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First of all:

VERY GOOD MORNING!

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FLUE GAS MONITORING

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WHY MONITORING AT ALL??

If we don't know "what and how much", we don't know "how to reduce it"

- **Emission Monitoring documents the efficiency of Emission Control Activities**

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REGULATIONS

There are basically two blocks of regulatory approach:

- **U.S.A.**
  - **US-EPA regulations are laid down in 40CFR60 and ASTM's**
  - **Instruments cannot get type-approval – there is no scheme like that in USA**
  - **Extensive site testing after installation is required**
- **EUROPE**
  - **European regulations are laid down in EN's as well as country-specific laws and regulations, f.e. in Germany: TA-Luft, BImSchG, and BImSchV 1 – 45**
  - **Instruments have to successfully complete type-approval ("TUEV-Test, MCERTS") = QAL 1**
  - **Extensive site testing after installation is required = QAL 2**

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What is it we are interested in?

There are plenty of pollutants we can / have to measure:

- **Particulates:**
  - **Total Dust or Opacity, Heavy Metals**
- **Inorganic Compounds:**
  - **CO, CO_2, SO_2, NO/NO_2/NO_x, NH_3, HCl, HF, Total Hg**
- **Organic Compounds:**
  - **THC, Dioxins & Furans**

- **Reference Values:**
  - **O_2, H_2O, Temperature, Pressure, Gas Velocity / Flow**

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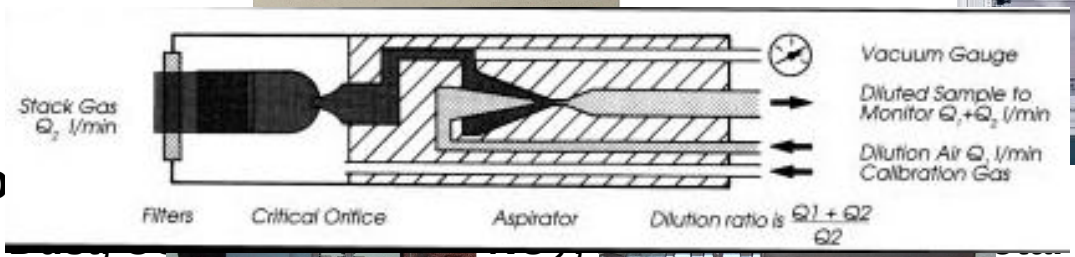
CEMS DESIG

- CEMS (Continuc onitoring Syste designed in thre s (or a combina between them):
  - ☐ Direct In-Situ
    -
  - ☐ Co
    - Hg, THC, Di Sampl
  - ☐ Dilution-b ve Ar
    - Dust, SO_2, NO, NO_2 , NO_x, Total Hg



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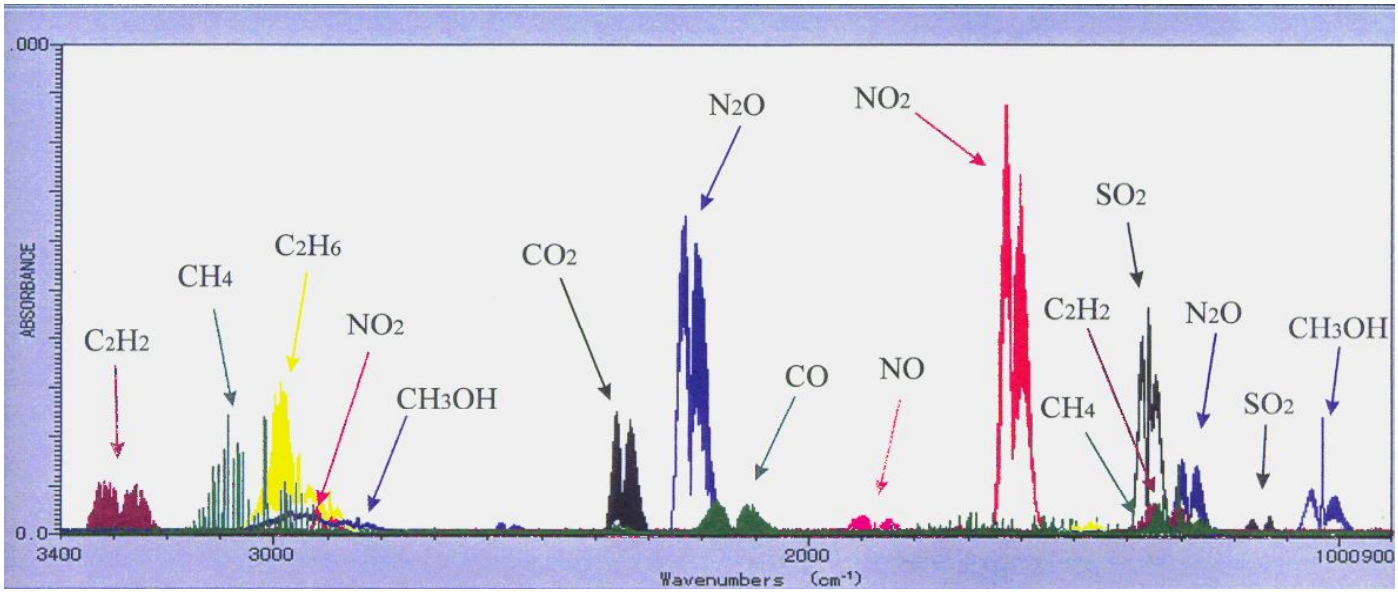
Gas Measurement in the Infrared



