Data Acquisition and Handling System for CDM/JI Projects

The Kyoto Protocol introduced two project-based mechanisms: the Clean Development Mechanism (CDM) and Joint Implementation (JI). These instruments were designed to lower the overall cost of participating countries in meeting their domestic emission reduction targets and to help developing countries and countries in transition in their sustainable development by encouraging technology transfer.

This will focus on the CDM as laid out in Article 12 of the Kyoto Protocol. The CDM grants Annex I parties the right to generate or purchase emissions reduction credits from projects undertaken within non-Annex I countries. In exchange, developing country parties will have access to resources and technology to assist in the development of their economies in a sustainable manner.

One of the most important requirements for CDM/ JI project validation by UNFCCC is the evidence of correctness in data collection, evaluation and result calculation. To fulfil these requirements in detail, DURAG data system has developed the system D-EMS2000CDM.

The system D-EMS 2000CDM has been certified by TUV Germany and assures, due to its specially developed software, fulfilling the require ments of UNFCCC for CDM/ JI projects. In the system D-EMS 2000CDM all necessary statistic evaluations are done for various approved methodologies (AM) (e.g. AM0021, AM0028, AM0034, ACM0001, ACM0009, AMS-3.B, AMS-3K, further methodologies are in the pipeline)

The system D-EMS 2000CDM operates under Windows. It is network compatible and has all features of a modern software product able to communicate. The system has a modular structure and offers the possibility of implementing most diverse user specific solutions. It is therefore worthwhile to be applied not only for complex systems, but also for the smaller ones. (Figure 1)

The hardware consists of the Data Communication Units D-MS 500 KE, a 19" rack unit with 3 hu, connected via Ethernet network or RS485 serial connection to the D-EMS 2000 system workstation. Data to be measured can be connected hardwired (4-20 mA) or by Modbus/ Profibus to the D-MS500KE. All calculations, storages and representations are performed in the D-EMS 2000 system workstation.

Main data storage will be on the system workstation in a Raid1 or Raid5 package and optionally on an external hard disk or on a server in the customer's data network.

For proper calculation according to the approved methodologies all data will be stored parallel to the original data base in a redundant data base with correction function. If incoming data as well as parameterised values are incorrect or not available, the operator can substitute these manually with the correct values (commentary of reasons of substitution required). For correct statistics campaigns can be recalculated after value correction during campaign processing or after the end of the campaign as often as necessary. Start and end time respectively amount of nitric acid production (NAP) can be set for each recalculation.

The D-EMS 2000 System Workstation (SW) consists of a 19" industrial or standard pc, operating system Windows XP and 17" monitor/ keyboard/ mouse. The software D-EMS 2000CDM is available in 17 languages. Optionally the pc can be equipped with a GPS time receiver to synchronise all components of the system with the local time.

The data communication unit D-MS 500KE has an internal ring memory of 16 days (expandable up to 32 days). If there is a problem with the system workstation D-EMS 2000SW or the connection to it, no data will be lost within this time. After reconnection, all stored raw values in the D-MS500KE (analogue and digital) will be delivered automatically to the system workstation and all calculations, statistics as well as the protocols will be generated correctly in the right order.

The measured and calculated data will be stored over a freely selectable period of several years and can be displayed in bargraphs, time chart diagrams or as simple logs for each baseline, project line and entire campaigns. A special "Cross Check Module" for the stored data allows an effective working of the UNFCCC verifier.

For information of persons in charge all current and historical data as well as the protocols can be transferred to a server in the internet. So it will be easily possible, even if the person is outside, to get detailed information about current and historical values as well as all protocols by using internet explorer. For data protection username and password are required.

Within the last 3 years Durag data systems GmbH has finished 47 projects worldwide with systems D-EMS 2000CDM for data acquisition, evaluation and complete statistics in CDM and JI projects. Most of them have been realised in fertiliser plants, and have already been verified by a DOE (Designated Operational Entities, designated by COP/MOP).

