MANUAL

ON-LINE PROCESS STREAM ANALYSIS - ANALYSER HOUSES

DEP 32.31.50.13-Gen.

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DESIGN AND ENGINEERING PRACTICE

PREFACE

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Shell International Exploration and Production B.V. (SIEP)
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The Hague, The Netherlands,

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The objective is to set the recommended standard for good design and engineering practice applied by Group companies operating an oil refinery, gas handling installation, chemical plant, oil and gas production facility, or any other such facility, and thereby to achieve maximum technical and economic benefit from standardization.

The information set forth in these publications is provided to users for their consideration and decision to implement. This is of particular importance where DEPs may not cover every requirement or diversity of condition at each locality. The system of DEPs is expected to be sufficiently flexible to allow individual operating companies to adapt the information set forth in DEPs to their own environment and requirements.

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1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for the design, construction and climatic conditioning of analyser houses.

This DEP is a revision of the DEP with the same number dated December 1986.

Further definition of the scope of this DEP is given in section 2.2.

Excluded from the scope of this DEP is the design and construction of premises not having an artificial means of maintaining a non-hazardous area, such as walk-in shelters for analyser systems. The design of such premises and their analyser systems shall comply with IP 15 (The Institute of Petroleum Model Code of Safe Practice, Part 15).

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by SIOP and SIEP, the distribution of this document is confined to companies forming part of the Royal Dutch/Shell Group or managed by a Group company, and to Contractors nominated by them (i.e. the distribution code is "C" as defined in DEP 00.00.05.05-Gen.).

This DEP is intended for use in oil refineries, chemical plants, gas plants and, where applicable, in exploration and production facilities and supply/marketing facilities.

If national and/or local regulations exist in which some of the requirements may be more stringent than in this DEP, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable as regards safety, environmental, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this DEP which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned with the object of obtaining agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party which carries out all or part of the design, engineering, procurement, installation, and commissioning or management of a project or operation of a facility. The Principal may sometimes undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party which manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party which initiates the project and ultimately pays for its design and construction. The Principal will generally specify the technical requirements. The Principal may also include an agent or consultant, authorised to act for the Principal.

The word **Shall** indicates a requirement.

The word **Should** indicates a recommendation.

1.3.2 Specific abbreviations and definitions

Alarm	an audible and/or visible signal to warn that appropriate action is necessary.
Analyser House	a building with a specific closed room containing one or more analysers, which may be connected to a process installation, together with associated electrical equipment and auxiliary devices.
NOTE:	Laboratories are not included in this definition.
Artificial Ventilation	a method of mechanical movement of air to reduce the potential concentration of flammable gases or vapours in the analyser house. Such ventilation may also be used to maintain the pressure inside the analyser house above or below the external ambient pressure.
CCR	Central control room or its auxiliary room
FAR	Field auxiliary room
Instrumented Protective Function (IPF)	A function comprising the Initiator function, Logic Solver function and Final Element function for the purpose of preventing or mitigating Hazardous Situations.
Lower Flammable Limit (LFL)	the volume ratio of flammable gas or vapour in air below which an explosive gas atmosphere will not be formed.
PGC	Process Gas Chromatograph
Purging	the operation of passing a quantity of a protective gas through a room and its associated ducts in order to reduce to a safe level any concentration of flammable gas or vapour which may be present.
Upper Flammable Limit (UFL)	the volume ratio of flammable gas or vapour in air above which an explosive gas atmosphere will not be formed.
Ventilation Failure	a situation where the required air flow and, if applicable, the required pressure cannot be maintained.
Ventilation System	the complete installation required to produce artificial ventilation.

1.4 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section is shown in brackets. Other documents referenced by this DEP are listed in (13).

2. GENERAL

2.1 PURPOSE OF ANALYSER HOUSES

The main purpose of an analyser house is to ensure continuity of operation of analyser systems at a specified rate of reliability by providing a suitable operating environment for analysers which cannot otherwise operate properly, i.e. if exposed to outdoor, ambient conditions.

The operating environment may be affected by requirements concerning:

- area classification;
- environmental conditions, mainly temperature and humidity;
- sample handling and conditioning;
- effective maintenance.

As analyser houses are complex and therefore expensive in both CAPEX and OPEX, they contribute significantly to the Total Cost Of Ownership. They should therefore only be erected when strictly required and their size shall be optimised in accordance with this DEP.