Many gaseous pollutants show absorption band(s) in the infrared

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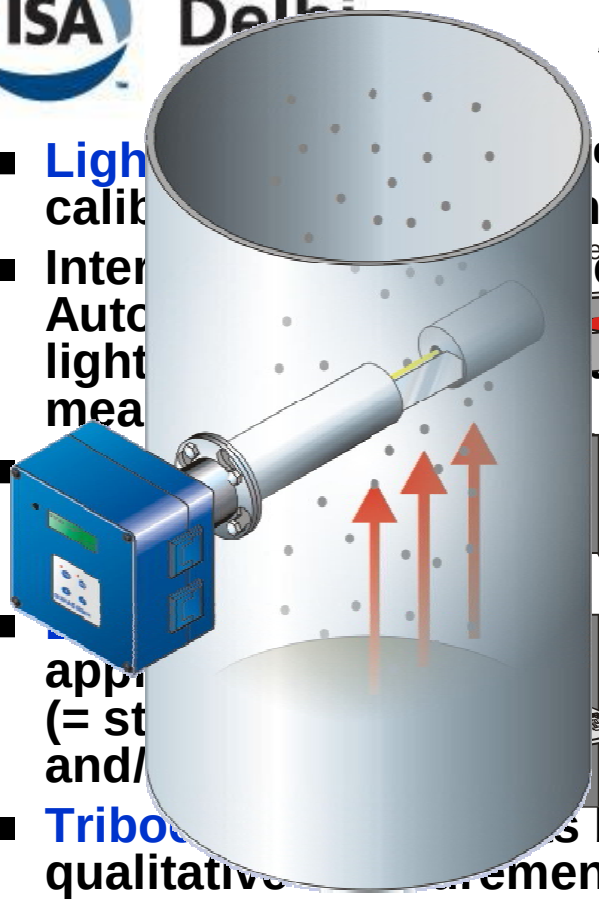
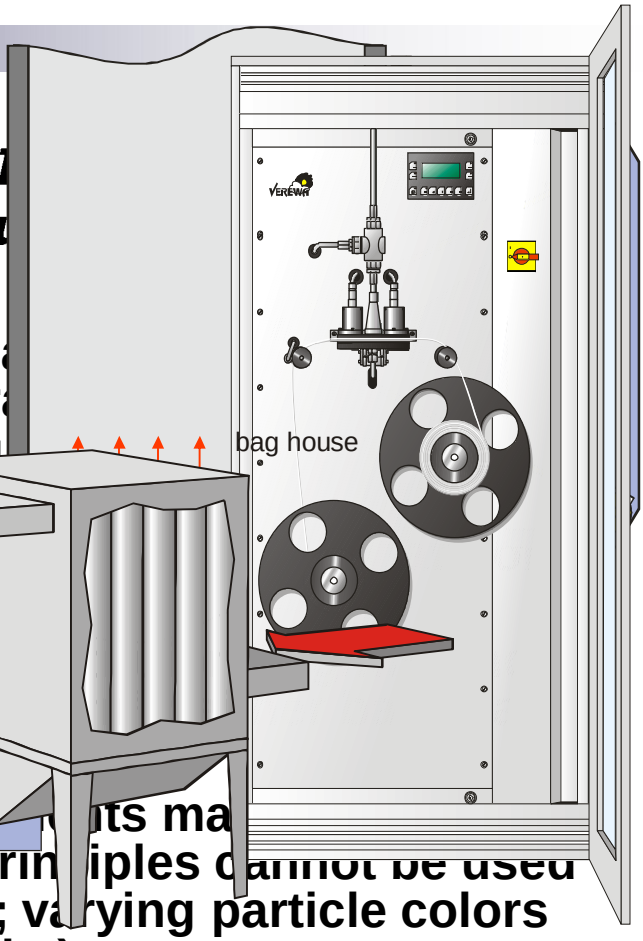
OTHER DETECTION TECHNOLOGIES for gas measurement

- **UV-Absorption is used for a number of pollutants like NO and NO_2**
- **Chemiluminescence is used for NO, NO_2, NO_x**
- **FTIR Spectrometry is used as Multicomponent Analyzer**
- **Flame Ionization Detector (FID) is used for Total Hydrocarbons (THC)**
- **UV-Photometrie or CVAFS, together with sample preparation, are used for Total Mercury**
- **ZrO_2 probes are used for O_2**

DETECTI… for du…





- Ligh… %-Opa… calib… ncentra…
- Inter… epted… Auto… light… mea… h…
- t…
- …nts ma… app… ical prin…iples cannot be used (= st… point; va…ying particle colors and/… density)
- Tribo… …s broken bag filter detector – qualitative …rement

