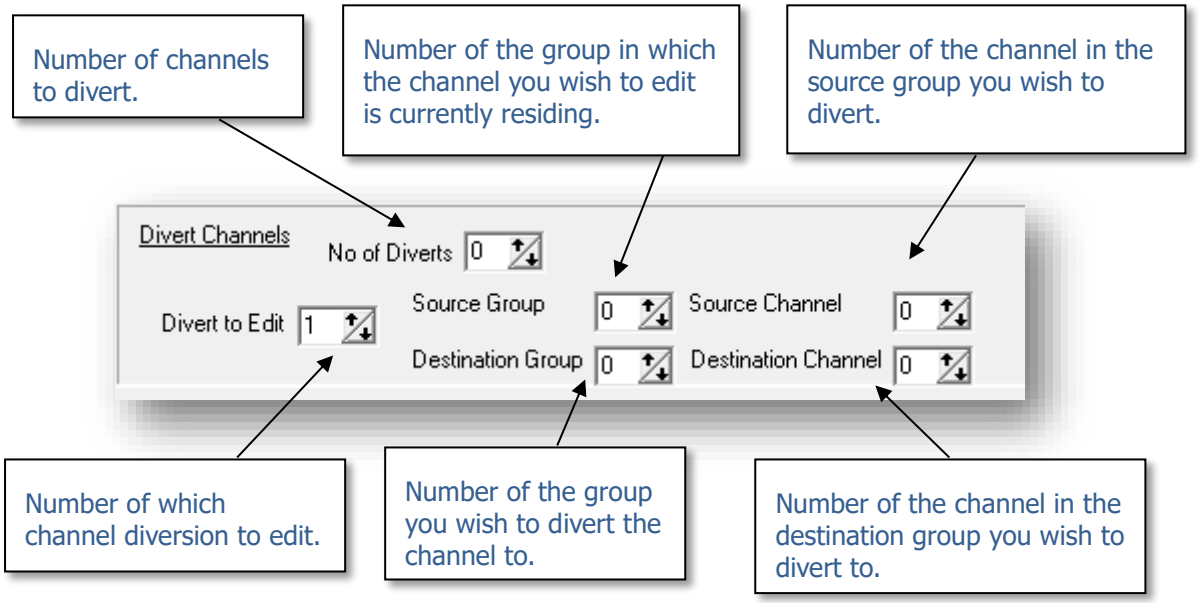
7.17 BACKUP DSU CONFIGURATION

Some sites may have a backup DSU on the system configured to take over the data collection duties in the event of a problem with the main DSU. This function is govenered by CEMSync and is configured under the 'General/Data Comms' tab and the 'FTP/MultiDSU/CEMBus' sub-tab in CEMCFG.



7.18 DIVERT CHANNELS

CEMSync has the ability to manage the diversion of multiple channels from one group to another. For example, you may require a channel that is currently in group 4 to be displayed in group 1. From the instructions entered into CEMCFG, CEMSync will recognise which channels need to go where and edit the data string accordingly. This change not only affects CEMForm but all reporting modules – LCPD, CEMQual, WID and CEMPort.



7.19 CUSTOM FOLDER COPIES SETUP

To set this up make sure you have a copy of CEMSync v3.40 or later and configure using the ftpsync.ini entries listed below:

```
[Main]
No Custom Folders=1                 // Number of custom folder copies on the system (max 10).

[Custom Folder 1]                   // First Custom folder copy.
Username=administrator              // Username to create the share drive.
Password=ems                        // Password to create the share drive.
Share Drive=Share drive letter      // If you are connecting to an existing share drive (i.e. a DSU)
                                    then the username, password, share drive and Host + Path
                                    entries are not needed.
Host + Path=DSUTEST2\SyncFolder     // The hostname\IP address + path to the share drive.
File Mask=Comments.db               // The files to copy can be *.* for all files or any mask.
File Path=y:\SyncFolder\            // The source path for the files.
File Dest Path=Histdata\            // The destination path for the files.
Overwrite=1                         // Set if the file already exists to overwrite or not.
CEMForm Controlled =1               // This setting waits for CEMForm to send a message to tell it
                                    the files are ready to download.
Every Min=0                         // Download the files every minute.
Every 30 Min=0                      // Download the files every 30 minutes.
```

Note: Make sure the share drive you set up is accessible in Windows explorer after CEMSync has started.

7.20 USING CEMSOCKET TO SET NETWORK PC TIME

To setup add the following lines to ftpsync.ini on the master PC:

```
[TimeSync]
Host1=192.168.0.32                  // Hostname/IP address of the PC requiring to have its time
                                    synchronized with the master PC.
NoSendTime=1                        // Number of PCs to synchronize.
```

You can also add the 'Port=' setting if the port of the receiving CEMSocket has been changed from the default of 1023.

To test this function has been set up correctly make sure CEMSocket is running on all PCs. Change the time on the master PC by more than 2 minutes and after a few seconds the time should change on all the other PCs.

Note: CEMSocket v4.00 or greater required.

7.21 SYNCHRONIZE COMMENTS ON MULTIPLE PCS

To synchronize comments on multiple PCs both the PC and the DSU need to be on the same network. The DSU should be set up as normal. Then add the following entries to the Main.ini file:

For the first PC:

```
[Main]
System No=1
Comment Sync=1
CommentSyncNo=1                 // This is the custom folder copy to use.
Comments 2nd Path=              // If this is left blank or not added then the path for the
                                   comments will be the first DSU on the system (normally not
                                   used).
```

For the second PC:

```
[Main]
System No=2
Comment Sync=1
CommentSyncNo=1                 // This is the custom folder copy to use.
Comments 2nd Path=              // If this is left blank or not added then the patch for the
                                   comments will be the first DSU on the system (normally not
                                   used).
```

Ftpsync.ini entries on both PCs:

This example config is a standard Custom folder sync setup except for the extra line 'CEMForm Controlled=1'

```
[Main]
No Custom Folder=1

[Custom Folder1]
Username=administrator
Password=ems
Share Drive=
Host + Path=DSUTEST2\SyncFolder
File Mask=Comments.db
File Path=y:\SyncFolder\
File Dest Path=Histdata\
Overwrite=1
CEMForm Controlled=1
```

To test this has been correctly setup, start-up CEMSync and CEMSocket on both PCs, wait for them to turn green and then start CEMForm.
Go to the trends page in CEMForm and put a tick in the comments selection to show all comments on both PCs. Left click an area on the trend to put down a cursor.
Click Add/Edit and type in a comment. Then click OK.
The comment should appear in the trend on the PC you have entered it on. Then wait a minute or two and the trend comment should appear on the other PC.

7.22 SMS AND EMAIL ALARMS

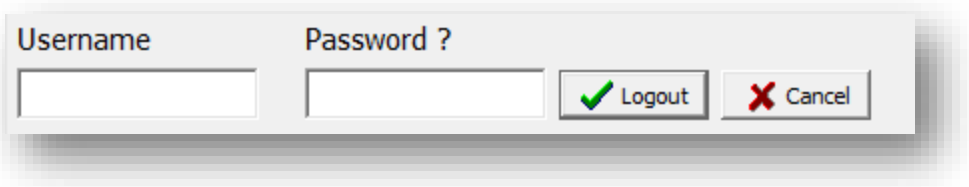
To set up SMS and email alarms add the following entries to fileserv.ini.

```
[SMS]
Port=1                  // Comport number set to 0 for none.
Baud=38400              // Baud Rate.
Databits=8              // Number of data bits.
Parity=None             // Parity.
StopBits=1              // Number of stop bits.
```

Add the following entry to Main.ini for SMS and Email.

```
[Main]
Sms=1                   // To enable SMS
Email=1                 // To enable Email.
```

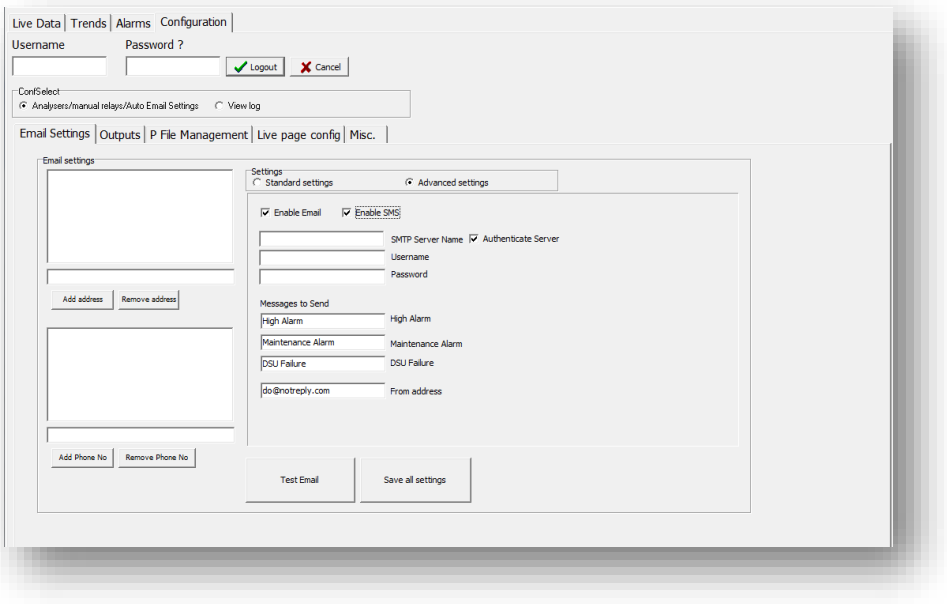
Launch CEMForm and go to the Configuration page and enter your username and password. Then click Login.



Select the Email Setting tab and select Advanced settings.

- For SMS select 'Enable SMS'
- For Email select 'Enable Email'

The relevant configuration panels will appear on the left as below.



For SMS you need to add the phone numbers you require to send SMSs to and the messages for the relevant alarms.

To set up Email you will need the following SMTP server details:

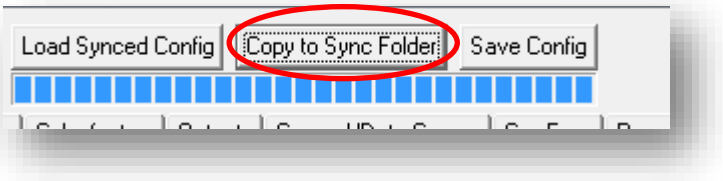
- SMTP server name.
- Username.
- Password.
- And if the server is authenticated.

Then add the email addresses of the people that need to receive the alarm information. Once everything is added click 'Save all settings'.

7.23 SYNCRONIZE CONFIGS ACROSS PCS

Launch CEMCFG and log in using your username and password.

To copy the config to the sync folder on the first DSU click 'Copy to Sync folder'. The progress bar should go all the way to the end.



To import a config from the sync folder click 'Load Synced Config'.

Once the progress bar is filled a copy of the config will exist in the SyncFolder directory. You can now review this, make changes and then save this to be used as the PCs config by either clicking 'Save Config' or exiting the program and selecting yes to the save config prompt.

7.24 PROBLEM WHEN MAPPING DRIVES TO A DSU

Occasionally Windows 7 can refuse to map a drive to the DSU giving an invalid user / password error.

It is not known what causes this problem and a potential fix to this it to add a new username and log with this new user. Conducting the following:

1. Add a second user to the DSU – Name it 'Cemsuite' with the password 'ems'
2. Make sure the DSU will auto login to the Administrator account.
    a. Click the windows Start menu and type "control userpasswords2" and click OK.
    b. Add a tick to the 'Users must enter a username and password to use this computer' and then click apply.
    c. Then remove the tick and click apply – a window will pop up – make sure the username is 'administrator' and password is 'ems'.
3. On the PC you should now be able to map a drive using the username 'Cemsuite' and password 'ems'.

8 CONFIGURATION ENTRIES (.INI)

8.1 CEMSYNC CONFIGURATION ENTRIES

8.1.1 FTPSYNC.INI

[Main]	// Main Section.
NoDSU=1	// Number of DSUs in the system.
NoGroups=1	// Total Number of Groups in the System.
GRP1=21 GRP2=22 … etc.	// First number is the DSU, second number is the Group.
FTPUpdate=5000	// FTP timer - Default: 5000.
CemFormPort=1023	// CEMform Socket Port default: 1023 for Multi-DSU, where MultiSocket is in use; 1024 for Single DSU use.
NoCemFormGrps =	// This sets the number of groups which multisocket transmits to CEMForm this is usually used when extra groups are on the system that CEMForm doesn't want to see.
SkipMin=0	// Changes the update time from every minute to every 2 minutes if set to 1.
OffSetTime=0	// If there is more than 1 copy of CEMSync on the system you can set an offset time in seconds on when the data is collected so for 0 its between 10-15 seconds after the minute if you set it to 5 it would be between 15-20 seconds after the minute.
MaxMinFunction=0	// This puts range constraints on the data if it exceeds and is less than the entries found in MainCfg.db (Max and Min columns) then it invalidates that data point with the error code from the "Range Error Byte" entry.
Range Error Byte=$FB	// This is the error code that is displayed when the data is out of range.
CEMSocket Exists=1	// This enables a socket connection to CEMSocket to receive the DSUSTAT message this tells CEMSocket if the DSU(s) is still connected to the network and working correctly.
DSU Address=localhost	// This is the address of the copy of CEMSocket to receive the DSUSTAT info from.
DSU Port=1023	// This the port of the copy of CEMSocket to receive the DSUSTAT info from.
PingCheck=1	// This will ping each DSU in sequence to check they are still operating on the network correctly before trying to do a file copy.

HideByte=0 // Alternative valid byte is something other than 0 is required.

No Custom Folders=0 // Number of custom folders to sync (maximum is 10).

NoProcessData=0 // This stops the processing of incoming DSU data just copies.

8.1.2 BACKUP DSU(S)

This allows you to set up multiple master/slave backup DSUs on a system.

[Main] // Still in Main section.

NoBackupDSU=0 // This is the number of Master/Slave pairs in the system.

Backup1=12 // This is the entry for backup pair 1 – The Master is DSU1 and Slave is DSU2.

Backup2=34 // This is the entry for backup pair 2 – The Master is DSU3 and Slave is DSU4.

Etc.

8.1.3 OUTPUT CONTROLLER

This maps the drive for the output controller software to use.

[Output] // The output controller settings are stored in their own section.

Output=false // Enable the mapping of the drive.

Drive Letter=x // The drive letter to map.

Host=x // The hostname of the output controller DSU.

Username=x // The log in username of the output controller DSU.

Password=x // The log in password of the output controller DSU.

8.1.4 DSU

[DSU1]	// There will be a duplicate section for each DSU in the system – numbered [DSU1], [DSU2] etc.)
Host=DSU	// DSU hostname.
UserName=administrator	// DSU Username - default: administrator.
Password=	// DSU password - default: blank for LV671 and ems for LV699 or above.
HistStartDir=DSU1\HistData	// HistData start directory for single DSU - default: Histdata. For multi-DSU set to DSU1\Histdata, DSU2\Histadata, etc.
LiveStartDir=DSU1\LivedataLocal	// LiveData Start directory for single DSU – default: Livedatalocal. For multi-DSU set to DSU1\LiveDataLocal, DSU2\LiveDataLocal etc.
No Groups=2	// Number of groups for that DSU.
Num Chans Group1=1 Num Chans Group2=8	// Number of channels for the group.
Group1 Ch Type=A Group2 Ch Type=AAAAAA	// Type of channels; A for Analogue, W for Weather and D for Digital.
SocketPort=1024	// Socket Port for the DSU.
TimeSync=1	// This tells Multisocket not to sync the time to this DSU - default is 1.
Share drive=z	// This is the drive letter or path to assign to this DSU's CEMSuite folder.
Create Drive=1	// If set to 0 then the drive letter assigned to this DSU would not be created, useful if you are gathering DSU data already downloaded from the DSUs from another copy of CEMSuite running on another CEMSuite PC.
Skip=0	// Enables you to skip this DSU. Useful if commissioning a multi-DSU system.
VMaskG1=	// This sets the validity mask for group 1 enabling you to ignore codes coming from the analyser etc. (2 bytes per channel, total of 16 channels).
VMaskG2= Etc.	// This sets the validity mask for group 2.

8.1.5 DIVERT CHANNELS

This section configures the redirection of channels between groups which is useful when you have a single DSU collecting data, which you then want to display in the Main analyser groups section.

[DIVERTCH]

NoDiverts=1	// Sets the number of channel diverts required.
DS1=G03CO1	// Source channel and group for the first divert.
DD1=G01CO9	// Destination channel and group for the first divert.

The above example copies the channel from group 3 channel 1 to group 1 channel 9.

8.1.6 DATABASE ENTRIES

The only configuration database file used in CEMSync is MainCfg.db

Max	// Max value used in the MaxMinFunction (maximum value before going invalid).
Min	// Min value used in the MaxMinFunction (minimum value before going invaid).

8.1.7 CUSTOM FOLDERS

These are used to copy any files or group of files on a daily, half hourly or minute basis.

[Custom Folder1]	// Up to 10 of these can be used.
Overwrite=0	// Set if to overwrite the files if they already exsist.
Username=CEMSuite	// This is the username for the creation of the share drive.
Password=ems	// This is the password for the creation of the share drive.
Share Drive=z	// This is the letter to assign the share drive. If left blank no drive is created.
Host + Path=127.0.0.1/CEMSuite	// This is the host name and path to the share drive.
File Mask=*.db	// This is the file mask of the files to copy.
File Path=z:\HistData	// Source file path.
File Dest Path=Histdata\	// Destination path.
Every min=0	// Copy files every minute.
Every 30 min=0	// Copy files 10 and 40 minutes after the hour.