In selecting the measurement methodology it shall therefore be borne in mind whether the required operating environment can only be provided by an analyser house.

The suitability of cheaper alternatives, e.g. a walk-in shelter, shall be checked. The selection of either a walk-in shelter, a site-erected analyser house or a pre-fabricated analyser house (with all analyser systems installed) shall be evaluated in terms of Total Cost of Ownership.

2.2 BASIS OF DESIGN

This DEP specifies the design and construction of analyser houses with regard to:

- provisions to maintain a non-hazardous area with regard to flammable gases from possible external flammable gas atmospheres and from internal releases of limited extent;
- protective measures in case the above provisions fail;
- safe procedures for producing and maintaining the installed electrical protection measures;
- maximum and minimum limits for climatic conditioning, if required;
- verification and testing of installed instrumented protective systems.

NOTE: Hazardous situations created by external toxic gas atmospheres shall be dealt with separately for each individual case.

Recommendations are given for the design, construction and operation of systems for forced ventilation of analyser houses, for their associated equipment such as air ducts and for the auxiliary devices necessary for providing and maintaining the required conditions by ventilation and overpressure above ambient.

NOTE: For the purpose of this DEP, analyser houses are assumed to have forced ventilation systems. Induced ventilation systems shall not be used.

Hazardous situations arising from the toxicity of gases and vapours which have to be handled shall be the subject of a special study, on the basis of which the appropriate measures shall be decided on and submitted to the Principal for approval.

Hazardous situations arising from products in the process environment around the analyser house shall be addressed in the plant hazard study during the preliminary and final design study (see 2.4).

2.3 BASIC DESIGN STANDARDS

The following standards shall apply in conjunction with this DEP:

- IP 15 for ventilation requirements of analyser houses and adjacent sample conditioning areas;
- IEC/TR 60079-16 for the procedures to achieve a safe area inside the analyser house that satisfies IP 15;
- IEC 61285 for maintaining the integrity of the analyser house and its direct vicinity.

2.4 HEALTH, SAFETY AND ENVIRONMENTAL (HSE) CONSIDERATIONS

The following HSE measures shall be taken to ensure that the interior of the analyser house can be classified as non-hazardous under normal operating conditions:

- The quantity of flammable materials entering the interior of the analyser house shall be kept to a minimum. This shall be achieved by applying DEP 32.31.50.11-Gen.
- An efficient air ventilation system shall be provided to continuously dilute accidental internal releases of flammable gases or vapours, if any, to below the levels recommended in IEC/TR 60079-16.

NOTE: To ensure that electrical equipment does not create a hazardous condition if the ventilation system should fail, additional precautions shall be taken (5.1, 6.7, 8.1).

- Provision of systems for safe disposal of waste material. For example, if the vent gas from analyser houses is continuously contaminated with hydrocarbons, then an environmentally acceptable and safe means of disposal of this vent gas shall be provided (8.3).
- Provision of fire protection features as described in DEP 34.17.00.32-Gen.

3. LOCATION OF ANALYSER HOUSES

Analyser houses shall be located in a non-hazardous area or a Zone 2 area. Analyser houses shall not be located in a Zone 0 area or a Zone 1 area.

Additional to the requirements of IEC 61285, the location:

- shall be at least 15 m away from furnaces;
- shall be such that the vibration level does not exceed that specified for the equipment accommodated inside the analyser house;
- shall be free from spills of water and process liquids.

NOTE: Locations under pipe bridges or other structures should be avoided.

4. CIVIL ENGINEERING ASPECTS OF ANALYSER HOUSES

4.1 GENERAL

An analyser house typically comprises:

- the analyser room, which shall have forced ventilation to make it by design a normally non-hazardous area, and
- sample handling area(s) on the outside of the longest walls, back-to-back with the analyser(s) inside. These areas shall be designed so that the area classification shall not become more hazardous than Zone 2 (4.3).

4.2 BUILDING STANDARDS

The construction of analyser houses shall be in accordance with DEP 34.17.00.32-Gen. and one of the following drawings:

- S 17.001 "Typical analyser house for tropical areas", or
- S 17.002 "Typical analyser house for non-tropical areas".

NOTE: S 17.001 is also applicable for use in countries with mild climates, whereas S 17.002 is intended for countries with cold climates. In case of doubt, the Principal shall be consulted.