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ADVANTAGE / DIS-ADVANTAGE
IN-SITU

- **No sample transport – gases / dust are analyzed in their stack environment**
- **Typically Multicomponent Analyzers – reduction on space and accessories**
- **Unknown / Unexpected interferences possible – difficult to consider during calibration**
- **If a key component fails, the whole Multicomponent Analyzer is down**
- **Sensitivity might be depending on available pathlength (stack diameter)**

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ADVANTAGE / DIS-ADVANTAGE
CONVENTIONAL EXTRACTIVE

- **Relatively simple way of calibrating the entire CEMS**
- **With individual analyzers: typically no common breakdown possible; Multicomponent Analyzers – reduction on space and accessories**
- **Requirement of A/C instrument shelter**
- **With Sample Gas Chillers: probability of loss of components; with High Temperature Systems: probability for higher maintenance and service**
- **Accuracy of measurement depending on quality of sample handling and sample transport – *THE SAMPLE HANDLING PART IS OFTEN NOT PROFESSIONALLY DESIGNED!***

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ADVANTAGE / DIS-ADVANTAGE
DILUTION EXTRACTIVE

- **Relatively simple way of calibrating the entire CEMS**
- **Dilution reduces interferences from inappropriate sample handling**
- **With individual analyzers: typically no common breakdown possible**
- **Requirement of A/C instrument shelter**
- **Ambient Air Analyzers with lower LDL required = typically more expensive**
- **Accuracy of measurement depending on stability of dilution; Critical Orifices are sensitive to inlet-pressure changes**
- **Typically not possible to perform dry-basis-measurement, complex to report dry-basis values**

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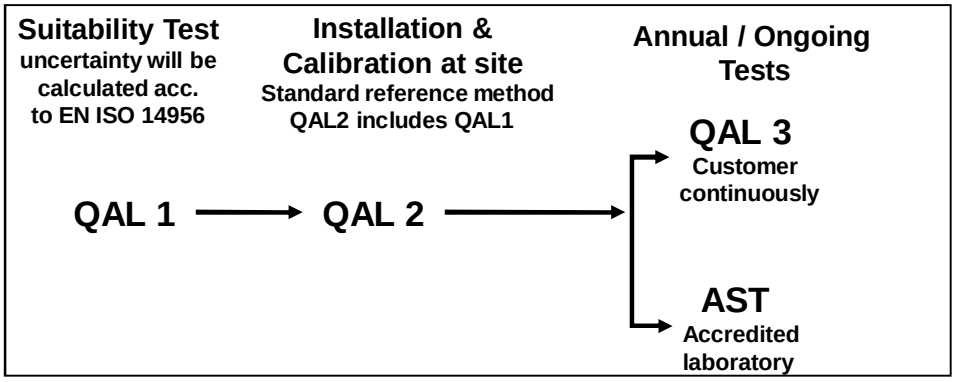
QUALITY ASSURANCE 1

- **USA:**
  - **Quality and Accuracy of CEMS measurements are assured by extensive site acceptance tests after installation and by annual reference calibrations from accredited laboratories**
- **EUROPE:**
  - **Quality Assurance of any CEMS is acc. to EN 14181 and following the QAL-scheme:**



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QUALITY ASSURANCE 2
EUROPE

- **QAL 1 is the „TUEV-Test“ (Germany) or MCERTS (UK) – an *instrument type approval*. In Europe only instruments having successfully passed QAL 1 are allowed to be used for statutory monitoring. Approvals can expire or be revoked.**
- **QAL 2 is an extensive site acceptance test after installation, performed by an *accredited laboratory or agency*. Testing is for quality of the installation, sample handling, as well as accuracy of the instrumentation. Only QAL 1 approved instrumentation is allowed. QAL 2 to be repeated every five years.**
- **QAL 3 is the ongoing daily quality assurance (zero & span checks, regular maintenance), performed by the *user.***
- **AST – Annual Surveillance Test - is a short QAL 2 test to be performed annually by an *accredited laboratory or agency*. If AST fails, the instrumentation has to be rectified and immediately a complete QAL 2 test is required.**

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WHY MONITORING AT ALL?

Predictive Emission Monitoring Systems (PEMS) offer an alternative to CEMS:

A PEMS is a software based data acquisition system that is interfaced with the process control system and inputs from the combustion or pollution control process.

It utilizes these inputs to determine the emission rates of the various pollutants that are regulated.

The predictive emissions monitoring system has no gas analyzers.