8.2 CEMSOCKET CONFIGURATION ENTRIES

8.2.1 FTPSYNC.INI

[Main]

NoDSU=6	// Number of the DSUs in the system.
NoGroups=10	// Total number of Groups in the system.
GRP1=21 GRP2=22 GRP3=21 GRP4=31 Etc.	// First number is the DSU, second number is the group.
CemFormPort=1023	// CEMForm socket port - default: 1023 for multi-DSU where CEMSocket is in use; 1024 for single DSU use.
NoCemFormGrps=	// This sets the number of groups which CEMSocket transmits to CEMForm. This is usually used when extra groups are on the system that CEMForm doesn't want to see.
TimeMaster =0	// If set to 1 this stops this copy of CEMSocket syncing the time to any of the DSUs etc.
SocketTimer =5000	// This is the time in milliseconds between updates of the live data to CEMForm - Default: 5000.
StatTimeOut=1	// This is the time in minutes after the last DSU message when the DSU is set to not connected. This info is sent to CEMForm, CEMSync etc.
NoReSend=0	// This sets CEMSocket not to resend to the DSUs DSUSEND requests from CEMForm etc.
HoldLive=1	// Sets CEMSocket to hold the last value when the DSU loses comms.
SendStats=1	// Send the DSUSTAT info via socket to CEMForm, CEMSync etc.
OutDSU=1	// This allows you to set the output DSU number this would only be used on systems with multiple CEMSockets.
TimeMaster=0	// This is used on systems with multiple CEMSuite PCs running CEMform etc. to synchronize all PCs (you would connect another copy of CEMSocket to this CEMSocket and the time would be set on the second pc)

8.2.2 BACKUP DSU(S)

This allows you to set up multiple master / slave backup DSUs on a system.

[Main]	// Main section.
NoBackupDSU=0	// This is the number of Master/Slave pairs in the system.
Backup1=12	// This is the entry for backup pair 1 - Master is DSU1 and Slave is DSU2.
Backup2=34	// This is the entry for backup pair 2 - Master is DSU3 and the Slave is DSU4.
Etc.	

8.2.3 DSU

[DSU1]	// There will be a duplicate section for each DSU in the system, numbered [DSU1], [DSU2] etc.
Host=DSU	// DSU Hostname.
UserName=administrator	// FTP Username – default: administrator.
password=	// FTP passworsd – default: blank for LV671 and ems for LV669.
No Groups=2	// Number of groups for that DSU
Num Chans group1=1 Num Chans Group2=8	// Number of channels for the group
Group1 Ch Type=A	// Type of channels; A for Analogue, W for Weather and D for Digital.
Group2 Ch Type=AAAAAAAAAAAAAAA	
SocketPort=1024	// Socket Port for the DSU
TimeSync = 1	// This tells multisocket not to sync the time to this DSU. Default is 1.
Skip = 0	// Enables you to skip this DSU – Useful if commissioning a multi DSU system.

8.2.4 DIVERT CHANNELS

This section configures the redirection of channels between groups, which is useful when you have a single DSU data collection which you want to display in the main analyser groups.

[DIVERTCH]

NoDiverts=1 // Sets the number of channel diverts required.

DS1=G03C01 // Source channel and group for the first divert.
DD1=G01C09 // Destination channel and group for the first divert.

The above copies the channel from group 3 channel 1 to group 1 channel 9.

8.2.5 SEND TIME

Sends the current time to other copies of CEMSocket to sync their time.

[TimeSync]

NoSendTime=0 // The number if computers to sync the time to.

Host1=128.0.0.50 // The Host/IP of the computer to sync.
Host2=
Etc.

Port1=1023 // The Port used by the CEMSocket on the PC to sync.
Port2=
Etc.

8.2.6 SMS

[SMS]

NoSMSNo=0 // Number of phone numbers to send the SMS to.

PhoneNo1= // First phone number
PhoneNo2= // Second phone number.
Etc.

Host=127.0.0.1 // Host of the CEMServer program.

Port=6000 // Port of the CEMServer program – locked at 6000 – Do not change.

NoAlarmMess=3 // Number of alarm etc. messages.
Mess1=Alarm // First message.
Mess2=

8.3 CEMFORM CONFIGURATION ENTRIES

8.3.1 MAIN.INI

[Main]	// Main section.
Language=English.ini	// This points the program to the required language ini file.
Local Data=1	// If set to 1 the program operates as normal but if set to 0 it no longer uses socket connections and gets its live data from a cembus.db copied from the first CEMform. Also minute trends are no longer available, only long term trends.
No P Files=0	// This turns off P File generation.
SMS=0	// Enables the SMS panel.
Email=0	// Enable the email panel.
Silent=0	// This makes CEMForm not make sounds when alarms are activated etc.
AutoStart CEMSync=0	// This makes CEMSync auto start when CEMForm is started up.
NumDataGroups=	// Number of real data groups.
NumGroups=1	// Number of groups (pages) in the system including calculated groups.
Look back day count=60	// Number of days to look back to calculate the P files.
TrendCustom=0	// Enable the custom screen on the right hand side of the trend page.
TimeSync=0	// Stop CEMForm from sending the time to the DSU (needs to be off for systems with CEMSocket as this already performs the time sync function).
NetPath=	// Give an alternative location for the databases (not really used anymore).
MaxFlow=2000	// Set the Maximum possible flow value before setting the data to invalid.
NoNet=0	// Set data files to local.
Net?=0	// Set data files to local.
TCP Timeout=60	// Sets the time from the last DSU data received to set the invalidity to no data.

Email=0	// Enable the email configuration panel in CEMForms Config panel.
UseCalcGrps=0	// Use calculated groups.
Number of output units=0	// The number of analogue outputs.
Number of relay units=0	// The number of relay outputs.
DSU Address=DSU	// The host name of the DSU or the copy of CEMSocket to connect to
Alstoms alarm=False	// Enable special alarms for Alstoms
Special relay outputs=0	// Enable special relay outputs for B
Use TCPIP=1	// Enable socket live inputs (should always be set to 1)
Outputs=0	// Enable Outputs
Measurement Delay=0	// Set a measurement delay to invalidate the data after invalid periods.
UpDate=45000	// Set the update timer interval. This will be the time in milliseconds that the system will update the screen. However, as an update is forced by the arrival of new data, this is largely redundant, and just acts as the trap when not connected to the DSU.
FuelChange=0	// Set CEMForm to check for fuel changes.
ABB=1	// Effects whether the NO requires converting to NO2 (a factor of 1.53).
Send relay data=0	// Save the first channel of the relay data to export.db.
Master=1	// Set this copy of CEMForm to the master copy overriding the check for a second copy of the application running.
Use nmg for kg calc=1	// Use Nmg instead of mg for kg cals.
Export long term data=1	// Export the long term data to export.db.
Skip live count=1	// Lets you skip live reads used on large systems.
ExPort Path=	// Set a second location to save the export.db to.
Update data=1	// Recreate the Livedata.db on startup from livedata.bak.
Look back day count=60	// Number of days to go back to create the daily averages for.
Thirdparty=0	// Select if to show a third party logo in the about box.
Plantname=	// Set the plant name.
Live only=0	// Set to export only the live data.

Ambient O2=21.0	// Set the level for ambient for O2.
DSU Port=1024	// The port to connect to the DSU (usually 1024) or CEMSocket (usually 1023)
[CommFont]	// CommFont Section these are the settings for the common font used on the trend display.
Colour=0	// Text colour.
Name=Arial Narrow	// Font type.
Size=8	// Text size.
Bold=0	// Bold on or off.
Italic=0	// Italic on or off.
[Options]	Options Section
Data grid units=3	// Units to use for the data grid.
Live trend average=3	// The average for the Live trends.
Live trend units=3	// The units for the Live trend.
Max Live trend width=700	// Set the maximum width for the Live trend.
Custom live height=400	// Set the custom Live bottom panels height.
Hide Live trends=0	// Hide the Live mini trends.
Average to start reset=4	// 2= Average 2,3,4 / 3= Hourly + Daily / 4= Daily average resets at midnight.
Use WID Alarms=0	// Use WID alarms.
WID Profile start channel=9	// WID start channel.
WID Units=3	// WID Units
WID Average=3	// WID Average
Wet02=0	// Set Wet 02
Reverse logic=0	// Reverse the logic of the relay output file data.
BlockAverage=0	// Set block average.

LockUnits=0	// Lock the units so they can't be changed.
Print type=0	// Fixed size for the trend screenshot (set to 1) or full application screenshot (set to 0).
TrendColour=255	// Background colour of the trend display.
TrendtextColour=0	// Text colour for the trend display.
Wet flow=0	// Set the Wet Flow.
Use Confidence=0	// Use Confidence.
Show Alarms=0	// Show alarms or have them automatically acknowledged
Sound Alarm=2	// Set sound alarm.
Number of custom screens=3	// The number of custom live screens available.
Start in custom screen=0	// Start in the traditional live screen (set to 0) or start in the custom live screen display (set to 1).
Custom Comment colour=0	// Set the text colour of the comments on the custom live screen.
Custom profile number=1	// Set which custom live screen to start up into.
Al1yellow=1	// Go yellow if above Alarm 1 (otherwise stays green).
Flow m/s at STP=1	// Calculate the flow in m/s at STP (use temperature and pressure in calcs).
ShowTicks=1	// Show the alarm ticks at the alarm levels on CEMForm.
ShowComments=1	// Select on startup if the comments are shown (this is a tick box at runtime).
CommentsYVal=10	// Offset for the y position of the comments
Reset Average=0	// Reset Average.
Wet Gas=0	// Corrects the flow to a dry reading.
ChecdkValid=0	// Check that the plant is in a valid state before triggering an alarm.
MakeAlarmFile=0	// Create a file if an alarm present – rarely used.
NONO2NOx=0	// Calculate the NOx from adding NO and NO2.
CO2norm=0	// CO2 rather than oxygen normalisation.
Mgmj=0	// Calculate a weight to power ratio – rarely used.
Normalise flow=0	// Normalise the flow.

Cursor Width=1	// Width in pixels of the cursor lines.
CorO2Neg=1	// Allow corrections less than 1, i.e. the O2 is less than the reference.
PlantOnFlag=0	// There are two ways of using the plant status; assume that it is ON and selected triggers will turn it OFF, or consider it OFF and triggers will turn it on. Only significant when multiple measurements will trigger the plant status.
Prevent negative NOx=1	// Zero any negative NO or NO2 readings before calculating the NOx value.
Mgdp=0	// Sets the number of decimal places for the mg data.
Kgdp=0	// Sets the number of decimal places for the kg data.
ExtraKgdv=1	// An extra divider for the kg data if required. Can compensate for differing flow units.
ValidPercentage=66	// Set the minimum amount of valid data in an hour for that hour to be valid.

8.3.2 FTPSYNC.INI

[Main]	// Main Section
OutDSU=1	// This allows you to set the output DSU number. This would only be used on systems with multiple CEMSockets.
NoDSU=6	// Number of DSUs in the system.
GRP1=21 GRP2=22 Etc.	// First number is the DSU, second number is the group.
NoBackupDSU=0	// This is the number of Master/Slave pairs in the system.
Backup1=12	// This is the entry for backup pair 1. The Master is DSU1 and the Slave is DSU2.
Backup2=34	// This is the entry for backup pair 2. The master is DSU3 and the Slave is DSU4.
Etc.	

8.3.3 LCPD.INI

```
[Report Parameters Group 1]     // There is a section for each group.
Use Channel 1=0                 // Use channel 1
Channel Level1=0                // Use channel level 1.
```

8.3.4 CUSTOM.INI / MAIN.INI

```
[Options]                       // Options Section.
Number of Live trends=4         // Number of live mini trends (max 8).
Graph Data 1=13010203           // Group channel average etc to use in the graph.
```

8.3.5 DB FILES

MainCfg.db

Name	// Channel Name
Type	// Channel Type 10..13#ABB gases(12=oxygen, 13=TOC) 15#Durag 800 dust 16#ABB no errors 17#Durag 290 Dust 18#Goyen data 19#Durag dust (on ABB RS485 network) 23#ABB Digital input 24#ABB Analogue input 20#Adam 4017 input 25#Adam 5017 input 21#Adam 4052 digital input 22#Adam 4051 digital input 26#Adam 5051 digital input 31..39#Davis weather station 41..43#Pi 44#Pi logic 50..55#Land FGA data 56#Land 4500 Dust 57#Land FGA analogue input 58#Land FGA digital input 60..69#Opsis 70..79#Gasmet - 79 = Status register 80..89#Servomex 90..99#Siemens 100#Cembus data (words) 101#Cembus data (IEEE754) 102#Cembus logic 110..119#Modicon PLC word data 120..128#Modicon PLC IEEE754 data 129#Modicon logic data 130..139#Monitor labs data 140#Adam TCPIP Analogue 141#Adam TCPIP Digital 150#Procal measurement data 151#Procal logic data
ELV	// Emission limit level.
ELV2	// 2nd Emission limit level.
Display	// Which channels to show hints for. 1 for show, 0 for not show.
PenColor	// Pen colour of the channels trend graph.
CompositeTChan	// Set which channels go into a composite group.
SpanPPm	// Span for PPM measurement.

SpanMg	// Span for Mg measurement.
SpanKg	// Span for Kg measurement.
Confidence	// Confidence factor.
IPType	// Input type. (Same types as channel type).

8.4 CEMBUS CONFIGURATION ENTRIES

8.4.1 CEMBUS.INI – [MAIN]

Address=1	// Address for serial Modbus, range 1 to 255, default = 1.
Transfer validity channel=0	// Used to transfer the validity from the 1st channel within this group to the defined channel here. Set to 0 to switch feature off – the default. This has been used to move the validity from a main measurement to a peripheral measurement.
Hold on invalid=1	// Hold the data if it becomes invalid. Useful for preventing calibrations or intermittent faults if the data is used for process control. Default is ON (=1). Off set to 0.
Channels for ELV Check=7	// The number of channels (1..7 here) that will be used to drive an alarm should any exceed the ELV – used where systems want a single indication that an emission is beyond its limits. Note that this is used in conjunction with setting 6 for the logic setting.
Number of registers=64	// The number if data registers to use.
Number of validity registers=64	// The number of validity bits to use.
Delay invalidity=0	// Delay the validity of data after an invalid condition. As an example, this may be used to prevent a spike following a calibration.
Delay counter=8	// This sets the delay for the above, in intervals of 10 seconds (80 seconds as shown).
IEEE754=0	// The measurement data may be set to transmit in double word format (set to 1 in this case) or set to 0 (as here) for a single word per measurement.
Reverse words=0	// Set to 1 to reverse the words of the double word format; this arrangement is more commonly used in the USA.
Test=0	// Used for commissioning; set to 1 to force each output to its output number. Start Valid zero=0 – use a constructed byte at the first logic byte position.
Reverse bytes=0	// Set to 1 to reverse each pair of logic output bytes; this effectivity adjusts for the data when written in WORD bit order rather than BYTE bit order.
Import host=local	// Set to 'temp' for older versions of CEMForm <v3.00.
Data offset=0	// Where the request for data may be 30000 or 40000 (true Modbus notation) set this offset here. This will route the data to be read from the correct location, i.e. if set to 30000, a read from register 30000 will actually read from register 0.
Logic offset=0	// As above but for the logic data reads (function codes 01, 02 etc).

Int16=1	// If set to 0 will prevent the roll-over of negative data in the word output format, i.e. -1 would be clamped at 0 rather than taken to 65535. This setting depends upon how the DCS is configured.
Hold delay alarm hour=0	// Used to delay an alarm that has been placed on the day average. As this is started at midnight it is very sensitive for the first hour of operation. Set to 1 to prevent the alarm until after 1 am.
Return TCP Unit Identifier=1	// This is used to return the unit identifier (the Modbus address) when using TCP Modbus; it will default to true. In reality the address is not required (the TCP address takes over), however, DCS systems that push data to us may or may not require it.
Transmit Start Addr=199	// If data is received from the DCS using different function codes ($10– multiple words, $06 – single word, and $0F – multiple bits), they will arrive as separate commands to different memory locations. For CEMBus, this address is within a separate block of memory, so will not clash with its existing data. So, as an example, should the DCS write data to address 200, it may be written back to the DSU with either a setting here of 199 or 200 (just moves the start of the data write). This may be fine-tuned by observing the diagnostics.
No transmit Words=20	// Used in conjunction with the above - the number of words to write back.
Second count max value=1000	// If a second counter is transmitted back to the DCS; this is its maximum value before being set back to zero.

8.4.2 CEMBUS.INI – COM PORT SETTINGS

Two serial ports are available for configuration, these are identified as [Port] and [Port2]:

Port=0 – Set to the com port number of the serial port (repeat for port 2 if used). Don't use port 10, see the Moxa settings below.

Baud=9600 – Baud rate selection.

If set to com port 10, CEMBus will assume that a Moxa serial server is to be used. This is a special mode of operation that bypasses the com port mode of the PC and Moxa device and requires the IP address and port to be entered as below for both Moxa ports:

```
[MOXATCP1]
Host=192.168.0.12
Port=4001

[MOXATCP2]
Host=192.168.0.12
Port=4002
```

8.4.3 PAIRED REDUNTANT GROUPS

Where each analyser group is one of a redundant pair, CEMBus can output the validity of the non-selected group of data. That is, if the Duty analysers are selected the validity of standby analysers is seen and vice versa if not selected. So, to reflect the selected analysers, the validity group is set to the relevant calculated page of CEMForm (already switched by CEMForm) and for the non-selected analysers the first actual analyser page.