In addition to the above, the following aspects shall be attended to:

- connection of effluents from the vents and drains to a dedicated collection sump or vessel located near the analyser house.
- potable water supply and the recommendation that its piping and fittings shall be designed to prevent back-syphonage (8.1).
- material for sink.
- fire call button outside of the main entrance door.

4.3 CONSTRUCTION AND LAY-OUT REQUIREMENTS

This DEP deviates from IEC 61285 on the following subjects:

- spare space as per part 5.3
- ventilation requirements as per part 5.5.6.

In addition to IEC 61285 and IEC/TR 60079-16, the following aspects shall be considered.

Openings in the analyser house shall be provided for

- electrical power and instrument signal cables to enter and leave the building. These shall be in the corners of walls at floor or ceiling level;
- ventilation air inlet duct(s) (6.5);
- ventilation air outlet ducts or louvres (6.5);
- sample and utilities inlet and outlet lines;
- any other services that are deemed necessary by the Principal.

The minimum walk space between fixed obstacles should be 1000 mm taking into account the constraint that cabinet doors may be locked in the open position on one side at a time.

The internal length shall suit the number of analysers to be installed plus a further 20% spare. There shall be sufficient clearance between cabinets and equipment to allow for maintenance access.

Door dimensions shall allow free access for analysers and analyser racks and shall be 0.90 m wide and 2.10 m high. Doors shall be fitted with door closers.

Rooms shall have exits at both ends if flammable or toxic materials are stored or handled therein.

Space (the "sample handling area") shall be reserved on the outside walls of the analyser house for the installation of sample conditioning systems, and should allow the analysers and sample conditioning systems to be installed back-to-back.

The length and height of this sample handling area shall be the same as that of the analyser house. The unobstructed walk space shall be 750 mm minimum.

The degree of weather protection of the sample handling area depends on local conditions and the required condition inside but shall include at least a canopy. Sample handling areas can typically be:

- of fully open construction, for use in mild climates (see S 17.001), or
- of partly enclosed construction, to provide protection for sample handling components against cold and harsh weather conditions (see S 17.002), but still with adequate (natural) ventilation.

The Principal shall be consulted if a fully enclosed sample handling area is required.

Sufficient space shall be provided inside the analyser house for installation of a sink, work bench and auxiliary equipment such as control units and, if required, recorders, signal converters, printers, computer terminals, etc.

In view of the possibility of accumulation of hydrocarbon spills, drain pits are not allowed inside the analyser house but shall be located outdoors instead.

Door sills shall be flush with the floor to prevent tripping hazards, and to allow hydrocarbon spills, if any, to be flushed to the drain pit outside.

The roof should be "nominally flat" with a slope of at least 1:100. No equipment (e.g. an HVAC unit) should be installed on the roof. Otherwise the analyser house shall be provided with a permanent ladder on the outside,a galvanised steel catwalk for access to the roof and a roof railing for personnel safety. For structures on the outside of the analyser house, fire retarding materials other than steel shall not be used unless approved by the Principal.

4.4 ADDITIONAL REQUIREMENTS FOR PRE-FABRICATED ANALYSER HOUSES

Concrete should be used as the material for pre-fabricated analyser houses.

Design and finish shall be based on a 20 year lifetime.

Finish and packaging shall take into account open deck sea freight, if applicable. Lifting lugs shall be provided for handling, shipping and installation.

The design shall be such that the completed analyser house is capable of withstanding the loads imposed by lifting, shipping and other loads described below.

Building design calculations shall meet DEP 34.00.01.30-GEN.

The Supplier shall supply drawings showing the required lay-out of foundation beams and location of bolting to foundation and shall submit structural and/or civil design calculations as specified in the order. Calculations shall be in SI units and in the English language.

4.5 FURNITURE

An analyser house shall be equipped as standard with a work bench as a minimum.

5. ELECTRICAL ENGINEERING

5.1 GENERAL

The design and construction of the electrical installation and the selection of the electrical equipment shall be in accordance with the requirements of DEP 33.64.10.10-Gen.

Electrical facilities inside the building should have a type of protection suitable for a Zone 1 hazardous area unless an alternative is specified by the Principal.

All electrical facilities inside the building which are not suitably protected for a Zone 1 hazardous area shall be connected via industrial socket outlets to IEC 60309 which shall be automatically isolated by an alarm and trip initiation system if a ventilation failure occurs (7.1).

NOTE: For adequate types of protection for use in gas hazardous areas refer to IEC 60079-14.