No Existing CEMS on Site for Data Collection

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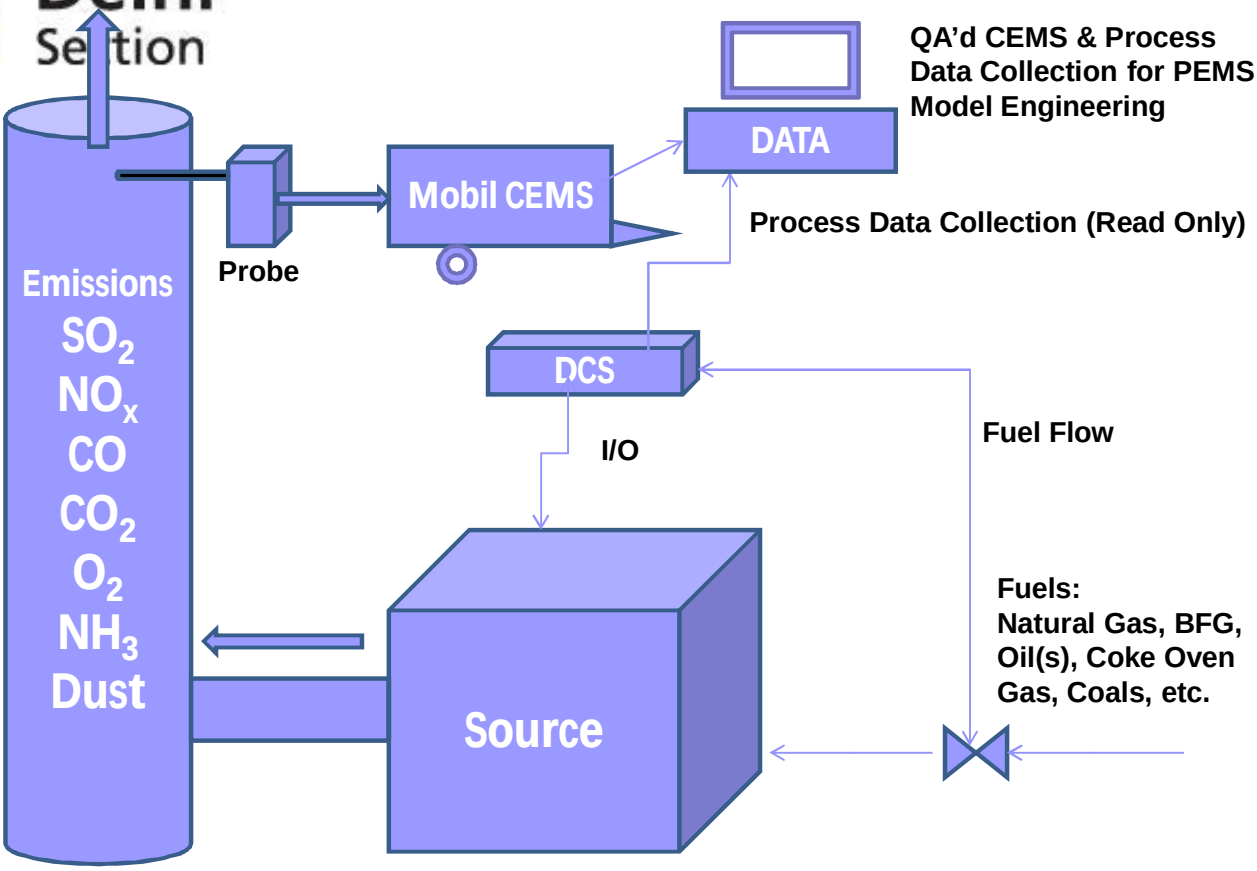

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PEMS Capital and O&M cost

- **PEMS vs. CEMS Quality Assurance**
  - **Costs app. equivalent**
- **PEMS vs. CEMS Initial Capital Costs**
  - **App. 50 – 70% of CEMS**
- **PEMS vs. CEMS Operational Costs**
  - **App. 10 – 30% of CEMS**

PEMS is in accordance with US-EPA and European Regulations and is already successfully used. PEMS seems to offer an interesting alternative to conventional emission monitoring.

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AMBIENT AIR / AIR QUALITY MONITORING

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WHY MONITORING AT ALL??

Air Quality Monitoring gives assurance / information about the quality of the air we breathe.

- **Air Quality Monitoring can be used (based on local regulations) to cut back temporarily on emissions from factories.**

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COMPONENTS / CONCENTRATIONS

- **Particulates: TSP, PM-10, PM-2.5, PM-1.0**
- **Gases: O_3, SO_2, NO/NO_2/NO_x, CO, TOC-CH_4**
- **Meteorological Data: Wind speed & -direction, Temperature, Pressure, Precipitation Quantity**

- **Ambient Air Concentrations of Pollutants are typically by the factor 1000 lower compared to emission Concentrations. This requires different type of detection systems.**