So for a triple redundant pair system with a miscellaneous group of data at page 4, pages 8, 9 and 10 should be used for the selected analyser validity and pages 1, 2 and 3 for the deselected analysers. The [Group Pairs] part of the Main.ini file should be set as below:

```
[Group Pairs]
Group 1=5
Group 2=6
Group 3=7
Status byte=64          // Equates to the status code of the switch $40 for gas, $20
                        for dust etc.
```

8.4.4 MOVE LOGIC DATA

Where the data is to be read by the DCS using one function code (such as Profibus) the logic bytes may be moved into the measurement data map area. Eight possible logic byte areas may be defined:

```
[Move Logic N]          // N = 1 to 8.
Quantity=0              // Set to how many bytes to move.
Move from=0             // Set to the logic byte location to start…
Move to=0               // …and where to move it to in the data grid.
```

8.4.5 DSU CONNECTION SETTINGS

Use these settings to set the Ethernet connection between the CEMBus program and the DSU (or CEMSocket):

```
[DSU Socket]
Host=DSU                    // or TCP IP address. If CEMSocket then either use 127.0.0.1
                               or localhost.
Port=1024                   // TCP port used of DSU connection. If CEMSocket then
                               usually set to 1023.
```

9 MODBUSLOOKUP

9.1 MODBUSLOOKUP.DB – MAP OF CEMSUITE DATA.

Use either the DBUtils program or CEMCfg to edit the lookup files directly. The Modbuslookup.db file is illustrated below and contains the following information:

PBus rec	Group	Channel	Average	Units	Raw unit	Raw Divider	Processed divider	Comments
0	1	1	1	1	1	1	1	ed
1	1	13	1	2	1	1	1	Main H2O Raw
2	1	4	1	2	1	1	1	Main HCl Raw
3	1	2	1	2	1	1	1	Main CO Raw
4	1	1	1	2	1	1	1	Main NOx Raw
5	1	3	1	2	1	1	1	Main SO2 Raw
6	1	12	1	2	1	1	1	Main O2 Wet
7	1	6	1	2	1	1	1	Main NH3 Raw
8	1	5	1	2	1	1	1	Main TOC Raw
9	1	11	1	2	1	1	1	Main CO2 Raw
10	1	7	1	2	1	1	1	Main N2O Raw
11	1	8	1	2	1	1	1	Main HF Raw
12	2	13	1	2	1	1	1	Main H2O Raw
13	2	4	1	2	1	1	1	Main HCl Raw
14	2	2	1	2	1	1	1	Main CO Raw

- PBus rec: Not used by CEMBus but useful for keeping track of positioning.
- Group: The group where the measurement lies.
- Channel: The channel ID of the measurement.
- Units: Desired measurement units, typically these will equate to: 1=ppm, 2=mg/m3, 3=mg/Nm3, 4=mg/Nm3-C, 5=Kg/hr, 6-10= Special.
- Raw unit: Defines which of the above is the raw unit – this has minimal impact.
- Raw Divider: Used when raw data has been defined to produce correctly scaled numbers.
- Processed divider: As above but for non-raw data – not relevant for IEEE754 format.
- Comments: Information only.

9.2 SPECIAL UNIT SELECTIONS WITHIN MODBUSLOOKUPD

Measurement units of 1 to 5 are as seen on the CEMForm main displays (ppm, mg/m3, etc), selecting units 6 to 10 will reflect the following:

Units=6: Four numbers are available for each measurement depending upon the value in the average column:

1= The last complete average for average 2 (should be set to 10 mins).
2= The 7th highest 10 minute average (for 95th percentile 10 mins).
3= Number of 10 mins > ELV.
4= Mass released so far today in kg.

Units=7: Four numbers are available for each measurement depending upon the value in the average column:

1= The year to date average: Nmg.
2= The month to date average: Nmg.
3= The year to date: Kg.
4= The month to date: Kg.

Note: That the normalised concentration figures will be confidence adjusted if this is what is displayed in the data grid of CEMForm.

Units=8: Four numbers are available for each measurement depending upon the value in the average column:

1= The year to date bad day count – From average 3 (30 or 60 min). Three hours or more bad data.
2= The month to date bad data – From average 3 (30 or 60 mins).
3= Target value for average 3 at the data grid units (usually 30 or 60 mins).
4= Target value for average 4 at the data grid units (usually the day).

Units=9: Four number are available for each measurement depending upon the value in the average column:

1= Invalid averages so far today.
2= Invalid day's this year.
3= Invalid day's this month.
4= Yesterdays average Nmg.

Units=10: Raw data direct from the DSU (or CEMSocket). Also set the average to 1 if required.

Units=11: A count in seconds from the program start, wrapping at a set value (default = 1000). Note that the group, channel and average settings should be set to 1.

9.3 MODBUSLOOKUPV.DB – MAP OF CEMSUITE VALIDITY DATA.

Use either the DBUtils program or CEMCfg to edit the lookup files directly. The ModbuslookupV.db file is illustrated below and contains the following information:

	PBus rec	Group	Channel	Average	Units	Mask	Alarm	Comment
▶	58	3	1	1	1	1		89 des. cems error
	59	3	1	1	1	4		89 des. cems MR
	60	3	1	1	1	2		89 des. cems MM
	61	11	1	1	1	128		SPARE
	62	11	1	1	1	128		SPARE
	63	11	1	1	1	128		SPARE
	64	11	1	1	1	128		SPARE
	65	11	1	1	1	128		SPARE
	66	8	1	1	1	1		69 O2 depletion alarm
	67	9	1	1	1	1		79 O2 depletion alarm
	68	10	1	1	1	1		89 O2 depletion alarm
	69	1	1	1	1	1	3	Watchdog 1
	70	1	1	1	1	1		T shelter alarm
	71	1	1	1	1	1		Turbo ring alarm
	72	1	1	1	1	64	7	69 selected CEM
	73	2	1	1	1	64	7	79 selected CEM
	74	3	1	1	1	64	7	89 selected CEM
	75	1	1	1	1	1		SPARE
	76	11	1	1	1	128		SPARE
	77	11	1	1	1	128		SPARE

- PBus rec: Not used by CEMBus but useful for keeping track of positioning.
- Group: The group where the measurement validity lies.
- Channel: The channel ID of the measurement validity.
- Average: Only for alarm selection.
- Units: Only for alarm selection.
- Mask: Only the bits within the mask (AND function with the defined validity byte) will set the output bit.
- Alarm: See the next page for these settings.
- Comments: Information only.

9.4 SPECIAL ALARM SETT

The Alarm column may be used to define several special settings, these are examined now:

0 or null entry: Use the normal validity byte and mask.

1, 2: Use alarm 1 or 2 from CEMForm at the average and units defined in CEMForm to derive the bit.

3: A flip-flop watchdog that will change state every data read (10 seconds). This may be used by the DCS to monitor the connection and make sure that is active.

4: DSU health on a multiple DSU system. Uses the entry in the channel column to select DSUs (01 = DSU1, 03 = DSUs 1 and 2 etc). The reality is that if there are DSU problems, multiple data errors are also seen – seldom used.

5: Set for logic state input. This will reflect a change in a logic state, set the mask to the value (usually 1 or 0) that will set this bit on and the rest to define the logic channel – group etc.

6: Multiple ELV alarm. Will use the number of channels defined in the Main.ini and check for an ELV excursion at the units and average defined. If any are found this bit is set on.

7: Plant status byte. This may be used to reflect the data within the plant status byte determined by CEMForm. This is also used for the data switching which sits at the high nibble of this byte. The mask will determine which bits in the plant status drives this output bit.

Notes on the status byte (hexadecimal on the left):

00= PLANT OFF.
01= PLANT ON.
02= PLANT ON BUT NO REPORT.
10= Custom data switch (set to 16 decimal).
20= Dust data switch (set to 32 decimal).
40= Gas data switch (set to 64 decimal).

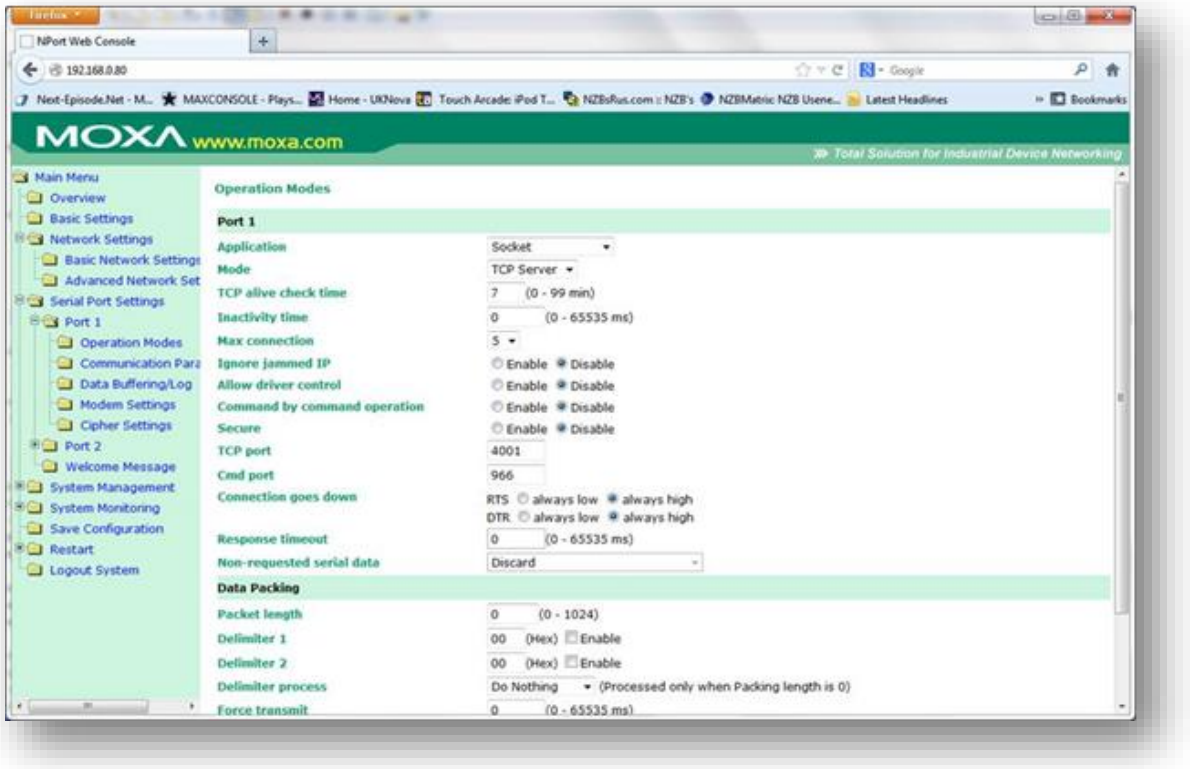
8: Average has ended. Also note that the bit will clear if the data has been read by defining the start address for reset variable. After this address has been read by the Modbus master the average bit is set off again.

10 SETTING UP A MOXA FOR USE AS A SERIAL SERVER

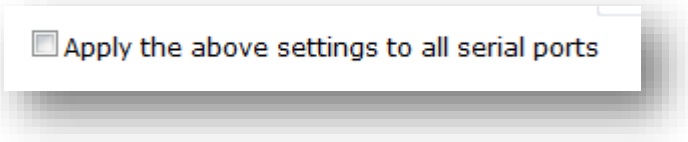
Moxa 6150 and 6250 devices may be set up as serial server rather than as a COM port. This improves the long term reliability and enables more than one master to connect to the device.

To set up the Moxa, log into the web interface at the IP address for the Moxa unit – User: 'admin' / Password: *Leave blank.*

Set the following:



Then check the box below (located at the bottom of the page above):



And apply the settings.

Default TCP values should be:

- Port 1 – 4001
- Port 2 – 4002 (Only for the dual port 6250)

10.1 CEMBUS.INI - SETTINGS FOR THE MOXA SERIAL SERVER

In CEMBus.ini

1st Port:
[MOXATCP1]
Host=192.168.0.80 // Example IP address.
Port=4001

2nd Port (6250 Only)
[MOXATCP2]
Host=192.168.0.80 // Example IP address.
Port=4002.

Finally in the port and port 2 sections se 'Port=10' for the comm ports that need to communicate via the Moxa.

11 INTERFACE TO DCS & OTHER PROTOCOLS

11.1 ANYBUS CONFIGURATION

11.1.1 PROFIBUS-DP SERIAL GATEWAY CONFIG.

1. Connect the Anybus Communicator to the PC with a serial to RJ11 lead and open the Anybus Configuration Manager.
2. When prompted, select 'Blank configuration' and click OK.
3. Connect to the Anybus Communicator making sure the correct port is selected under 'Tools' -> 'Port'.
4. Select 'Fieldbus' in the left-hand menu and make sure the Fieldbus type is set to 'Profibus-DP'.
5. Open up the 'Subnetwork' menu and rename 'New Mode' with a relevant title (e.g. Envirosoft DSU). Confirm slave address is set to 1.
6. Right click on the node and select 'Add Command'. When prompted select '0x04 – Read Input Registers'. New submenu selections should appear below the node.
7. Open up the 'Read Input Registers' submenu and expand the 'Query' menu.
    a. Under 'Starting Address', set the location of the first byte\register to be read in hexadecimal (usually 0x0000).
    b. Under 'Quantity of Input Registers'
8. Expand 'Response' menu.
    a. Under 'Byte Count' set the number of bytes to be written in hexadecimal (e.g. if 100 bytes are to be written then that would be 64 in hex).
    b. Under 'Input Registers' repeat the number of bytes to be written under 'data length' and enter the posiiton of where the first byte written is to be located in the Anybus 'In area' in hexadecimal under 'data location'.
9. Confirm all the details entered are correct, then under 'Tools' select 'Download configuration to Comunicator'.
10. Once the configuration has been uploaded, confirm that data is being received by the Anybus Communicator by right-clicking on the node name and selecting 'Node Monitor'. If configuration is correct there shoud be data displayed in the 'In Area' and the subnet status light on the Anybus Communicator should be green.

11.1.2 PROFIBUS ETHERNET/IP SERIAL CONFIGURATION

1. Follow steps 1-3 above.
2. Select 'Fieldbus' in the left-handed menu and make sure the Fieldbus type is set to 'Ethernet/IP'.
3. Open up the 'Subnetwork' menu and rename 'New Mode' with a relevant title (e.g. Limas\Uras#1). Set the slave address of node to address of analyser.
4. Right-click on the node and select 'Add Command'. When prompted select the type of command you wish to use (e.g. 02 – Read Discrete Inputs, 04 – Read Input Registers). New submenu selections should appear below the node.
5. If '0x04 – Read Input Registers' was selected then follow steps 7 and 8 above.
6. If '0x02' – Read Discrete Inputs' was selected then open up the submenu and expand the 'Query' menu.
    a. Under 'Starting Address' set the location of the first byte\register to read from the analyser in hexadecimal (refer to the Modbus section of the relevant analyser manual for information on where the digital signals begin in the table)
    b. Under 'Quantity of Inputs' set the number of digital inputs to be read in hexadecimal.
7. Expand the 'Response' menu.
    a. Under 'Byte Count' set the number of bytes to be written in hexadecimal.
    b. Under 'Input Status' repeat the number of bytes to be written under 'data length' and enter the position of where the first byte is to be located in the Anybus 'In Area' in hexadecimal under 'data location'
8. Follow steps 9-10 above.

11.1.3 BRINGING DATA IN OVER THE PROFIBUS CONNECTION

1. Follow steps 1-3 above.
2. Right-click on the node and select 'Add Command'. When prompted select '0x10' – Write Multiple Registers'. New submenu selections should appear below the node.
3. Open up the 'Write Multiple Registers' submenu and epand the 'Query' menu.
    a. Under 'Starting Address' set the location of the first byte\register to be read in hexadecimal.
    b. Under 'Quantity of Registers' set the number of registers to be read in hexadecimal.
    c. Under 'Byte Count' set the number of bytes to be read in hexadecimal.
    d. Under 'Registers Value' set the number of bytes to be written under 'data length' and enter the position of where the first byte written is to be located in the Anybus 'Out Area' in hexadecimal under 'data location' (first byte is located at 0x200).
4. Expand the 'Response' menu
    a. Under 'Starting Address' repeat the location of the first byte\register to be read in hexadecimal.
    b. Under 'Quantity of Registers' set the number of bytes to be read in hexadecimal.
5. Follow steps 9-10 above.

Note: You can test the Profibus inputs using the Profibus-DP Master Simulator program along with a RS232\Profibus simulator device connected to the Anybus device.

11.2 REMOTE OPC DA QUICK START GUIDE (DCOM)

11.2.1 OVERVIEW

This section intends to provide information for quickly setting up a secure DCOM connection between an OPC server and a client running on Microsoft Windows XP Service Pack 2 or later.

11.2.1.1 WHAT IS DCOM?

Distributed Component Object Model (DCOM) is an extension of Component Object Model (COM) that allows COM components to communicate among objects on different computers. DCOM uses Remote Procedure Call (RPC) to generate standard packets that can be shared across a network, which in turn allows COM to communicate beyond the boundaries of the local machine.

Because DCOM poses a security threat, care should be taken to not expose more than what is required for the application. Although multiple security layers exist, it is still possible that some part of the system will be compromised.

11.2.1.2 WHAT IS OPCENUM?

The OPC server stores OPC specific information in the registry. Since OPC clients need to be able to discover servers running on both the same machine and remote machines there needs to be a standard method for accessing this registry information (which is not available for remote access). To do so, a component called OPCEnum is provided by the OPC Foundation. OPCEnum is an executable that is typically installed on a computer along with the OPC server. It runs as a System service and provides a means to browse the local machine for OPC servers and then expose the list to the OPC client.