5.2 DISTRIBUTION SWITCHBOARDS AND TERMINAL BOXES

The electrical equipment in the analyser house should be fed from the nearest electrical substation or switch room. The installation of local distribution switchboards in hazardous areas should be avoided. However, if such switchboards are required they should be installed immediately outside the analyser house in the least hazardous area, either on a free support with a weather cover or against that part of the wall that is protected from the weather.

Segregated compartments shall be provided for,
- power distribution panel for electrical apparatus;
- emergency power distribution panel for fan, lights, gas detectors (if any), and HVAC control panel;
- signal wiring termination;
- alarm signal wiring termination.

At least 10% spare capacity shall be provided in junction and terminal boxes.

All wires shall be identified at each termination with suitable wire markers that correspond to the appropriate wiring diagram.

5.3 POWER SUPPLY CONNECTIONS

Electrical apparatus suitable for operation in the hazardous area shall be connected via junction boxes unless hazardous area socket outlets are specified by the Principal. Test equipment, electrical tools and electrical equipment without adequate protection for the hazardous area shall be connected to the electricity supply via general purpose industrial type socket outlets only. The supply to these outlets shall be controlled by the instrumented protective system of the analyser house (7.3).

5.4 EARTHING

An earth-loop of 70 mm^2 earthing conductors shall be installed inside the analyser house and shall be connected to the plant earth ring.

NOTES: 1. Signal cable shields shall be earthed at a single point to the instrument earth in the Control Room.

2. The integrity of intrinsically safe electrical apparatus shall be retained.

Metal parts of the building shall form one electrical earthing continuity and shall be bounded to the 70 mm^2 earth-loop.

The earth-bar of the switchboard, unless it is installed elsewhere (e.g. in the nearest sub-station/FAR/CCR), shall be bonded to the 70 mm^2 earth-loop and the earth bar of the supply substation.

5.5 LIGHTING

The luminaires used inside and outside the analyser house shall be fluorescent and of the same design as those used in the plant.

Inside lighting shall be suitable for a Zone 1 hazardous area. Permanent lighting shall be controlled by switches installed at each entrance door.

Emergency lighting shall be provided by self-contained lighting fixtures or from the plant emergency lighting system. The lighting fixtures shall be located inside the building above each door entrance.

The illumination level inside the building shall be at least 400 lux in accordance with DEP 33.64.10.10-Gen., and shall be provided by at least two lighting fixtures.

A single light shall be installed above each door entrance and at least two lighting fixtures shall be installed in each sample handling area.

Exterior lighting should be controlled from the nearest sub-station lighting panel. If this is not possible, control shall be by a photocell, but with a delay timer with an adjustable period of 30 minutes maximum.

6. VENTILATION AND AIR CONDITIONING OF ANALYSER HOUSES

6.1 GENERAL

The purpose of ventilation and air conditioning is to provide:

- a safe operating environment for equipment and personnel;
- the required climatic conditions for optimal equipment performance;
- a sustainable climate for the comfort of personnel in line with local regulations and/or practice.

Artificial ventilation of the interior of an analyser house is required to achieve either:

- dilution ventilation:
  the dilution of flammable gases and/or vapours that may accidentally escape from equipment inside the analyser house to a non-hazardous level around any potential means of ignition; or
- overpressure ventilation:
  to prevent flammable and toxic gases from the outside atmosphere entering the internal of the analyser house;
- or both of the above, which is a normal requirement for analyser houses located in an area where hydrocarbons are processed.

Dilution ventilation and overpressure ventilation shall comply with IP 15.

The ventilation and air conditioning system shall comply with DEP 31.76.10.10-Gen. Construction shall be in accordance with IEC/TR 60079-16 and this DEP.

Despite the absence of primary grade sources of release inside well-designed analyser houses, the ventilation shall not be demoted to a lower level (e.g. “adequate” as per IP 15) because it will never create the right conditions for a non-hazardous area inside the analyser house.

6.2 ARTIFICIAL VENTILATION

6.2.1 Dilution ventilation

Dilution ventilation is only practicable if the maximum possible rate of release is positively restricted. Therefore, the total amount of flammable fluids flowing to any analyser accommodated inside the analyser house shall be limited by a properly adjusted excess flow valve in accordance with DEP 32.31.50.11 Gen. A limited flow of 100 litres per hour (at standard conditions) covers the need of most gas analyser applications.

The ventilation rate shall be at least the greater of the following fresh air changes:

- **20m^3 per hour per analyser** (including those already installed and those projected for future spares);
- **12 volume changes per hour**.