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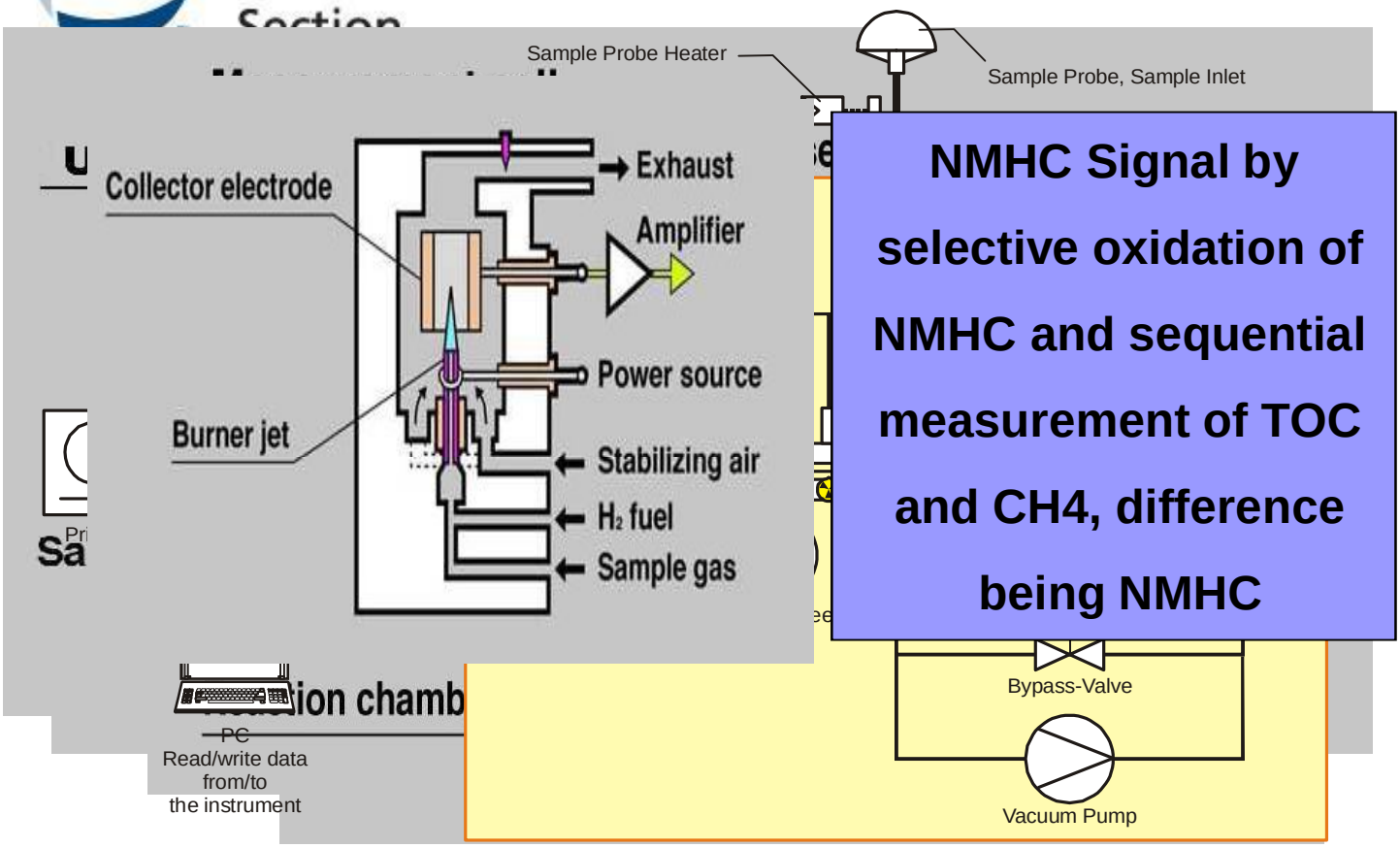
Detectors



NMHC Signal by selective oxidation of NMHC and sequential measurement of TOC and CH4, difference being NMHC

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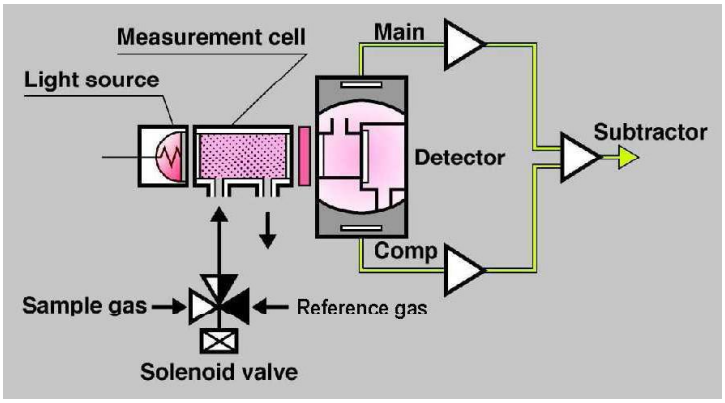
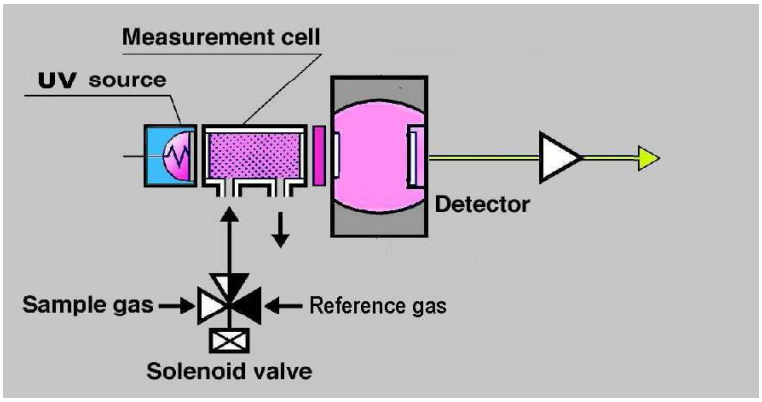
CO / O_3