11.2.2 USERS AND GROUPS

To ensure that an OPC connection is secure, create users and groups that are exclusively for this use. These can be manually added by any user who has the proper credentials to do so.

11.2.2.1 DOMAINS AND WORKGROUPS

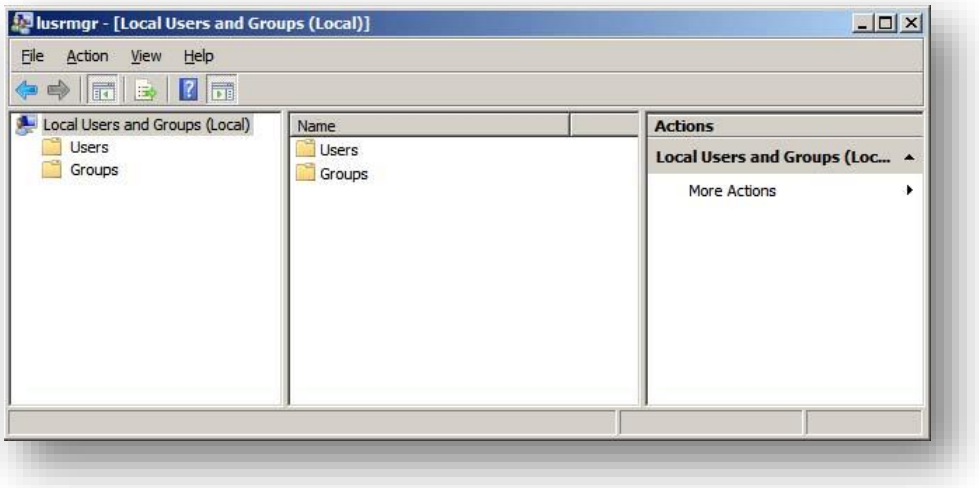
When working within a workgroup, each user will need to be created locally on each computer involved in the connection. Furthermore, each user account must have the same password in order for authentication to occur. A blank password is not valid in most cases. Because changes may need to be made to the local security policy on each computer, remote connectivity within a workgroup has the potential to be the least secure connection. For more information, refer to Local Security Policies.

When working within a domain, local users and groups are not required to be added to each computer. A domain uses a central database that contains the user accounts and security information. If working within a domain is preferred, a network administrator may have to implement the changes.

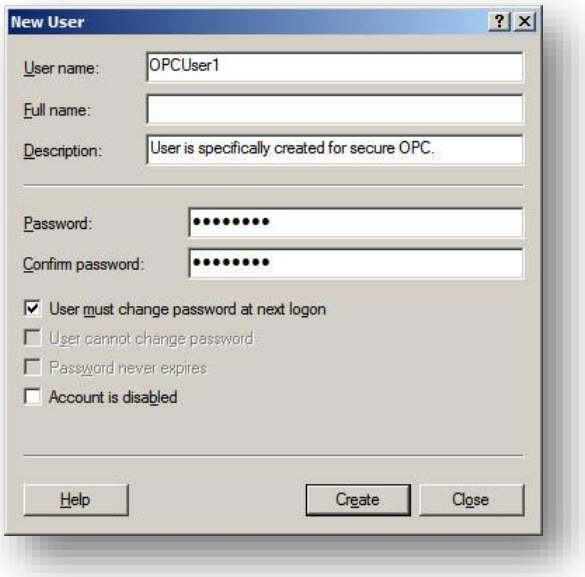
Mixing domains and workgroups will require both computers to authenticate with the lesser of the two options. This means that the domain computer will require the same configuration as it would if it were on a workgroup. Local user accounts must be added to the domain computer.

11.2.2.2 ADDING A LOCAL USER

1. Launch the **Local User and Groups** snap-in, which is part of the 'Microsoft Management Console'. It can be viewed directly by selecting **Start | Run** and then typing "**lusrmgr.msc**".
2. Next, click **Users**. Then select **Action | New User**.

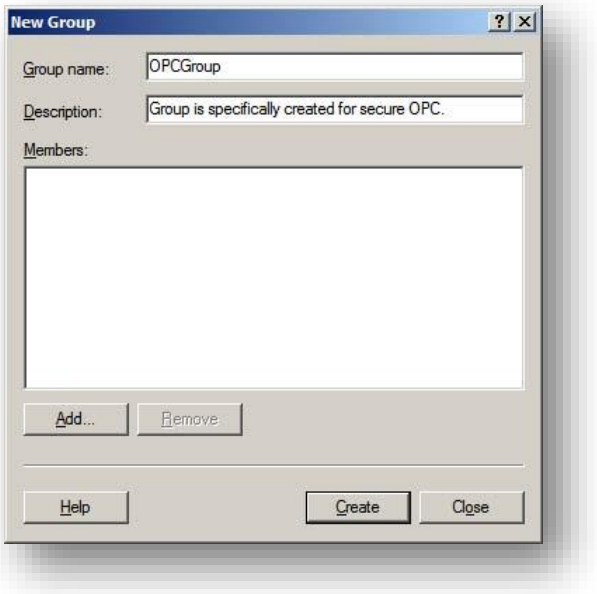


3. Type the appropriate information in the dialog box.
4. Change the following options as required:- **User must change password at next login / User cannot change password / Password never expires / Account is disabled**.
5. Click **Create**. Then click **Close**.



11.2.2.3 ADDING A LOCAL GROUP

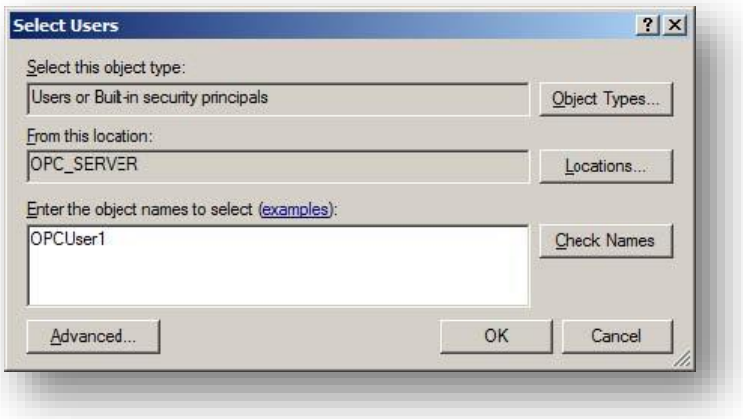
1. Launch the **Local User and Groups** snap-in, which is part of the 'Microsoft Management Console'. It can be viewed directly by selecting **Start | Run** and then typing "**lusrmgr.msc**".
2. Click **Groups** and then select **Action | New Group**.



3. In **Group name** type a name for the new group.
4. In **Description** type a description of the new group.
5. Click **Create** and then click **Close**.

11.2.2.4 ADDING USERS TO A GROUP

1. Launch the **Local User and Groups** snap-in.
2. Next select **Groups**. Then right-click on the group in which a member will be added and point to **All Tasks**. Click **Add to Group | Add**.



3. In **Object Types** select the types of object to find.
4. In **Locations** click the domain or the computer that contains the users to add. Then click **OK**.
5. Type the name of the user or group that will be added to the group and then click ok. To validate the user or group names being added, click **Check Names**.

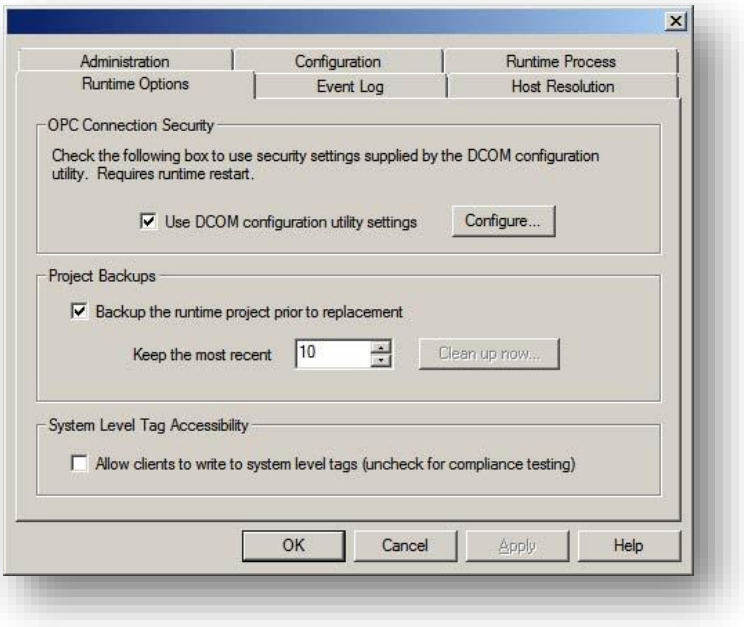
11.2.3 SERVER RUNTIME

Before DCOM is configured on the server computer, both the level of security and the Runtime's process mode should be considered. To provide the highest level of security, users must enable the appropriate settings. The process mode should be chosen since the DCOM configuration is reset when the process mode is changed.

For more information on which process mode is appropriate for the specific application, refer to the server's help file.

11.2.3.1 OPC CONNECTION SECURITY

To provide the highest level of security DCOM must be enabled in the Runtime. This option, which is enabled by default, ensures that DCOM settings are obeyed and user authentication is performed. Disabling the option is not recommended since the server will impersonate the security of the client when performing any actions on behalf of the client application.



1. Right-click on the server **Administration** icon in the system tray and then select **Settings**. If the Administration icon is not present it can be accessed from the **Start** menu.
2. Select the **Runtime Options** tab.
3. Check **Use DCOM configuration utility settings** (if not already enabled).
4. Select **Apply** then **OK**.

Note: If prompted to restart the Runtime choose **Yes**.

11.2.3.2 PROCESS MODE

The server runtime has the ability to run as a service or to run interactively under a user account. By default, the Runtime is installed as a service. In a few cases, however, it may be necessary to change the process mode to allow interactive functionality. For more information on how to switch the process mode, refer to the server's help file.

Caution: Application DCOM settings are reset when the server's process mode is changed.

When remote OPC connections are required, selecting System Service Mode will produce the most predictable results. The Runtime will be started when the system starts and will not require user intervention. A specific user is not required to be logged on.

Using the Runtime in Interactive Mode may require additional DCOM configuration. The simplest way to authenticate the connection and prevent this additional configuration is to have a DCOM privileged user account logged on to the Windows operating system on both the server and client side. This user account must have the appropriate permissions set in the DCOM settings as described in the Windows operating system on both the server and client side. This user account must have the appropriate permissions set in the DCOM settings as described in the Windows operating system on both the server and client side. This user account must have the appropriate permissions set in the DCOM settings as described in DCOM Configuration.

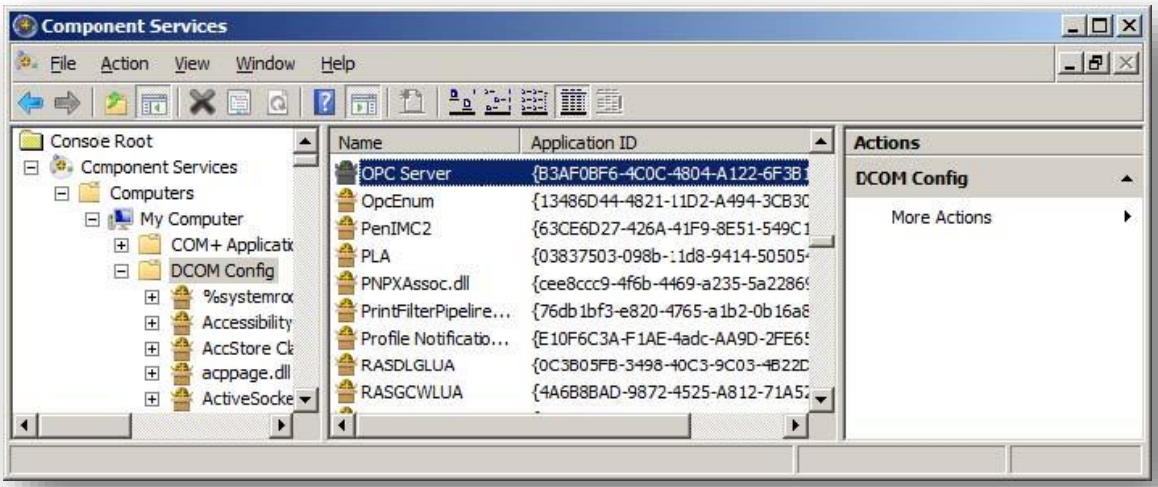
Note: For some situations, extra DCOM configuration is required. For more information, refer to Configuring the Application Identity (Optional).

11.2.4 DCOM CONFIGURATION

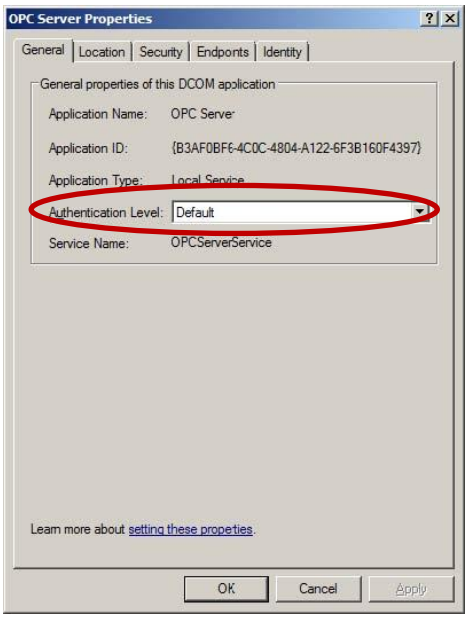
The computer running the OPC server must make changes to the application and system levels in order to setup DCOM correctly.

11.2.4.1 CONFIGURING THE APPLICATION

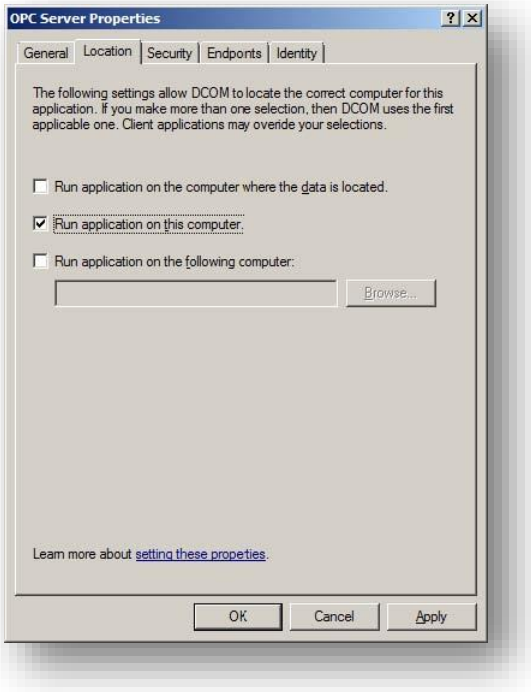
1. Launch the **Component Services** snap-in which is part of the 'Microsoft Management Console'. It can be viewed directly by selecting **Start | Run** and then typing "**dcomcnfg**".
2. Under **Console Root** expand **Component Services** > **Computers** > **My Computer** and **DCOM Config**.



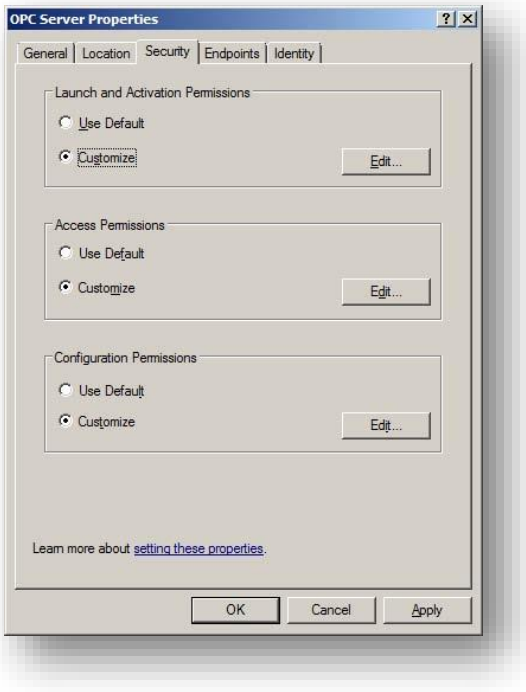
3. Browse the DCOM enabled objects until the OPC server application is located. In this example "OPC Server" is displayed where the actual application name will appear.
4. Right-click on the server application and select **Properties**.
5. Open the **General** tab. Then verify that the **Authentication Level** is set to '**Default**'.