Hereafter exemplified is the system D-EMS2000 in a CDM project acc. to methodology AM0034 (Fertiliser plant Figure 2).
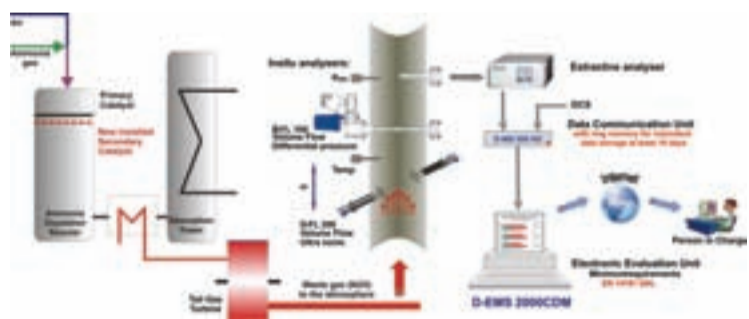

Figure 2: Principle of D-EMS2000 in a project acc. to AM 0034

Nitric Acid (HNO_3) is produced through the oxidisation of ammonia (NH_3) on precious metal catalyst gauze in the ammonia burner of a nitric acid plant. Nitrous Oxide (N_2O) is a by-product gas produced in the manufacture of nitric acid. It is typically released into the atmosphere, as it does not have any economic value or toxicity, but it has a high global warming potential (1 tonne of N_2O is equivalent to 310 tonnes of CO_2) which increase the global warming.

The methodology AM0034 covers project activities involving baseline emissions before installation of a dedicated N_2O abatement catalyst and project line emissions after the installation of the catalyst inside the ammonia burner of a nitric acid plant.

During the project activity, the measurements of N_2O, total flow rate and operational parameters are carried out on a continuous basis and new emissions factors are established for each project campaign.

The software module D-EMS 2000CDM34 has been developed to do all statistic evaluations according to the methodology AM 0034. The requirements of EN 14181 concerning QAL3 will be fulfilled by the software module D-EMS 2000QAL.
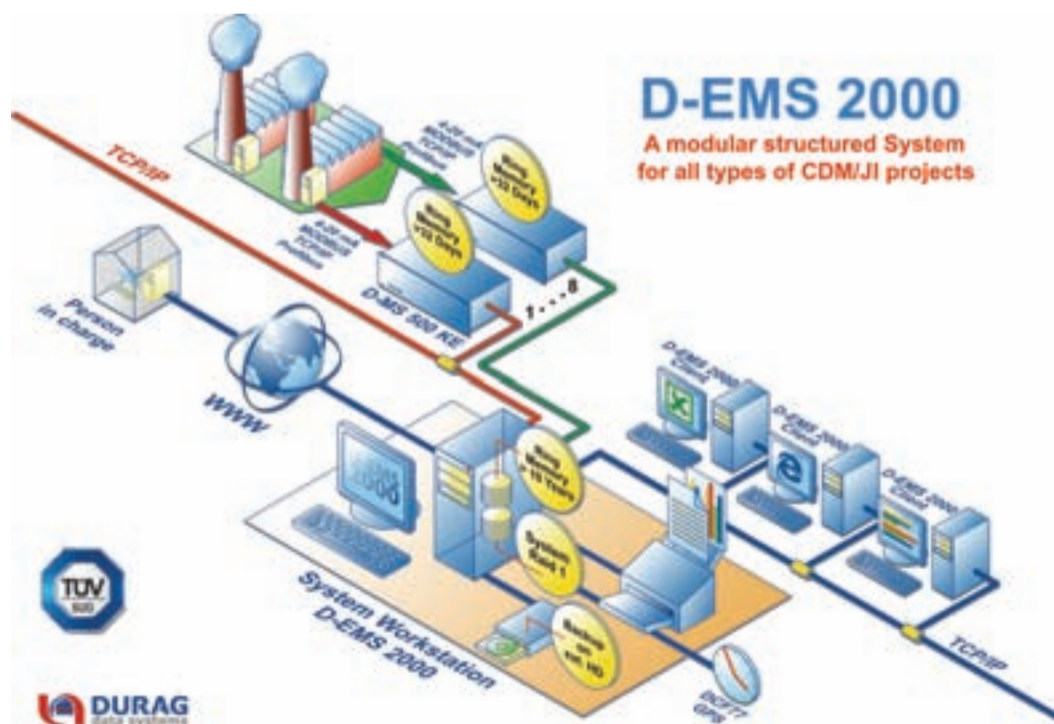

Figure 1: System D-EMS 2000CDM

All incoming data will be scanned every second and used to build the one minute averages. For detailed information of DOE the 1-second values can be long-term stored by help of the module D-RWS.

The one minute values are stored in one consecutive original data base for Base line and one consecutive original data base for Project line campaigns.

Baseline emissions are determined by measuring N_2O concentration and total flow rate in the tail gas of the nitric acid plant. These measurements are used together with the amount of NAP to determine a plant-specific baseline emissions factor ($tN_2O/tHNO_3$).