As far as practicable, the flow through the analyser house should be uniform and shall not leave any stagnant pocket of air where flammable mixtures may develop. An economical method to obtain efficient dispersion may be by using an internal ventilation fan.

The adequacy of the dilution ventilation shall be checked against the maximum possible rate of release, taking into account the nature and hazard of the flammable material. For a liquid sample, the vapour load produced by the maximum possible rate of release shall be used as the basis of this check.

Note: In this way the total release of all possible sources can be contained and diluted to a level even lower than that specified in IP 15 when the flammable material is propane at ambient conditions. In the rare event that the above specified ventilation rates are insufficient, appropriate measures shall be taken (e.g. redesign) to regain a non-hazardous classification of the analyser house.

6.2.2 Overpressure ventilation

The pressure differential of the analyser house with respect to ambient shall be controlled to 50 Pa under normal design conditions and shall be at least 25 Pa under minimum flow

conditions (e.g. due to fouling conditions of the filter).

6.3 NATURAL VENTILATION

Other premises which rely on natural ventilation, such as walk-in shelters and enclosed cabinets, shall be subject to area classification in accordance with IP 15.

Sample handling areas adjacent to the analyser house fall into this category and shall be designed so that they are not more severe than Zone 2.

6.4 ABSENCE OF ARTIFICIAL VENTILATION

Enclosed analyser houses requiring no artificial ventilation shall comply with the requirements for non-hazardous areas.

6.5 AIR INTAKE SYSTEM AND DUCTING REQUIREMENTS

The air intake shall be through a stack provided with a rain hood and wire mesh bird screen. The air shall be drawn from a non-hazardous area and the air intake location shall be at least 1 metre outside a hazardous area.

The diameter of the stack and the intake duct should be sufficiently large to limit the air velocity inside the stack and ducting to a maximum of 8 m/s.

Inlet ducts shall be air-tight and shall not pass through Zone 0 or Zone 1 areas.

Inlet ducts shall have connections for flow meters.

A filter shall be installed in the inlet air ventilation system so that it is easily accessible for cleaning or replacement. The size of the filter shall be sufficient to require cleaning/replacement not more than once per fortnight (or once per week in very dusty, e.g. desert, environments) under the maximum dust conditions expected. In cold climates measures shall be taken to prevent the filter from freezing up, e.g. by means of a slip stream from behind the ducting-mounted heater.

Air shall enter the analyser house at ceiling level from ducting via openings with adjustable flow diverters to facilitate a proper direction and flow of air throughout the analyser building.

The ducting material shall be corrosion resistant, e.g. hot-dip galvanized steel.

The ventilation air shall escape from the analyser house through vertical ducts at two opposite corners of the analyser house, via louvres with adjustable openings.

Ducts should either:

– be installed on the outside of the short walls and connected to the interior of the analyser house by openings in these walls which are flush at floor and ceiling level, or
– be triangular in shape, two sides being formed by the corner walls of the analyser house, and passing through the ceiling to the outside atmosphere.

The inlet and exit port areas of the flow diverters and louvres shall be adjustable to enable the trimming of flow direction and overpressure during the commissioning stage and later during normal operation.

Openings in the air outlet ducting shall be flush with the floor and ceiling to allow escape of gases and vapours both heavier and lighter than air.

The size of the ducting shall be such that air velocities inside will not create noise levels which exceed the acceptable limits specified in DEP 31.10.00.31-Gen.

Outlet stack openings shall be higher than any equipment (e.g. HVAC equipment) installed on the roof of the analyser house.

Outlet stack openings to atmosphere shall be fitted with rain hoods and wire mesh bird screens.

Adverse effects of outside wind direction and velocity on the ventilation and overpressure inside the analyser house shall be prevented by installing Nelson hoods, or devices with

similar features, on the openings of outlet stacks/ducts.

6.6 VENTILATION FAN REQUIREMENTS

Ventilation should be by means of a centrifugal or axial fan with blades of non-sparking material and driven by a directly coupled motor. The ventilation equipment may be mounted either inside the analyser house or outside (if suitably protected).

Motors positioned inside ducting or elsewhere inside an analyser house shall have a type of protection suitable for operation in a Zone 1 hazardous area.

The protection of motors installed outside the house shall be in accordance with the classification of the outside area.

The power supply to the fan motor shall be independent of all analyser house safety trip circuits.