6. Open the **Location** tab. Then verify that only the **Run application on this computer** option is enabled.

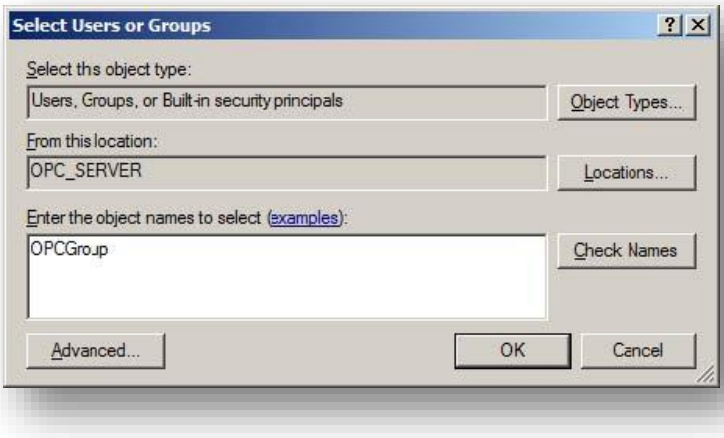


7. Open the **Security** tab.

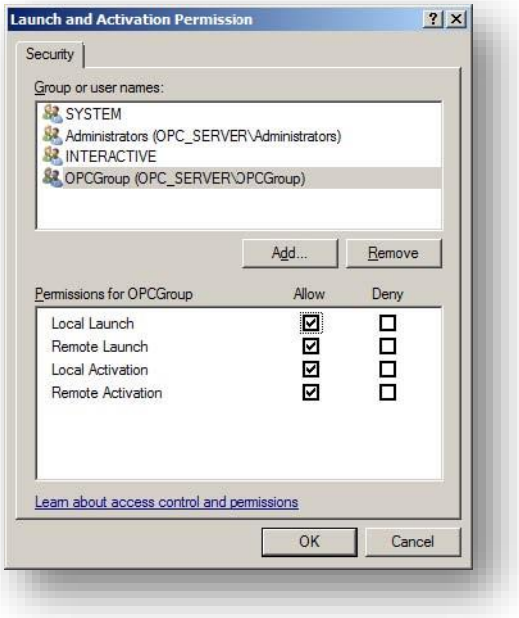


8. In **Launch and Activation Permissions** select **Customize**. Here users and groups can be granted permission to start the OPC server if it is not already running.
9. Click **Edit**.

10. In **Launch and activation Permissions** select **Add**.

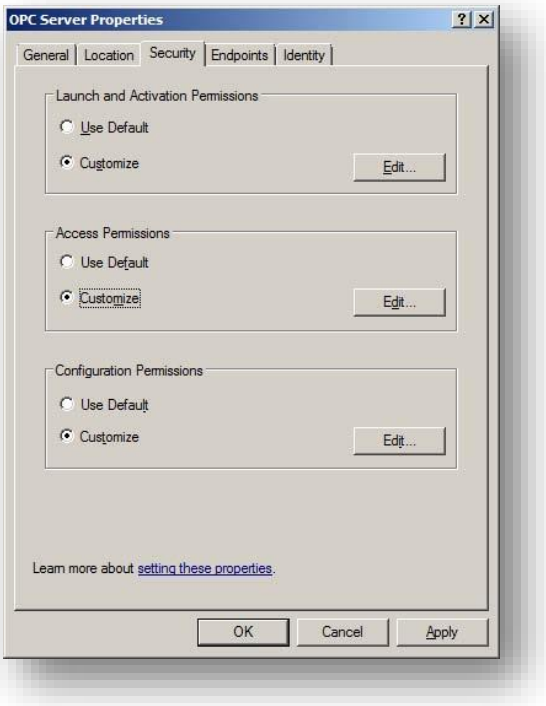


11. In **Object Types** select the desired object type.
12. In **Locations** click the domain or the computer that contains the users or groups that will be added. Then click **OK**.
13. Type the name of the user or group in the window. To validate the user or group names being added click **Check Names**.
14. After the account has been validated click **OK**.
15. Continue to add users and groups until all the desired accounts have been added. The new account or groups should be become visible in the **Group or Users Names** list.
16. Next, select the new user or group.

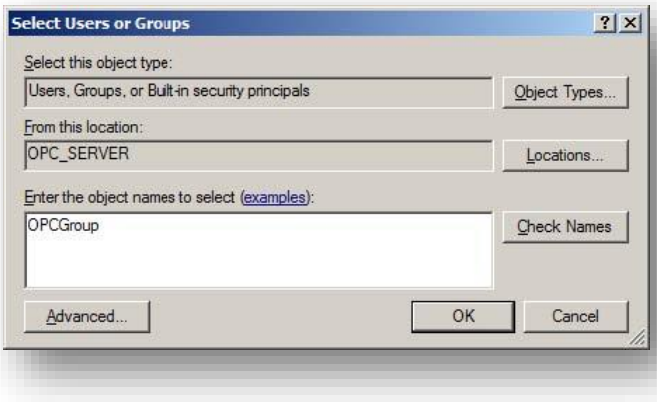


17. To only allow local applications to connect, only enable the local permissions for the account. In this example local and remote permissions are enabled.

18. Repeat the process for all accounts that have been added. Then click **OK**.

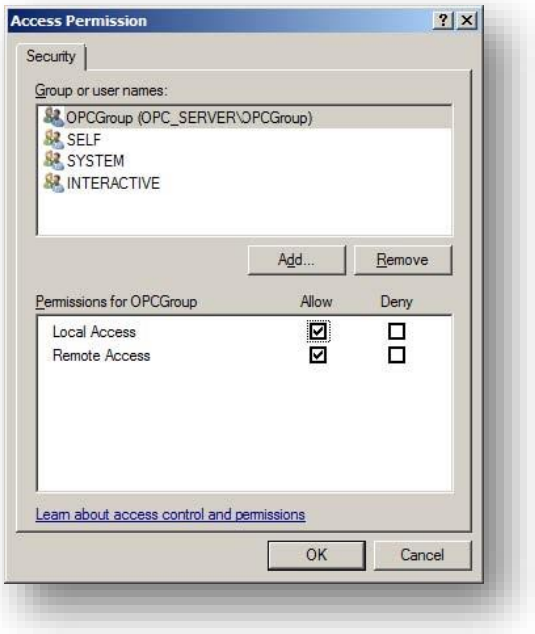


19. Select **Customise** in the **Access Permissions** group. Here users and groups can be granted permissions to make calls to the OPC server. These calls include browsing for items, adding groups and items or any other standard OPC call.
20. Click **Edit**.
21. In **Access Permssions** select **Add**.



22. In **Object Types** select the desired object type.
23. In **Locations** click the domain or the computer that contains the users or groups that will be added. Then click **OK**.
24. Type the name of the user or group in the window. To validate the user or group names being added, click **Check Names**.
25. After the account has been validated, click **OK**.
26. Continue to add users and groups until all the desired accounts have been added. The new account or group should be visible in the **Group or user names** list.

27. Select the new user group.



28. To only allow local applications to connect, only enable the local permissions for the account. In this example, local and remote permissions are enabled.
29. Repeat the process for all accounts that have been added. Then click **OK**.
30. Click **OK** to close the **Application Properties** window.

11.2.4.2 CONFIGURING THE APPLICATION IDENTITY (OPTIONAL)

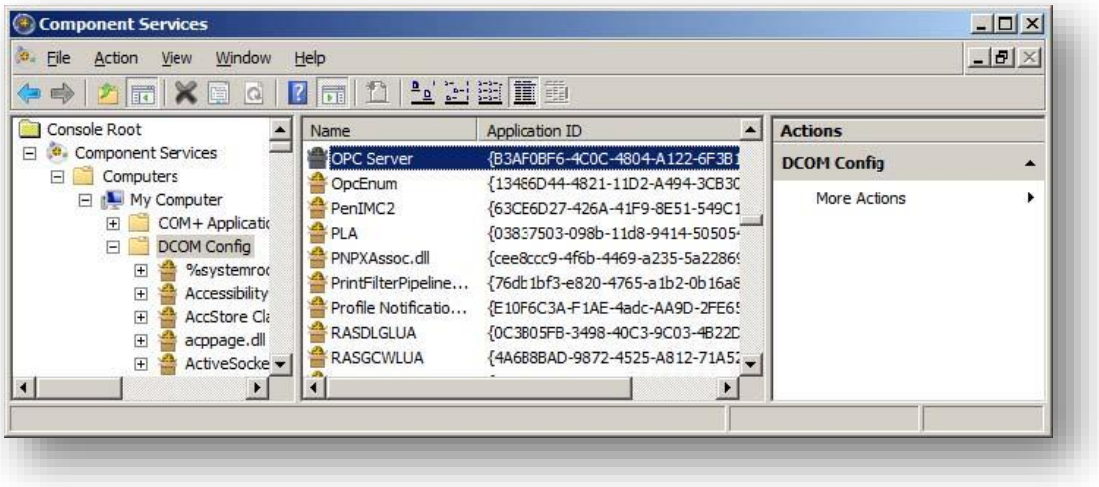
The **Identity** needs to be set when the process mode is set to Interactive and one of the following conditions is present:

- The computer that is being used as the server is required to run with multiple user accounts.
- User that have not been granted DCOM permissions will be using the computer.

Setting the Identity to '**This user**' allows a specific user account to be selected to run the application. Clients are then directed to the account allowing a connection to be made to the server. The specified user is not required to be logged on to the Windows operating system in order for this to happen.

Note: In this case, the specified user must be part of the Administrators group. If not, the server will not start.

1. Launch the **Component Services** snap-in, which is part of the 'Microsoft Management Console'. It can be viewed directly be selecting **Start | Run** and then typing "**dcomcnfg**".
2. Under **Console Root**, expand '**Component Services** > **Computers** > **My Computer** and **DCOM Config**.

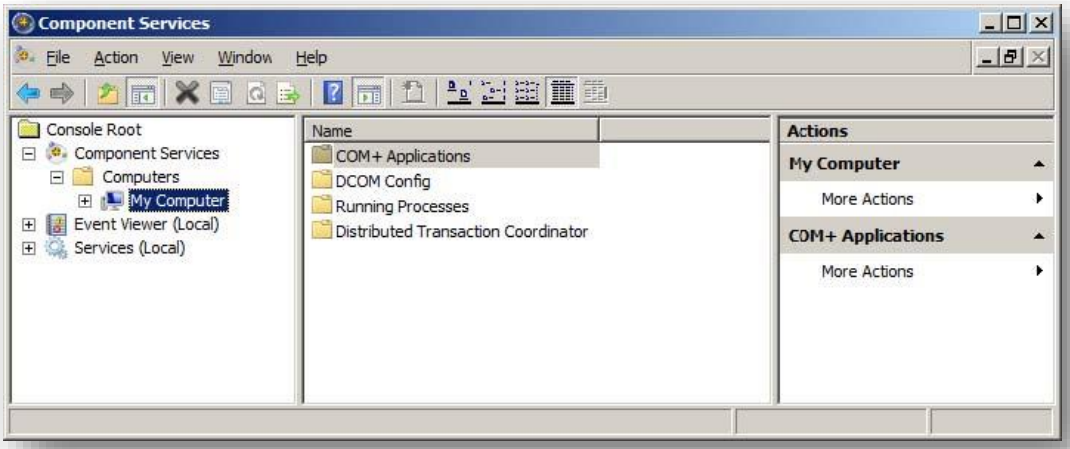


3. Browse the DCOM enabled objects until the OPC server application is located. In this example "OPC Server" is displayed where the actual application name will appear.
4. Right-click on the server application and then select **Properties**.
5. Next select the **Identity** tab.

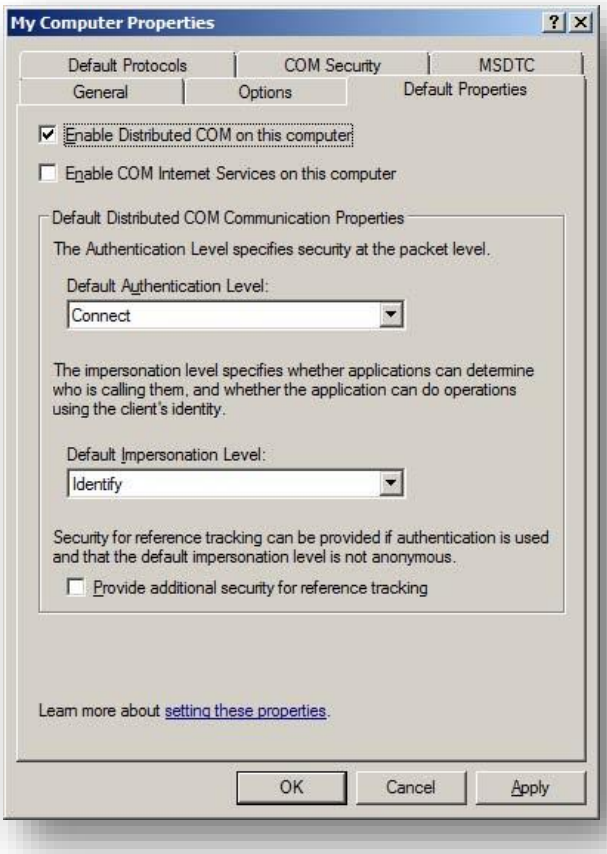
6. Enter the username or click **Browse** to launch the **Select User** dialog to assit in selecting a valid username.
7. Enter and confirm the password of the user that has been chosen to run the server application.
8. Select **OK** to close the **Server Properties**.

11.2.4.3 CONFIGURING THE SYSTEM

1. Launch the '**Component Services**' snap-in which is part of the 'Microsoft Management Console'. It can be viewed directly by selecting **Start | Run** and then typing "**dcomcnfg**".
2. Under **Console Root**, expand **Component Services** and **Computers**.

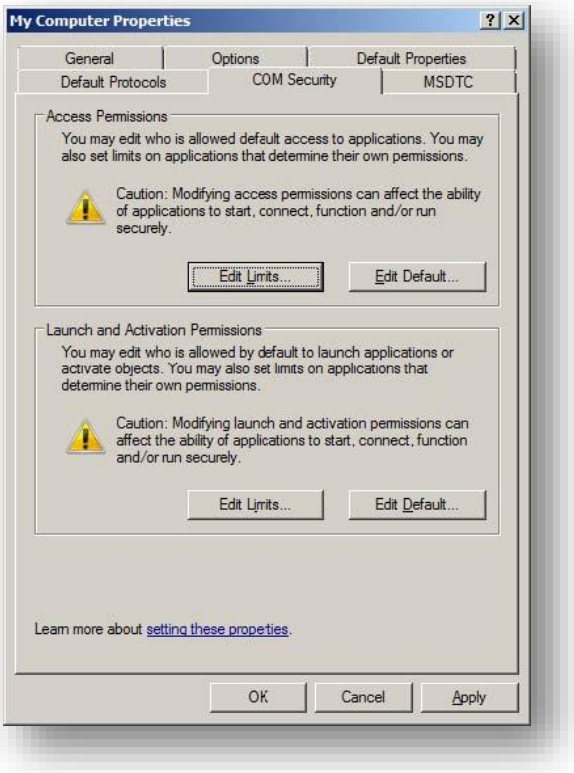


3. Right-click on **My Computer** and then select **Properties**.

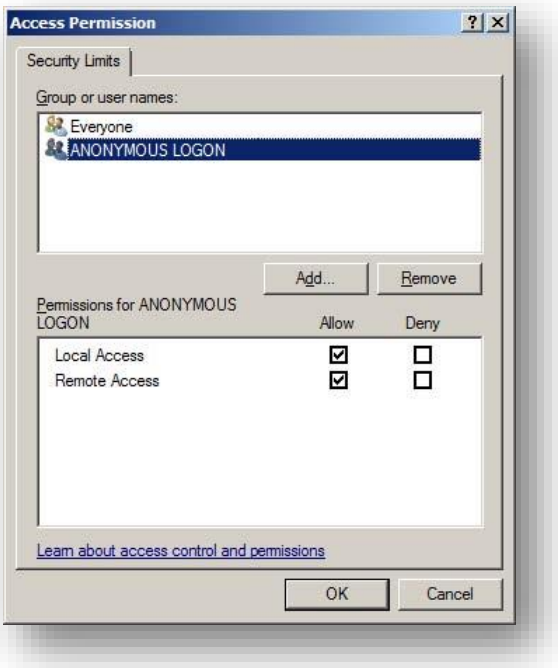


4. Next select the **Default Properties** tab.

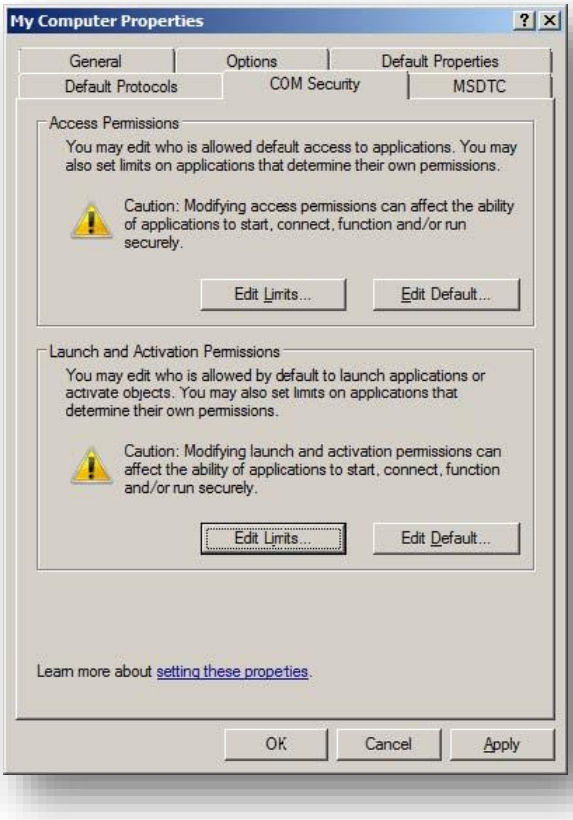
5. Verify that the **Enable Distributed COM on this computer** option is enabled.
6. Select **Connect** for the **Default Authentication Level**.
7. Select **Identity** for the **Default Impersonation Level**.
8. Next select the **COM Security** tab.