IR Detector for CO

UV Photometer Detector for O_3

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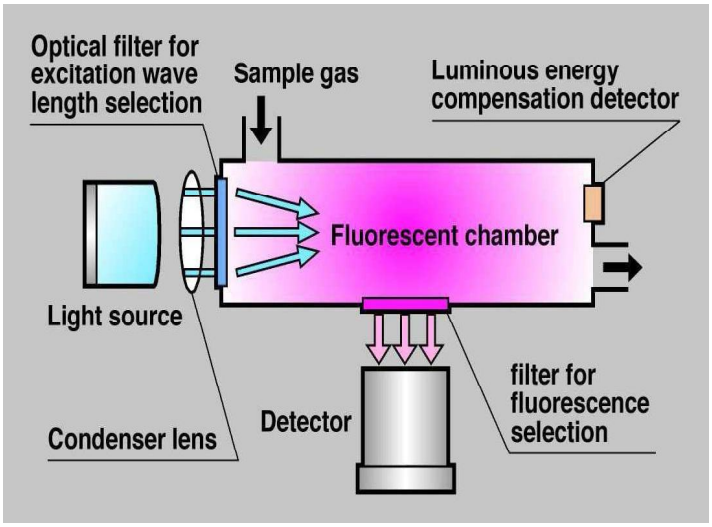
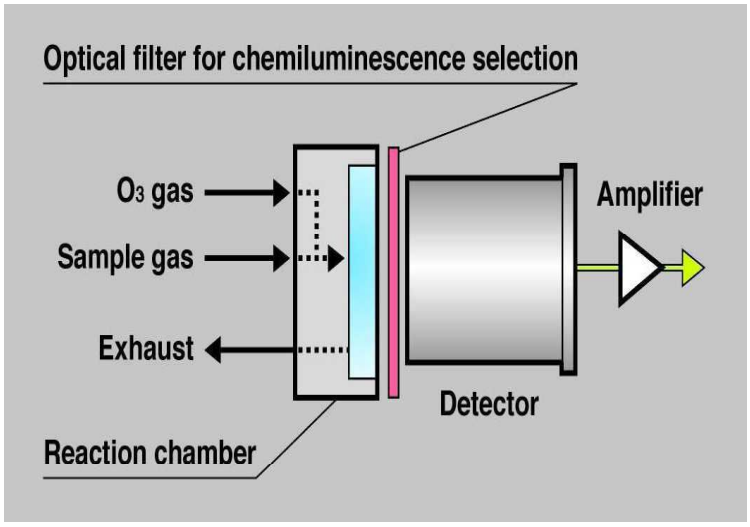
SO_2 / NO-NO_2-NO_x



UV Fluorescence Detector for SO_2



Chemiluminescence Detector for NO-NO_2-NO_x

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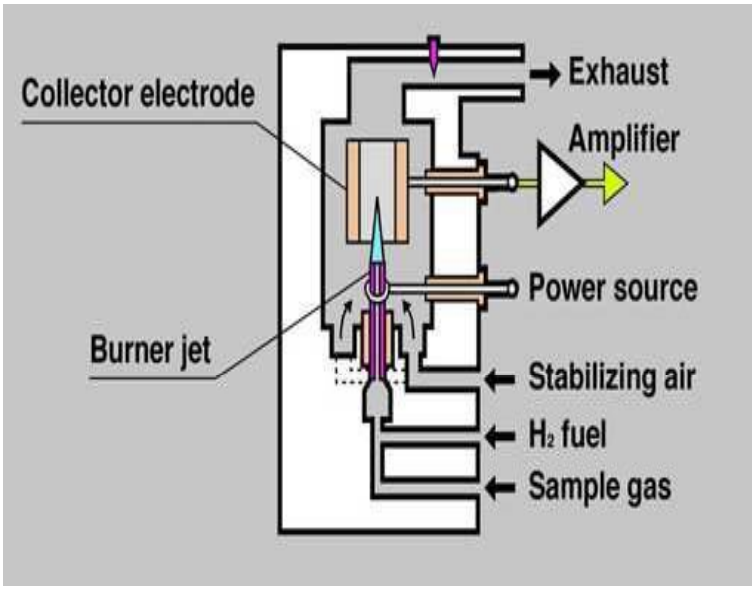
NMHC (= TOC-CH_4)



FID Detector for TOC

NMHC Signal by selective oxidation of NMHC and sequential measurement of TOC and CH4, difference being NMHC

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MONITORING STATIONS

Historically Air Quality Monitoring Stations where / still are quite bulky and have a significant footprint and requirement of power supply

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MONITORING STATIONS COMPARISON

„conventional“
Monitoring Station
or Mobile Station

Street-
Monitoring Station
or Trailer-mounted

airpointer

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AMBIENT AIR MONITORING NEW APPROACH

- **Various companies have already designed or are in the design-phase of compact monitoring stations with miniaturized detectors**
- **New detection technologies (gas-sensing semiconductors) are being developed – this will lead to lower cost solutions of ambient monitoring – up to now these new detectors are not approved yet**

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FINAL CONCLUSION

Big Question:

WHAT IS THE RIGHT INSTRUMENT FOR ME???