The fan speed shall not exceed 2500 r/min.

The fan support and casing construction shall be sufficiently rigid to prevent resonance and vibration (the bearing support shall be part of the fan casing).

6.7 HEATING

If duct heating is installed inside the ducting of an overpressure ventilation system, it shall be de-energised in the event of ventilation failure if the heater is not suitably certified to continue operation in Zone 1.

In all other cases the duct-heating shall be de-energised upon ventilation failure if there is a risk of damage due to overheating by lack of sufficient cooling.

7. ANALYSER HOUSE PROTECTION

7.1 GENERAL

The ventilated analyser house and personnel inside shall be protected against hazardous situations. In the event of ventilation failure or loss of overpressure inside the house, the system shall initiate the appropriate alarm and isolate the electricity supply to general purpose type convenience outlets.

The safeguarding sytems of ventilated anlyser houses shall comply with IEC/TR 60079-16.

Instrumented protective functions shall be classified and implemented in accordance with DEP 32.80.10.10 Gen. For typical IPF classes relating to analyser houses, refer to (7.3).

7.2 GAS DETECTION

The selection, location and mounting of gas detectors shall be done in accordance with DEP 32.30.20.11-Gen.

7.2.1 Air intake

The presence of flammable gas at the point of fresh air intake of the ventilation system shall be monitored following the overpressure ventilation requirements of IP 15. The gas detector(s) may either monitor the air flowing through inlet ducting or the atmosphere in the direct vicinity of the fresh air intake point.

If mounted in or adjacent to the inlet air ducting, they should be fitted in such a way that the prevailing flow profiles and air speed inside the ducting do not adversely affect either representative sampling or the accuracy of analysis. The detector(s) should be easily accessible for maintenance purposes.

If mounted in the open air, the gas detector(s) should be installed on a telescopic or swivel mast to monitor the ventilation air at the inlet of the stack.

If it is considered credible for toxic gas to enter the analyser house, toxic gas detectors should be installed to monitor the quality of the intake air, mounted in the same way as the flammable gas detectors.

7.2.2 Inside the analyser house

The design specifications of the ventilation air system in this DEP and good installation and maintenance procedures normally make it unnecessary to detect accidental releases of flammable and toxic vapours inside the analyser house. Gas detection is therefore only required if, under abnormal conditions (which are not covered by IP 15), the release of significant amounts of gas is credible.

Flammable gas detectors should be located in the direct vicinity of the controlled outlet openings of the ventilation system inside the analyser house.

Toxic gas detectors should be located at positions where leakage into the analyser house is most likely to occur in case of failure or mis-operation.

7.2.3 Flammable gas detection

Infra-red types of gas detectors should be used in preference to catalytic types, unless the flammable gas species are not detectable by infra-red types.

It is not normally required to provide for detection of hydrogen/air mixtures in analyser houses where hydrogen is used for the operation of PGCs.

7.2.4 Toxic gas detection

Site maintenance instructions for analysers and sample handling systems containing toxic vapours or liquids shall prescribe adequate precautions for normal working and for preventing accidental releases of vapours and liquids.

Toxic gas detection is then not required if STEL (Short Term Exposure Levels) are not

exceeded for a period of more than 10 hours per year, unless otherwise advised by the responsible HSE function.

NOTE: If continuous toxic gas detection is still considered to be necessary, it should be realised that if toxic gas concentration in flammable vapours is less than 1% molar, a flammable gas detector set at an alarm level of 10% LFL would normally be sufficiently sensitive to give an early warning for the toxic gas constituent as well as for the flammable gas.

If the presence of toxic gas is considered credible, a rubber pass-through grommet shall be installed, e.g. in one of the entrance doors, to allow probing the atmosphere with a portable gas detector.

7.3 ANNUNCIATION, SAFEGUARDING AND IPF CLASSIFICATION

Table 1 is a typical IPF classification matrix for a ventilated analyser house with overpressure and dilution ventilation, i.e. flammable gas detection in the fresh air intake, ventilation flow and door position.

Also included are toxic gas detection in the fresh air intake and flammable and toxic gas detection inside the analyser house. Their IPF classification and other additional safeguards that may be deemed necessary should be classified on a case-by-case basis.