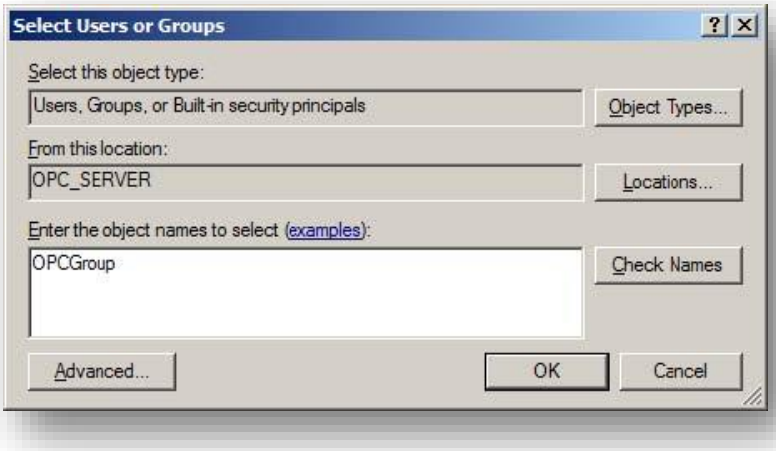
9. Select **Edit Limits** in the **Access Permissions** group.
10. Select the **ANONYMOUS LOGON** group account in the **Group or user names** list.



11. Enable the local and remote permissions for this group. OPCEnum overrides DCOM settings and opens accessibility to everyone. In Windows XP Service Pack 2 and above, this step is required because applications are not permitted to perform this action without user interaction.
12. Click **OK** to return to the **COM Security** tab.

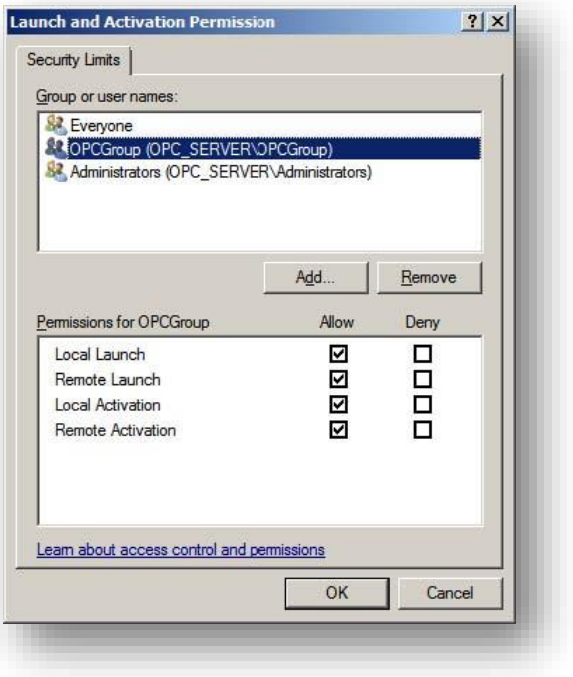


13. In the **Launch and Activation Permissions** group select **Edit Limits**.
14. In **Launch and Activation Permissions** select **Add**.



15. In **Object Types** select the desired object type.
16. In **Locations** click the domain or the computer that contains the users or groups that will be added. Then click **OK**.

17. Type the name of the user or group in the window. To validate the user or group names being added, click **Check Names**.
18. After the account has been validated, click **OK**.
19. Continue to add users and groups until all the desired accounts have been added. The new account or group should be visible in the **Group or user names** list.
20. Next select the new user or group.



21. To only allow local applications to connect only enable the local permissions for the account. In this example, ocal and remote permissions are enabled.
22. Repeat the process for all accounts that have been added. Then click **OK**.
23. Click **OK** to close the **My Computer** properties window.

11.2.4.4 APPLYING CHANGES

After the DCOM settings have been modified the changes made may not be applied immediately. While some operating systems require a reboot for DCOM changes to take effect, others will only require restarting the Runtime. To do so, right-click on the **Administration** icon in the **System Tray** and then select **Stop Runtime**. Once the Runtime has stopped, the **Start Runtime** menu item will be enabled and ready for selection.

11.2.5 FIREWALLS

In some cases it is easier to turn off any firewalls that may be running on both the client and server machine before DCOM is setup. Once a connection has been successfully created it is recommended that the firewall security restored and the correct exceptions are added.

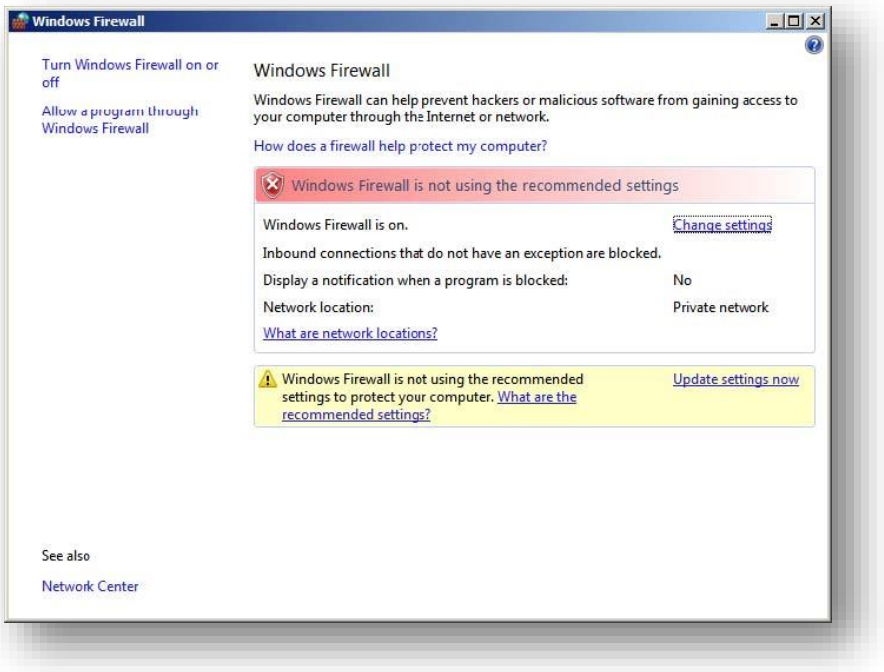
11.2.5.1 WHAT IS THE WINDOWS FIREWALL?

The Windows Firewall is the firewall service included with desktop and server releases of Microsoft Windows. Prior to Windows XP Service Pack 2, it was named "Internet Connection Firewall." Its purpose is to drop incoming traffic that is not expected (unsolicited traffic) or traffic that does not correspond to the exceptions (excepted traffic) that are set within the firewall.

Note: Aside from the server computer, the firewall must also be set on client computer so that callbacks can be received.

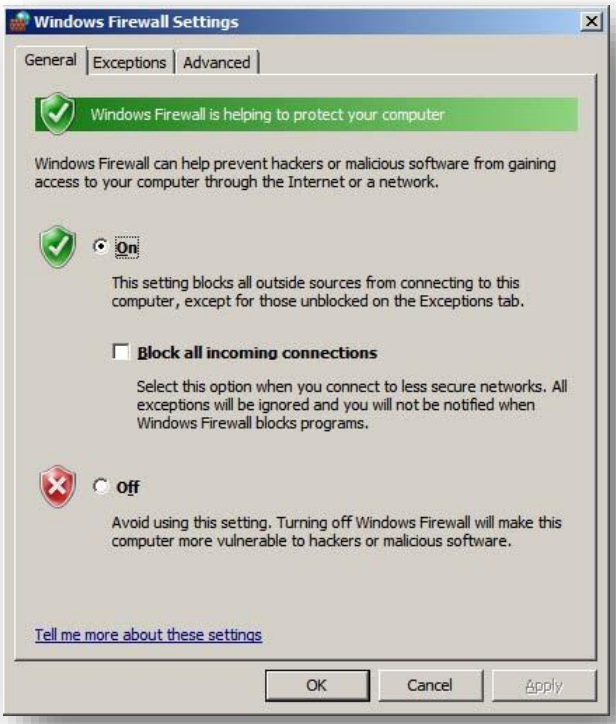
11.2.5.2 SERVER SIDE EXCEPTIONS

1. Launch the **Windows Firewall** by selecting **Start** | **Run** and then typing "firewall.cpl".

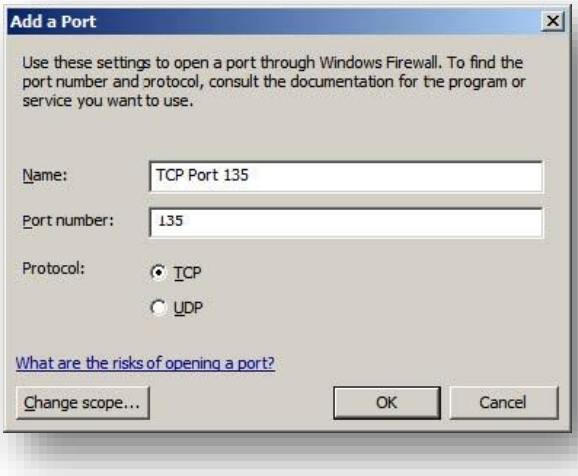


2. Windows Vista or Windows Server 2008 will not directly display the settings dialog. To view the dialog select **Change Settings**.

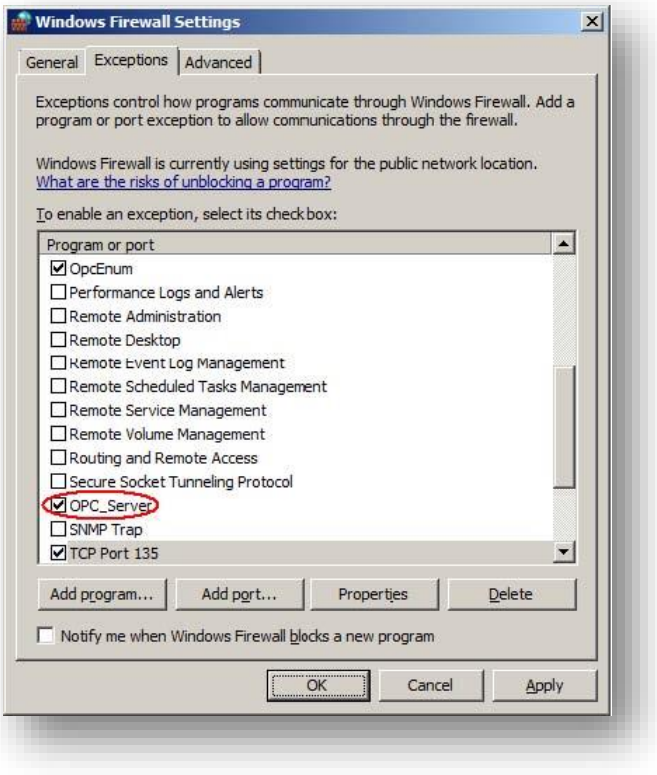
3. Next select the **General** tab.



4. Verify that the firewall is enabled by choosing **On**.
5. Select the **Exceptions** tab.
6. Click **Add Program**.
7. Click **Browse** and then locate **OPCEnum.exe**. This is located in C:\Windows\System32\.
8. Click **OK**.
9. Click **Add Program**.
10. Next, select **Browse** and then locate the OPC server application's executable file. This is usually located in C:\Program Files\<company name>\<product name>\ or in C:\Program Files\product name>\. **Note:** In this example, a generic server name of "OPC_Server.exe" is used in order to apply to any OPC server's configuration.
11. Click **OK**.
12. Click **Add Port**.



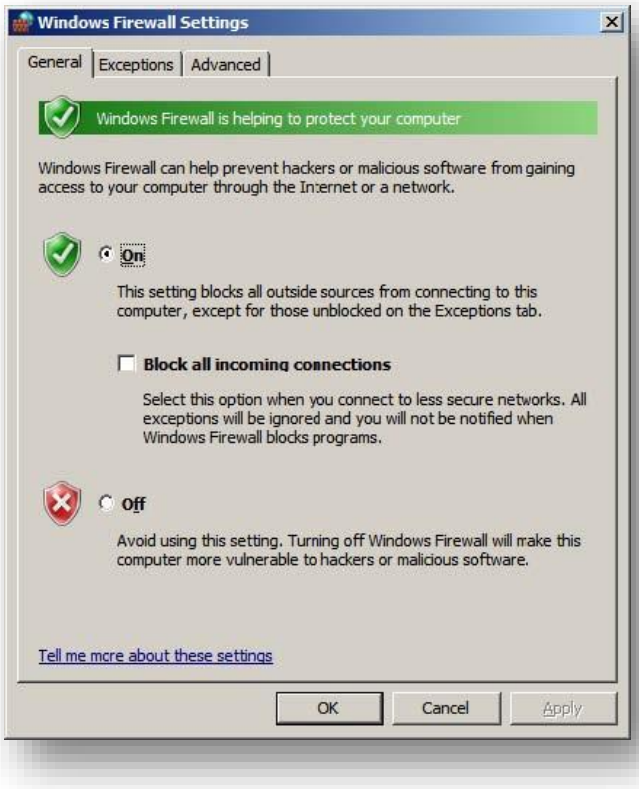
13. In **Name**, enter **TCP Port 135**. This port is commonly used for allowing clients to discover and utlize a DCOM service.
14. In **Port Number**, enter **135**.
15. Verify that the correct **Protocol** is selected. The defualt setting is **TCP**.
16. Click **OK**.



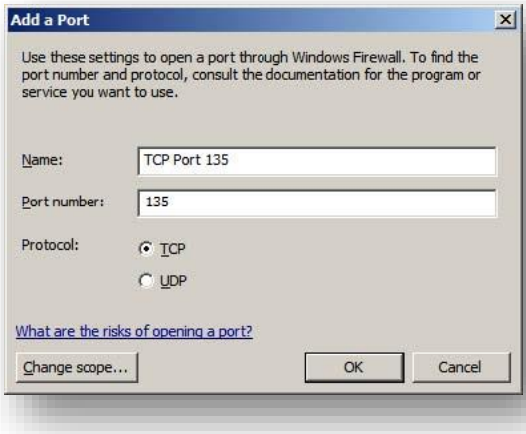
17. Click **OK** to close the settings dialog.

11.2.5.3 CLIENT SIDE EXCEPTIONS

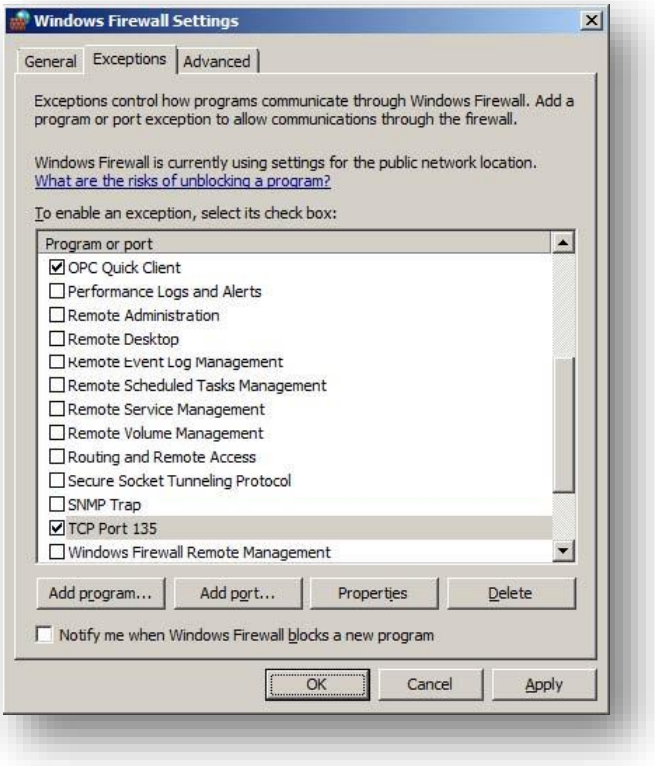
1. Windows Vista or Windows Server 2008 will not directly display the settings dialog. To view the dialog select **Change Settings**.
2. Next select the **General** tab.



3. Verify that the firewall is enabled by selecting **On**.
4. Next select the **Exceptions** tab.
5. Click **Add Program**.
6. Next click **Browse** and locate the server application's executable file. In this example, the OPC Quick Client is used and is usually located in C:\Program Files\<company name>\<product name>\.
7. Click **OK**.
8. Next click **Add Port**.



9. In **Name**, enter **TCP Port 135**.
10. In **Port Number**, enter **135**.
11. Verify that the correct **Protocol** is selected. The defualt setting is **TCP**.
12. Click **OK**.

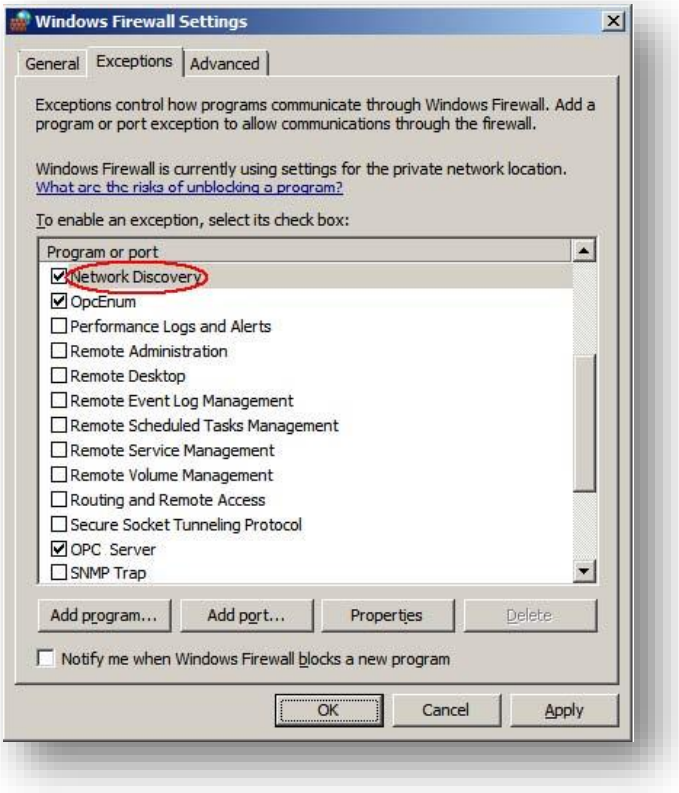


13. Click **OK** to close the setting dialog.

11.2.6 NETWORK DISCOVERY

The Network Discovery setting was first introduced in Vista and allows or prevents the computer to see or be seen by other computers on the network. If the setting is off (or if it is not set as an exception in the firewall) OPC clients might not be able to browse for the server.