Permitted ranges for parameters that influence the level of N_2O formation (B10-ammonia flow rate, B12-ammonia-air ratio, B16-oxydation temperature, B18-oxydation pressure) are established from historical campaigns to define the permitted ranges for which emission reduction credits can be claimed during the crediting period. 1-minute averages outside the permitted ranges will be automatically sorted out by the software D-EMS2000CDM from the calculation of emission factor. A detailed statistic about 95% confidence interval, campaign average and daily availability of operational parameters will be performed and represented in the software D-EMS2000CDM (Figure 3 and 4)

With the D-EMS2000CDM software the hourly averages will be calculated using the 1-minute averages, considering a freely selectable quorum. In case of downtime of the analysers (N_2O, Volume flow), the emission factor for this hour will set to the lowest between the conservative IPCC (4.5 kg N_2O / ton nitric acid) or the last measured value for the baseline campaign, and the highest measured value in the entire campaign for the project campaign.

Figure 3: Graphical representation of operational parameters (green bargraphs represent current value)
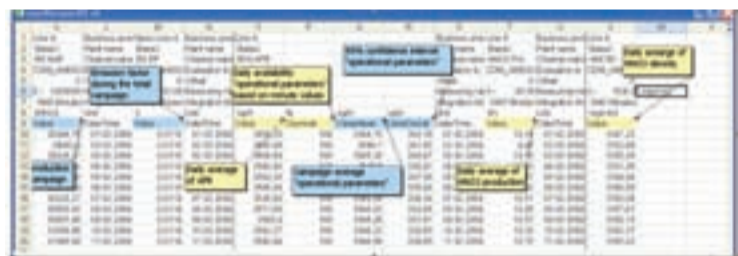

Figure 4: Details of operational parameters in an Excel-file

To avoid mavericks and to ensure a conservative approach, the following statistical evaluation will be applied in the software D-EMS2000CDM to the complete data series of N_2O concentration as well as to the data series for gas volume flow.

$$s = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(X_i - \overline{X})^2}$$

The cumulated 95% value will be calculated and stored in the system automatically after the end of each hour, so it will be possible to eliminate data if the baseline campaign is longer than the project campaign

The status in-/ out of operation of the plant should be provided by the DCS as a digital signal or could be derived from the operation parameters like flow, temperature and/ or pressure automatically by the system D-EMS 2000.

The emission reductions (ER) for the project activity over a specific campaign are determined by deducting the campaign-specific emission factor (EFP) from the baseline emission factor (EFBL) and multiplying the result by the production output of 100% concentrated nitric acid (NAP) over the campaign period and the GWP of N_2O (310):

ER = (EFBL – EFP) * NAP *GWPN2O (tCO$_2$e)

The emission reduction as well as the details of baseline and project line will be calculated automatically in the system D-EMS 2000CDM and recorded in protocols. All protocols are historically available in pdf and csv-files for representation and download. (Figure 4, 5 and 6)

Figure 5: Selection screen for all types of protocols

Figure 6: Example for campaign report

Summary

- Durag data systems has developed the system D-EMS2000CDM with special software to make evaluation and all statistics for CDM/ JI projects more easily
- Durag data systems software fulfils the requirements of UNFCCC methodologies e.g.
  • Continuous controlling of permitted operation parameters
  • Elimination of values if operational parameters are outside the permitted range
  • Graphical and numerical presentation of availability and 95% percentile of operational parameters
  • Automatically substitution of Emission Factor, in case of downtime of analysers, by lowest/ highest between the conservative IPCC and the last measured value
  • Statistical procedure to eliminate mavericks and other extreme values
  • On-line calculation of campaign availability
  • Automatic correction of campaign length if current campaign length is longer/ shorter than historical campaign length
  • Consideration of leakages if required
- Durag data systems software has special features
  • All data will be stored in 2 redundant consecutive data bases with correction function for modifying of implausible or unavailable values
  • Additional raw value storage in the Data Communication Unit (interface to the process) for bridge over temporary out of operation periods of evaluation pc with automatic procedure to do all statistics after reconnection without any gap
  • Recalculations of previous campaign results during current campaign processing
  • Opportunity of data migration from DCS for calculation of historical Baselines or manual data entry of conservative Baseline EF
  • Presentation of all measured and calculated values on-line in the Internet
  • Providision of all calculated and measured values in Excel and pdf file
  • Fulfils the requirements of EN 14181 incl. continuous check of drift and precision (QAL3)
- Durag data systems software has been approved by TUV Sud Munich and guaranties correct evaluation and statistics for CDM/JI project

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