Simple Answers:

- **All type of approved Analyzers are mature instruments.**
- **Correct Sample Handling for extractive Emission Monitors is essential for an accurate analysis.**
- **In-situ instruments are not always the better way to go!**
- **Not monitoring but Predicting might provide less headaches.**
- **Air Quality Monitors and Stations will become smaller (and lower cost) in the future.**

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FINAL CONCLUSION 2

The purchasing process takes little time in comparison to the time you have to life with the instrumentation. Therefore:

- **Select instruments which are Internationally approved.**
- **Support and Service, AMC's and Spare Parts Inventory, Manufacturer's Service Personnel in the country or Manufacturer-trained personnel are essential for a hassle-free operation.**
- **Purchasing requirement must always include at least 2 years of consumables, spare parts, and AMC – this way it is ensured that quality instrumentation is offered.**
- **Try to avoid purchase only based on "L1", base it on technology!**
- **For larger installations even a BOT scheme could be of interest.**

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THANK YOU

Credits for providing information for this presentation are going to the following companies:

HORIBA

ABB

OMC Solutions

OPSIS

VEREWA

recordum

DURAG GROUP

ISA Delhi Section

AND FINALLY:

THANK YOU TO YOU FOR LISTENING!

I &C Online Training Portal

PRESENTATION BY:
Ashok Kr. Panda,
HOD-C & I
LANCO INFRATECH LTD.

Crucial role of Control & Instrumentation in Power Sector

- Process instrumentation and control (I&C) typically represents 8-9% of the cost of an average Power project.

- It's a high-tech discipline critical to the success and survival of a Power plant and yet is typically not given major emphasis.

Lack of C & I Know How

- In today's economic climate, any shutdown caused by an instrumentation or control failure extracts an exceptionally very high price.

- Responding correctly to emergencies is not only a requirement for operators, but for other critical plant personnel as well.

Well Versed Staff – Challenge to Power Industry

- Power Industry Growing Tremendously
- Experienced Staff is Limited and Retiring
- Young & Untrained Staff Assuming Responsibility
- Lack of Experience Leads to Wrong Decisions and expensive Corrections.

In many, Large end-user companies many long-term Process Experts and Instrumentation Engineers, with deep and intimate knowledge of key equipment and processes, are leaving jobs and becoming “Independent Contractors” .

On Job Training – Way To Form A Well Versed Staff

- The opportunity for I&C Engineers and Process personnel to get ON-JOB training is invaluable. Good Design Practices and Training can Reduce Errors that could Potentially Lead to Failure.

Training Methods

- Onsite Training On Simulator
- Face to Face Training Programs by Experts.
- Online Training Portal.

On Line Training Portal

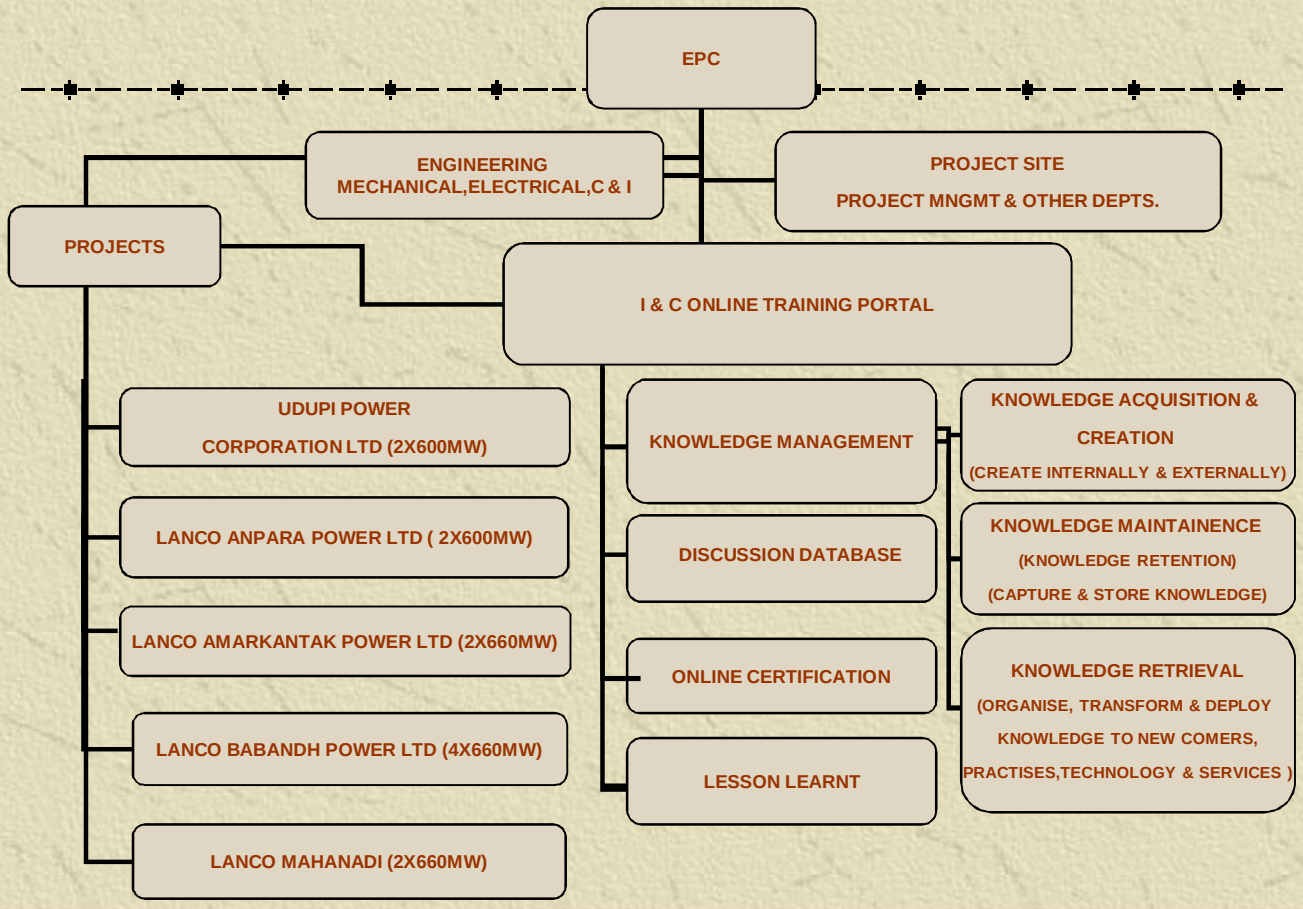
- The minimum requirements for e-learning are an Internet connection, a computer, and access to an e-learning provider on the Web.
- This approach provides training without the Employee having to travel — keeping the personnel on site.
- The I&C programs are applicable to technical personnel of any field coming from a setting in which they can apply the knowledge learned .