1. Click **Start | Control Panel | Network and Sharing Center**.
2. Under the **Sharing and Discovery** section, click the **Down Arrow** in the **Network Discovery** row.
3. Click the **Turn on network discovery** radio button and then click **Apply**.
4. If the state of **Network Discovery** displays **Custom**, it is because the firewall is not allowing for network discovery or because a required service (**dnscache**, **fdrespub**, **ssdpsrv**, and **upnphost**) is not running. While not all services are necessary, the firewall must be set correctly.
5. Launch the **Windows Firewall** and view the settings dialog.



6. Search for **Network Discovery** in the list and then verify that the exception is enabled.
7. Click **OK** to close the **Settings** dialog.

11.2.7 LOCAL SECURITY POLICIES

When the computers that are involved in the remote connection are part of a workgroup it may be necessary to edit the **Local Security Policy**. This can pose as a security risk and should only be done if it is absolutely necessary. In most cases the server computer may require changes to the authentication model whereas the client computer needs to have access to browse for servers.

11.2.7.1 SHARING AND SECURITY MODEL FOR LOCAL ACCOUNTS

This setting determines how local users will be authenticated. When the setting is set to **Classic**, remote logons will use the same level of access that is set for the local account given that it has the same username and password. If set to **Guest Only**, network logons will use the same level of access that is set for the **Guest** account.

The **Sharing and Security Model** may need to be set to **Classic** on the server computer only. An error code (HR=80070005) will be returned to the client when attempting to add items if this is required.

1. Launch the **Local Security Policy** snap-in which is part of the 'Microsoft Management Console'. It can be viewed directly by selecting **Start | Run** and then typing "secpol.msc".
2. Under **Security Settings**, expand **Local Policies**.
3. Select **Security Options**.
4. In the list, right-click on **Network Access: Sharing and Security Model for Local Accounts** and then select **Properties**.
5. Choose **Classic – Local Users Authenticate as themselves** and then click **OK**.

11.2.7.2 LET EVERYONE PERMISSIONS APPLY TO ANONYMOUS USERS

This setting determines the additional permissions that are granted for anonymous logons. When the option is disabled the permissions granted to the 'Everyone' security identifier do not apply to anonymous users. If the option is enabled, anonymous users are given the same permissions as the 'Everyone' group.

The **Everyone Permissions** setting needs to be enabled on the client computer only. If clients cannot browse for the remote server even after DCOM has been set up then this setting is required.

1. Launch the **Local Security Policy** snap-in, which is part of the 'Microsoft Management Console'. It can be viewed directly by selecting **Start | Run** and then typing "secpol.msc".
2. Under **Security Settings**, expand **Local Polices**.
3. Select **Security Options**.
4. In the list, right-click on **Network Access: Let Everyone Permissions Apply to Anonymous Users** and then select **Properties**.
5. Choose **Enable** and then select **OK**.

11.2.8 SUMMARY

Because OPC users DCOM to allow remote communications it is imperative that it is correctly configured. Users can create a secure connection by following the instructions in this document. For more information, refer to the OPC Foundation's support documentation at http://www.opcfoundation.org/.

12 ERROR MESSAGES FROM ANALYSERS

The invalid data codes and messages are unique for each type of analyser and are given here for information. The lowest four bits may also be driven from inputs to a digital input unit.

12.1 ABB CODES

$01 – System Status
$02 – Maintenance Mode
$04 – Maintenance Request
$08 – Module failure or out of range (ACFNT or Limas / Uras)

If the data from a Limas / Uras analyser requires more definition these codes can also be written to the higher four bits by the analyser concerned. This may then be used to drive alarms or relay outputs as required.

12.2 LAND CODES

$04 – Out of Range (divider is too big)
$08 – Calibration in progress
$10 – System not sampling
$20 – System status error
$40 – Start up, zero cal or unable to run
$80 – System error

12.3 SIEMENS CODE

$01 – Pump failure
$02 – Maintenance request
$04 – Parameters changed
$08 – Security 2 entered
$10 – Calibration

12.4 OPSIS CODES

$20 – Out of range
$40 – Summary alarm
$80 – Number returned from analyser not valid

12.5 GASMET CODES

$08 – Span gas 2
$10 – Span gas 1
$20 – Zero gas
$40 – Any alarm
$80 – Out of range (divider is too big)

12.6 SERVOMEX CODES

$04 – Warm up
$08 – Calibration
$10 – Maintenance
$20 – Analyser failure
$40 – Not a proper number for interpretation
$80 – Out of range (divider is too big)

12.7 PROCAL CODES

$08 – Any alarm
$10 – Span gas 1
$20 – Zero gas
$40 – Maintenance
$80 - Error

12.8 SICK CODES

$01 – System Status
$02 – Maintenance request
$04 – Maintenance mode
$10 – Span gas
$20 – Zero gas

13 CEMSUITE IED CONFIGURATION

13.1 INTRODUCTION

New legislation starting 1/1/2016 is to come into force. For Envirosoft, this reclassifies the plant status on our power generation sites, nearly all of which are gas turbines. CEMSuite requires some modifications in order to meet this new legislation.

13.2 PLANT STATUS CRITERIA

The plant status may now have four different conditions:

1. OFF - No combustion
2. Start-up/ shut down - ON but not reportable for any concentration data
3. Part load operation - ON but reportable for part load concentration data only
4. ON - ON and reportable for all ELVs

13.3 REQUIRED AVERAGES

From this data, the following concentration data are to be calculated:

1. Monthly mean from all hourly averages from condition 4.
2. Monthly highest day average from condition 4.
3. Monthly highest day average from condition 3.
4. Annual 95th percentiles of the hourly averages (from 1 above).
5. Annual 95th percentiles of the daily averages (from 2 above).

13.4 REPORT FORMS

Report forms for concentration data will be generated quarterly and will show the data for each month of the quarter and the current annual totals & percentiles. This is referred to as ESI/03B for gas turbines; practically all of our power generation business.

Mass will be calculated from plant status conditions 3 & 4 and calculated monthly, quarterly and annually and reported on Forms ESI/02 or ESI/04; these forms are attached at the end of this document.

IED Form AR1	– Energy usage and mass reporting
IED Form CEM1	– Invalidity assessment
CON1/ CON2	– Daily average, max and %ile summary
TNP	- Transitional national Plan report for mass

These reports are available from the LCPD software and have been configured as required. They are compiled on an annual basis and submitted quarterly, future months being left blank. The LCPD program has 3, 6, 9 and 12 month date range selections; all starting on the 1st January. Other reports are required by IED but these usually contain data outside of the scope of CEMs.

Waste incineration carries a standard monthly report for each pollutant measurement and these are submitted quarterly (3 reports for each pollutant).

Examples of all reports are given in the LCPD and WID manuals respectively.

13.5 DEFINING THE IED PLANT STATUS CRITERIA

So far, 4 different methods of identifying the plant status may be used, these are in addition to the existing 'hard' plant status used in CEMSuite; this remains the same and it is only the on conditions that are changed: startup/ shutdown, part load and steady state.

1. Two thresholds on one or more input channels (usually power output or fuel flow). Above threshold one and the plant is in part load operation, above threshold two and it is in steady state.
2. TWO out of three conditions (as Connah's Quay) defines the end of start-up or the beginning of shutdown. A load > nnnMW determines steady state.
3. As type 1, the LPL level, however, may be adjusted if in a special operating mode (as IoG U6).
4. As type 1 but with different start-up and shut down thresholds that define end of start-up and the beginning of shutdown (as Langage).

This list may be added to as different stations define the start/ stop and part load criteria. For CEMSuite, this will be an additional type. New sections are required in the Main.ini to define these conditions, and there is a section for each data group labelled as IED Data – group n in the examples below.

Type 1. Example of two thresholds. In this case, channel 13 is the channel that is receiving the load, and the two thresholds are 300 for steady state and 220 for part load.

```
[IED Data - group n]
IED calc type=1
Channel - 1=13
Threshold - 1=300
Channel - 2=13
Threshold - 2=220
```

Type 2. Example of two out three to define end of start-up or beginning of shutdown. In this case, channel 15 is the load in MW, and the steady state threshold is 240. The three other conditions are: load > 160 (channel and threshold 2), in premix mode (premix logic at channel 19) or the combustion reference temperature is above 82.5C (16 is the temperature channel).

```
[IED Data - Group n]
IED calc type=2
Channel - 1=15
Threshold - 1=240
Channel - 2=15
Threshold - 2=160
Channel - 3=19
Threshold - 3=1
Channel - 4=16
Threshold - 4=82.5
```

Type 3. Example of load/ part load operation, where the unit has a special mode of operation. In this case, channel 13 is the channel that is receiving the load, and the two thresholds are 300 for steady state and 220 for part load. If the measurement at channel 16 (logic) is on (1) then the thresholds 4 and 5 are used for part load and steady state respectively.

```
[IED Data - group n]
IED calc type=3
Channel - 1=13
Threshold - 1=300
Channel - 2=13
Threshold - 2=220
Channel - 3=16
Threshold - 3=1
Channel - 4=13
Threshold - 4=135
Channel - 5=13
Threshold - 5=220
```

Type 4. Example of two thresholds; one for start-up and one for shutdown. In this case, channel 13 is the channel that is receiving the load, and the two thresholds are 110 for start-up switch, and 63 for the shutdown. Note that there is no part load operation for this type.

```
[IED Data - group n]
IED calc type=4
Channel - 1=13
Threshold - 1=110
Channel - 2=13
Threshold - 2=63
```

14 MCERTS REQUIREMENTS

14.1 MATHEMATICAL SPECIFICATION – B3

14.1.1 NORMALISATION – M2: MONITORING OF STACK EMISSIONS TO AIR.

Practically all legislation considers emission levels in terms of mg/m3 at reference conditions (mg/Nm3 for the CEMSuite programs). This is to enable the measurements from similar processes to be compared and assessed under the same conditions and removes the diluting effects of 'tramp' air and water vapour.

These are as detailed in the EA Technical Guidance Note M2 Boxes 3.4 and 3.5

14.1.1.1 OXYGEN

Normally the biggest effect from normalisation is from the oxygen level and this reference level varies between processes:

Gas and Oil:	3%
Coal:	6%
Waste:	11%
Gas Turbines:	15%

This is not an exhaustive list but the reference levels required for most plants can normally be found on their process guidance notes.

CEMSuite uses the following formula to correct for air dilution:

Correction	=	(21 – O_2 Reference Level %) / (21 – Measured dry O_2 Level %)

See EA M2 v11 09/2015 – BOX 3.5

Early versions of M2 used 20.9 on the left-hand side of these equations and early versions of CEMSuite (<=3.07) used 20.95 (the actual ambient O2 level). These differences impart only very small changes to the normalised measurements.

14.1.1.2 WATER VAPOUR

Where measurements are made on a wet basis (i.e. they have not been dried by a chiller or filter before analysis) they should be corrected down to a dry measurement. It is preferable that a dynamic water vapour measurement is required but should this not be practical, a fixed value may be used. The fomula below is used by the software:

Correction	=	(100 %) / (100 – Actual H2O level %)

See EA M2 v11 09/2015 – BOX 3.5

14.1.1.3 TEMPERATURE

The reference temperature is usually 0^0C (273K) for Europe but may be 250C for the Americas. Most gas measurements are already corrected to standard temperature and pressure (STP) and so no correction applies. For dust and other measurements, however, the following formula applies:

Correction	=	(Actual Temperature C + 273) / (Reference Temperature C + 273)

See EA M2 v11 09/2015 – BOX 3.4

Note: The reference temperature is normally 0 (Centigrade).

14.1.1.4 PRESSURE

Most gas levels are reported at STP (see above) and no further corrections apply. For dust and other in-situ measurements however, correction may be required. In such cases the following formula applies:

Correction	=	(101.3 kPa) / (Actual Pressure kPa)

See EA M2 v11 09/2015 – BOX 3.4

14.1.2 AVERAGING

The CEMSuite programs consider the data down to each minute, each minute data point being the average of all raw data within that minute; most systems are set to gather data every 5-10 seconds.

For longer term averages, two averaging bases are provided; a rolling average and a block average. Data during plant off periods (see below) or invalid data are not used when calculating average values. Furthermore, there must be 2/3 of valid data for any given averaging time, i.e. for a one-hour average there must be 40 minutes of valid data while the plant was in operation for the averaged data to be considered valid.

The 2/3 requirement is configurable, but usually set at this level. It is noted that currently this validity threshold is accepted by all parties (EA and customers alike) but is not stated in IED documents; this point has been raised with our contacts and it is hoped that this is clarified during the next release of these documents.

14.1.2.1 ROLLING AVERAGE

A rolling average considers the data on a minute by minute basis; for each and every minute, the average is calculated from the preceding data for the selected average time.

14.1.2.2 BLOCK AVERAGE

Each block average is considered individually for the period; should a 1-hour average be selected then the day will consist of 24 block averages. Each average will end at 59 minutes past the hour.

Average 1	00:00	to	00:59
Average 2	01:00	to	01:59
Average 3	02:00	to	02:59
…			
Average 24	23:00	to	23:59

Should a 30-minute average be used then each will end at 29 and 59 minutes past the hour. As the average builds up during its period, it will be considered valid should 66% of the expected data points be available. So, for a 1-hour average at 00:29, there should be 30 points, so it will be considered valid if 20 minutes or more of valid data points exist.

This requirement is laid down in the Large Combustion Plant Directive – LCPD (1-hour averages) and the Waste Incineration Directive – WID (30-minute averages).

14.1.2.3 NEGATIVE NUMBERS – MCERTS B6.5

Within the averaging routine, negative numbers are not allowed in the resulting average dataset; they are treated as zero values. This will produce a small positive bias to those measurements that usually sit at zero or near zero levels. This is coded into the averaging routine for all pollutant CEMS measurements. Of course, some measurements (for example ambient temperature) do fall below zero, and in these cases, negative numbers are allowed into the total before calculating the average. This selection is controlled within the Boolean Function AllowBelowZero within Lib124.

14.1.2.4 NEGATIVE NUMBERS AND MASS CALCULATIONS

When calculating the mass of pollutants released, typically on an annual basis, the concentration of the gas is multiplied by the flue gas flow rate to produce a value in terms of mg/hour (or second). A factor is held within the software to convert this to a measurement of kg/hr, this is held within the GroupCFG.db as the "Flow x" variable, and may be set individually for each measurement point. Depending upon the units of flow measurement, the following factors are typical:

m3/hr - Factor = 1E-6 (0.000001)
m3/s - Factor = 3.6x10-3 (0.0036)

In all calculations, a negative flue gas flow is set to zero. This is to prevent a negative offset on the flow measurement from erroneously reducing the mass emissions over a long period of time.

Mass data may include or exclude plant start up and shut down. The parameters that determine these plant states are defined as part of the plant and report status within the CEMSuite software.

14.1.3 PLANT STATUS

Legislation requires that the CEMSuite programs must dilute the emission data by using information from plant off periods, i.e. if the plant is not in operation and the analysers are reading zero or near zero, if this data is used the averaged data will be lower. All CEMSuite programs have the ability to use any of the stored measurands or logic signals to drive this status. Typically these will include:

Parameter	Level	Comments
Temperature	~ 120 C	Sometimes too slow to react for use.
Oxygen	18%	Level varies according to process, quick to react.
Power	100MW	66% of minimum stable generation (MSG), Often used.
Flame On	Logic State	Available for most Gas Turbine Systems.

If the plant is deemed to be off, the averages will not be updated and the data not reported.

This information is held within the FuelCFG table and is modified from the CEMCfg program.

14.1.4 PERIODS CONTAINING INVALID & PLANT OFF DATA

Should a short-term average (usually either 30 or 60 minutes) contain Plant ON, Plant OFF, valid and invalid data, CEMSuite will assess the resulting average in the following ways.

Single Conditions:

- Data Valid, Plant OFF >33% = PLANT OFF, VALID
- Data Valid, Plant OFF <=33% = PLANT ON, VALID

Mixed conditions where total VALID and PLANT ON data >=66% will always result in data averages marked as PLANT ON and VALID.

Mixed conditions where total VALID and PLANT ON data <66%:

- Some data invalid during plant on and plant off >=16% = PLANT OFF, VALID
- Data invalid during plant on and plant off <16% = PLANT ON, VALID

The 16% threshold above accommodates analysers that have regular calibrations that may regularly invalidate the measurement for a few minutes. Normally these do not result in lost averages, however when coupled with a start up or shut down it can result in data that is marked as INVALID rather than OFF. Effectively, if the plant was marked as OFF for 16% of the average time (5 minutes for a 30 minute average and 10 mins for a 60 minute average) and there was some invalid data during the plant ON data, the data will be marked as OFF, not invalid.

Note: It will be the measurement at the first channel that will drive the validity for the mixed condition assessment.

14.2 CALCULATED MEASUREMENTS

The CEMSuite programs can provide a display channel that consists of a result of a calculation between one or more measurement channels. As far as CEMComm is concerned the settings at the DSU for this channel are redundant and any number stored at this channel ID will not be visible and overwritten by these calculations. The settings for the calculated channels are held in the 'mastertype' table and exist from 71 to 79; they are examined below.

14.2.1 TOTAL NOX

For most applications the NO or total NOx must be reported in terms of NO2. If both gases are measured the CEMSuite programs can convert the NO to NO2 weight (x1.53 – this value is held in the mastertype table for type 71 – molecular weight field) and then add to the NO2. To set this up at the PC conduct the following:

1. Set a channel to be type 71 (at the PC)
2. Ensure that a type 71 exists in the mastertype with appropriate units etc.
3. Make sure that the NO is type 12 or input type 12.
4. Make sure that the NO is type 15 or input type 15.
5. Set the NONO2NOX flag in the Main.ini.

As NO constitutes the majority of the NOx the validity of the calculated channel is set from the this measurement.

Note: This channel is now redundant at the DSU and can be set to anything; it will be constructed entirely by the CEMSuite programs at the PC.

14.2.2 FLOW

There are several methods of obtaining an estimate of the exhaust gas flow from various parameters on the system:

14.2.2.1 FLOW FROM FUEL OR ENERGY INPUTS (TYPES 75 & 78 – US EPA 40CFR60)

Set a new type in the Mastertype.db as Type 75 or 78. Important parameters: measbase = 0; divider = 1, unit strings = m3/hr. The selection of 75 indicates that the data input into the system should be fuel flow input(s) in terms of kg/s, l/hr etc. The software then uses this information to calculate GJ/hr based on the calorific value for the fuel (see the LCPD manual). Up to three fuels may be used and the channel number for their flow rate is set in FTV1 to FTV3 respectively; setting the value to zero will prevent an addition to the calculation. The program assumes that fuel 1 is for natural gas and fuel 2 is fuel oil.

If the type is set to 78 it is assumed that the input into the system will be in terms of GJ/hr already and no further calculations will be performed; this is a simpler method but demands these calculations are performed elsewhere.

This method returns the flow in terms of m3/hr and has the form:

$$Nm3/hr = GJ/Hr \times 1E9 \times F\_d \times (20.9 / (20.9 - O2\{\%\})) \times 0.932$$

Where:
F_d is the dry F-factor: 2.43 x 1E-7 scm/J for natural gas and 2.47 x 1E-7 for fuel oil. 0.932 is the correction for temperature.

14.2.2.2 SIMPLE FUEL FLOW TO EXHAUST FLOW CALCULATION

It is possible to estimate the flow directly from fuel flow by using a simple constant – normally referred to as q. To use this, set a type number as 79 (in a similar fashion to the example above). The program will then use the factor set in coefficient 7 of the fuel coefficients set in the LCPD program – see the LCPD manual. The data is then normalised for oxygen.

14.2.2.3 FLOW FROM DIFFERENTIAL, ABSOLUTE PRESSURE AND TEMPERATURE (TYPES 76 & 77)

Several manufactures produce an annubar or similar equipment to provide differential pressure (dp) for the calculation of flow. This can be used by setting a type in the mastertype table as either 76 or 77 with suitable unit strings (usually m/s). Depending upon the type of instrument, the dp will either come rooted (type 77) or require rooting (type 76). Correction for temperature and pressure will use the normal channels set up in the CEMCFG program (the GroupCFG). The channel for the dp signal, however, must be defined in FTV3.

14.2.3 WATER VAPOUR (WET & DRY OXYGEN)

Configure the wet O2 at the DSU as a normal O2 input.

1. At the PC set a type within the Mastertype table (70 or 80 something) and use the measurement base 41.
2. Fill the remaining columns so that the divider and decimal places match the DSU for the same measurement but change the units string for the ppm Units to '%O2 wet' and all other unit strings to just '%'. When this channel is processed, unit 1 (ppm) will be the wet oxygen level; all other units will be water vapour level.

The following equation is used:

H2O% = 100 x (Dry O2% - Wet O2%) / Dry O2%

This is described in M2 Table 6.3.3.

14.2.4 CO2 FROM OXYGEN

A simple stoichimetric conversion to produce an estimate of CO2 from oxygen may be used. Conduct the following:

1. At the DSU the channel settings are redundant.
2. At the PC set a type within the Mastertype table (70 or 80 something) and set the measurement base to 11 and all unit strings to '%'.
3. Set the stoichimetric CO2 level in the fueltable FTV1, e.g. 18.7 for coal etc.

The system will now use the oxygen level to provide an estimate of the CO2.

This is for information only and does not affect the reporting of emission data.

14.2.5 INVALIDITY CODES

As shown in the details of the data storage, a byte is stored for the validity of each measurement. A byte consists of 8 bits, if all are set we get FFh (255 decimal) and if none are set we get 00h (0 decimal). These conditions represent NO DATA and DATA VALID respectively. Any condition in between represents a DATA INVALID condition which will depend on the type of measurement or input as to its cause.

This information is held in the TypeInfo table and whatever is entered here is only reflected on the messages for invalid data on the CEMSuite programs; it does not affect how the data is treated at all – invalid data will not be used for any of the averages.

All messages that are seen on the CEMSuite program may be edited from the CEMCFG program.

14.2.5.1 ERROR MESSAGES FROM ANALOGUE INPUTS

The highest 4 bits ($10, $20, $40 and $80) are down to the A/D conversion and represent the following:

$10 – Under range (Only relevant for 2 or 4 – mA inputs).
$20 – Over range (4017 only. 5017 will read full scale).
$40 – Number returned does not represent a number.
$80 – Spare.

The lowest 4 bits ($01, $02, $04 and $08) are down to the A/D conversion and can represent a digital input that invalidates the data. This is set up from the CEMCFG program from the Group channels page – see the DSUCfg manual.

14.3 TRACEABILITY AND AUDITABILITY – B4

This topic is also dealt with as part of the CEMServer Programs – See the CEMServer Technical Manual.

14.3.1 DATA IDENTIFICATION – B4.1

All data will be organised into groups, each group will have a name identifying its origin and will consist of up to 16 measurements. These measurements will be made at a particular location, for example, Boiler 1.

Each measurement will have an identifying name, unique within its group.

See the CEMServer Technical manual for more details on the traceability and auditability of data.

14.3.2 TIME AND DATE OF MEASUREMENTS – B4.2

Measurements will be stored at local time, not UTC. This is judged to be a simpler technique as all industrial plants will use local time to cross-reference events with emission releases. Any errors caused by adopting this time are discussed in the CEMServer Technical Manual (TM05).

14.3.3 MEASUREMENT STATUS HISTORY – B4.3

Analyser status history is stored and checked for every data point (every 7 seconds or so). See section 4.3.2 for more information.

14.3.4 DATA RECORDS B4.4 & B4.5

All data records are stored in their raw formats, i.e. if an analyser measures and transmits its data in ppm, CEMSuite will not convert this to mg before storage with a coded checksum that is checked during all accesses to the database, in case of a mismatch, the operator is informed. Further, the data does not exist in human readable format, so this eventuality is thought to be unlikely.

14.3.5 AUDIT TRAIL

To provide an audit trail, the configuration program will store all configurations in encrypted compressed files and an Audit is available to display all changes between each of these data files.

14.4 STORAGE AND SECURITY OF DATA – B5

14.4.1 PASSWORD PROTECTION – B5.1 / C1.12.3

All CEMSuite programs offer full password protection where appropriate to prevent manipulation to the data and / or the program settings. Three levels of security are provided when necessary; 'Operator', allowing basic program function access, 'Engineer' allowing entering of QAL2 and user enterable parameters and finally 'Superuser' (in-house use only) allowing full program function access and configuration. The CEMSuite PC can also be password protected for overall CEMSuite password protection.

14.4.2 UNAUTHORISED ACCESS – B5.2

Any unauthorised attempts to access password protected CEMSuite programs will be recorded and highlighted the next time an authorised user logs into the system.

14.4.3 SECURITY OF DATA – B5.3

To avoid potential data manipulation, all data strings are marked with a coded checksum. CEMSuite programs monitor this checksum and any deviations will be highlighted to the operator and the measurements ignored. Manual changes to the stored data will be actively discouraged.

14.4.4 DATA CORRUPTION – B5.4 & B5.5

Any corruption will also be reported as a checksum mismatch, this operation is conducted during all reads of the database.

14.4.5 AUDIT TRAIL – B5.6, B5.9, B5.10 & B5.11

An audit trail is provided of all changes to the configuration, auxiliary data (e.g. normalisation reference levels, QAL2 data, etc), which version of the software was used to make the change and which user made the changes. This may be used at any time to examine this information and how it has changed over any period. The period available to audit will cover the complete life of the installation. The audit trail also gives the ability to revert to any previous configuration.

14.4.6 DATA LOCATION – B5.7

CEMSuite identifies all data according to its location and measurement. The CEMServer programs will also identify any Network node, addressing or input numbers – see CEMServer Technical Manual – TM05.

14.4.7 APPLICATION & DATA BACKUP / RESTORE – B5.8

All CEMSuite data is inherently backed up by PC from the DSU and in normal circumstances these are in different physical locations. As the DSU performs the fundamental data logging the PC can be switched off or reformatted without loss of data.

14.4.8 DATA TRANSCRIPTION – B5.12

CEMSuite does not allow any transcription of data.

14.4.9 COMPUTER SECURITY – B5.13

Antivirus and other security programs will be installed to provide adequate security for the operating environment.

14.5 INTERFACES TO MEASUREMENT DEVICES – B6

This is also dealt with in the CEMServer documentation.

14.5.1 LOSS OF DATA

CEMForm will display any loss of data in real-time (CEMForm acts as the interface to other data export programs to provide outputs from processed data). In the calculation of the averages for the reports, all programs check for and never use invalid data and all reporting software can provide an assessment of the availability of all measurands.

14.5.2 TIME AND DATE OF MEASUREMENT – B6.4

All data will be stored against a Date / Time stamp down to the nearest second. The format used is a double word and is suitable until at least the year 2100.

14.5.3 DAYLIGHT SAVING TIME CHANGES

All PCs and DSUs will be set to automatically update the time for daylight saving during March and October. This will produce a 23-hour day towards the end of March when the clocks go forward and a 25-hour day in October. The following will occur for each situation:

23 Hour Day – End of March
Data will exist for only 23 hours of this day. This is within the acceptable data loss for LCPD and WID, which permit 4 hours of missing data for each day for calibration and maintenance purposes.

25 Hour Day – End of October
Data between 1 and 2 in the morning will exist twice; the CEMSync program will average each minute regardless of how many data points fall within it. For this particular hour, it will effectively contain twice as much data as all other hours.

The advantages of storing data at the local time are considered to outweigh the small and infrequent effects of a missing hour and a double hour.

14.5.4 TIME SYNCHRONISATION

Time is controlled by a single computer on the CEMS network. Usually this is a PC and will synchronise the time to all connected CEMS PCs and DSUs – see the CEMServer manual for more details. This lead PC should be time synched to an external source, this is usually by one of the following methods:

1. Internet time server – internet connection required.
2. Radio clock
3. GPS time server
4. Network time server (NTP)

14.6 REPORT GENERATION

14.6.1 REPORTING INVALID DATA – B7.1

CEMSuite programs will not use invalidated data and will only consider an average valid if it contains at least 2/3 of valid information. Further, an assessment of invalid data is also provided for most emission data reports.

14.6.2 ENVIRONMENTAL POLICIES – B7.2

All calculations and presentations relating to Environmental Agency polices are referenced within each program's User Manual and via the program's Help guide.

14.6.3 REPORT / DISPLAY TITLES – B7.3

Official reports generated by the CEMSuite programs allow users to include all official titles provided by the legislative bodies, see relevant manuals.

14.6.4 MCERTS MARKING IN REPORTS – B7.4

In all cases where CEMSuite is installed to produce IED reports, MCerts certified analysers are always installed. The marking of the non-MCerts data in reports is therefore not conducted. Further, the standard EA report formats do not make provision for this and customers always wish to produce a report as true as possible to that suggested by the EA.

14.6.5 EXPORT OF REPORTS AND DISPLAYS – B7.5

CEMSuite programs export all displays and reports faithfully with no loss of any information.

14.7 SOFTWARE INSTALLATION - B9

14.7.1 INSTALLATION – B9.1

CEMSuite is provided on CD-ROM or memory stick with a fully automated installation process. This has been created with 'Install Aware 7 - Release 2' for Delphi.

14.7.2 UNINSTALL – B9.2

An automatic uninstall feature is provided via an option on the Start Menu. Start Menu -> All Programs -> CEMSuite -> Uninstall CEMSuite.

14.8 REPORTING REQUIREMENTS – C1

14.8.1 FORMATS – C1.2

The programs within CEMSuite cover all aspects of the Industrial Emissions Directive (IED), the Waste Incineration Directive (WID), the Large Combustion Plant Directive (LCPD) and the Environmental Permitting Regulations, 2007 (EPR-PPC) enabling the software to acquire, process and report in all the formats users require. Dust is measured by using a Tribo Electric Charge, laser or transmissometer.

14.8.2 AVERAGE GENERATION – C1.4

CEMSuite covers all averages required within the directives and legal drivers and can accommodate average times from 1min to 1 year. This is configured specifically from site to site and will depend upon individual requirements.

14.8.3 EVENTS AND CONDITIONS – C1.9

Through the programs contained within CEMSuite, all the following events and conditions will be able to be identified and reported; Invalid Averages, Plant Status, Maintenance alarms, attempts to adjust stored emissions data, calibration events (both zero and span), CEM operating status and CEM malfunctions.

Also see the CEMServer Technical Manual (TM05) for more information.

14.8.4 DAHS AVAILABILITY – C1.10

All CEMSuite systems are designed for 100% run time to provide the highest level of availability for users. For critical applications, backup systems are also available, see the CEMServer Technical Manual – TM05 for further details.

14.8.5 UNCERTAINTY REQUIRMENTS AND EMISSION LIMITS – C1.11

All emission results may be expressed either with or without the adjustment for uncertainty. This is laid down in LCPD and WID. The following factors are typically used:

CO	-	10%
NOx	-	20%
SO2	-	20%
Dust	-	30%
TOC	-	30%
HCL	-	40%

These factors may automatically be used to correct for uncertainty.

14.9 DAHS HARDWARE REQUIREMENTS – C1.12

Please refer to the CEMServer documentation for the interface details between the computer and the sensors.

14.9.1 PRINTING – C1.12.2

All systems with a CEMSuite installation will have the required hardware to allow users to connect an external printer.

14.9.2 TIMING SYSTEM – C1.12.4

If the CEMSuite PC is not part of a time-synchronised site network, external hardware and software may be used to synchronise the PC time. Envirosoft recommends the use of the Timetools GPS time server for this purpose. Using GPS has proved more reliable than using the Radio clock, where reception is less reliable.

14.9.3 POWER SUPPLY – C1.12.5

All systems with CEMSuite installed can be equipped with an uninterruptible power supply. Where sites have integrated UPS systems, the CEMSuite hardware can make use of these.

15 APPENDIX A – GLOSSARY OF TERMS

AMS: Automated Measuring System (see CEM).
AST: Annual Surveillance Test refer CEN standard EN14181.
CEM/S: Continuous emission monitoring system – the equipment for the sampling, analysis and data reduction of gaseous emissions measurements on a continuous basis.
Drift: Monotonic change of the calibration function over a period of unattended operation, which results in a change of the measured value.
EA: Environmental Agency responsible for England and Wales.
ELV: Emission Limit Value.
HWI: Hazardous Waste Incinerator, refer WID.
ISO: International Standards Organisation – Multinational organisation that develops and publishes measurement criteria and performance standard.
LAU: Environmental Agency Local Authority Unit.
Measurand: Particular quantity subject to measurement.
MID: Method Implementation Document – developed by EA and STA on how to apply standards in the UK.
Precision: Closeness of agreement of results obtained from the AMS.
QA: Quality Assurance.
QAL: Quality Assurance Level.
QAL1: Quality assurance level 1 – AMS as tested to the requirements CEN standard EN15267 or MCERTS CEM system.
QAL2: Quality assurance level 2 – Calibration of an AMS in accordance with CEN standard EN14181.
QAL3: Quality assurance level 3 – On going performance of an AMS in accordance with CEN standard EN14181.
Reference Material: Material simulating a measurand of known concentration of the input parameter and traceable to national standards.
SRM: Standard Reference Method.
SSP: Site Specific Protocol.
SD: Standard Deviation.
Sams: Standard deviation for the for the automated measurement system.
Variability: Standard deviation of the differences of parallel measurements between the SRM and AMS.
TC: Technical committee as referred to in standards organisations e.g. CEN.
TE: Technical Endorsement as referred to in MCERTS performance standard for personnel.
WID: Waste Incineration Directive.

16 DOCUMENT INFORMATION

16.1 MANUAL REVISION HISTORY

Revision Number	Date	Summary of Changes	Author
v1.01	14/12/07	New Manual	R Grant
v1.02	30/09/09	Format Change	R Grant
v1.03	13/04/11	Update to include common code library and additional measurement types	P Swindell
v1.04	17/12/11	Information on the processed data files and the ability to edit the report data.	R Grant
V1.05	1/1/12	General tidying	R Grant
V1.06	5/5/12	Addition of rules for averages that contain a mixture of invalid and plant off data New section detailing switched analyser systems and their configuration	R Grant
V1.07	08/04/13	General Update	P Swindell
V2.00	01/02/14	Content Update	P Swindell
V2.01	29/08/18	General additions & minor corrections	R Grant + P Swindell
V2.02	17/10/18	Minor additions. Mcerts req section expanded.	R Grant

16.2 APPROVALS

This document requires the following approvals:

Name	Title
R. Grant	Managing Director
R. Swift	Technical Manager