Key Features

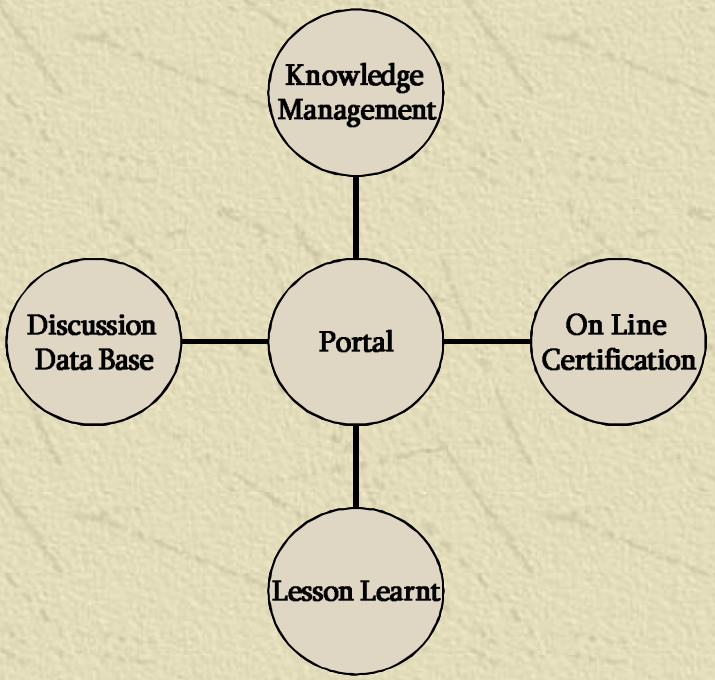
- Efficient & Economical
- Staff Can Learn while remaining at office Base.
- Learning at a relatively convenient pace.
- Online I&C Certificate lets an employer avoid the lost time ,travel expenses and confirm the Acquired Knowledge.

Therefore -The Fastest, Easiest and Most Inexpensive

Organizational Memory Structure



On Line Training Portal - Concept



Knowledge Management

- Identification of Legends and Symbols used for I&C and Process
- Basic Know-How of Field Instruments.
- Importance of discrete and continuous control loops in a Power Plant.
- Concepts and Implementation of alarm and Trip Systems
- Codes & Standards

Knowledge Management

- Basics of Automation Systems – DCS, PLC, Relay Panels etc.
- Designing of Good Operator Interface & Room Layouts
- DCS/PLC Configuration & Functional Grouping
- Basics of PID controls and Controllers
- P&IDs and Process Interfaces.

Knowledge Management

- Quality Procedures as per Latest IEEE standards
- Installation, Hook-Ups as per Latest Standards
- Asset Management Solutions
- Control Valve sizing and Flow Elements
- Latest Trends in Smart Instrumentation - HART,Profibus, FieldBus etc.
- Cable Tray layouts & Raceways
- Interconnection and Cable Schedules

Discussion Database

- For a company who's business consists of High Tech projects, the most important general deliberation is about: "Have we already done this before? Who worked on it? Can we improve the quality and efficiency of our Team members?"