Table 1 IPF classification matrix for an analyser house

CAUSE		CCR	inside / outside AH	LOCAL ANNUNCIATION PANEL ANALYSER HOUSE (at each entrance)						EXECUTIVE ACTION	
	IFP class (synerg. conseq.)	panel alarm	flashing / rotating beacon	normal operating (off)	convenience outlets isolated	ventilation failure	door alarm	flamm. gas	toxic gas	isolate convenience outlets	stop ventilation and / or HVAC
Abandon area from CCR	IV	A	A	A	-	-	-	-	-	-	-
Trip from CCR	IV	A	A	A	A*	-	-	-	-	A	-
Ventilation failure	III	B	C	B	C*	B	-	-	-	C	-
Doors open	IV (if D)	B	C	B	D*	-	B	-	-	D	-
Flammable gas air intake	III	A	C	A	C*	C*	-	A	-	C	C
Flammable gas inside	#	A	C	A	C*	-	-	A	-	C	-
Toxic gas air intake	#	A	A	A	-	A*	-	-	A	-	A
Toxic gas inside	#	A	A	A	-	-	-	-	A	-	-

CODES:

A = immediate action/annunciation upon activation of initiator

B = delayed action/annunciation during 60 seconds upon activation of initiator

C = delayed action/annunciation during one fresh air chance upon activation of initiator, i. e. 5 minutes in case of the 12 air changes

D = same as for C, but only if door is located in hazardous area (ref. IEC/TR 60079-16)

* = codes marked with * follow executive action or status

= IPF class shall be developed on a case-by-case basis

NOTES:
1. A local annunciation panel shall be installed at each entrance door
2. The analyser house protection system shall be designed so that power to all non-protected functions, e.g. general purpose type convenience outlets, can be switched on only after the ventilation system has been operating for at least 5 fresh air changes, i.e. 25 minutes in the case of 12 changes per hour.
3. An audible alarm inside the analyser house causes nuisance and should not be installed unless it (and its noise level) has been specified by the Principal.
4. The above matrix should be considered as a minimum requirement. Pitch of the audible alarms and duration, colours of flashing/rotating beacons and other details shall be as specified by the Principal.
5. The IPF classes shown in the matrix are typical. Each individual case shall be checked against specific project requirements.

8. UTILITIES AND FACILITIES

8.1 GENERAL

Gas and liquid utilities connected to the analyser house shall always terminate in a system consisting of at least an isolating valve, a filter or strainer, a pressure controller and inlet and outlet pressure indicators.

All utility lines shall be connected so that the product they contain cannot be contaminated by process liquids, gases or vapours.

NOTE: Sometimes potable water or refinery cooling water is used for cooling of process products. It is therefore essential that water supplies are protected against contamination from these products due to a cooling coil failure.

8.2 AIR AND WATER

Instrument air supply shall be in accordance with DEP 31.37.00.11-Gen.

Water supply shall be in accordance with DEP 34.17.00.32-Gen. and shall enter the house at a different position to the electricity supply. A syphon breaker or breaker vessel shall be installed immediately downstream of the main shut-off valve of water supplies (e.g. potable, cooling).

8.3 VENT AND DRAIN SYSTEMS

Vent and drain systems for analyser houses are described in DEP 32.31.50.11-Gen.

If required, the vent gas recovery system shall be installed outside the analyser house.

Regular liquid samples shall be returned into the process stream only. If this requirement cannot be met, the Principal shall be consulted.

Hydrocarbon liquids which cannot be returned to the process, e.g. resulting from maintenance activities or from incidents (drips), shall be discharged into either the plant hydrocarbon recovery system or a dedicated collection sump or vessel.

The disposal of (possibly oil contaminated) water effluent shall be discharged into a dedicated collection sump or vessel and shall be in accordance with DEP 34.17.00.32-Gen.

In order not to poison the biological mass of waste water treatment systems, chemically contaminated water shall be collected in a dedicated sump or vessel.

8.4 ADDITIONAL UTILITIES

The following additional utilities shall also be provided as appropriate, if required by the type of analysers to be installed in the analyser house:

- tool air;
- nitrogen;
- hydrogen gas (as a carrier gas for PGCs);
- LP steam;
- MP steam (15 bar);
- condensate supply and return lines;
- cooling water;
- refrigerated water supply and return;
- drain (liquid sample recovery) system (e.g. effluents which may not be returned to the site "oil contaminated drain system".

NOTES:
1. All flammable utility lines shall have main shut-off valves. They shall be grouped together in the vicinity of, but not less than 2 metres away from, the analyser house. They shall be clearly identified, e.g. by means of a red label.

2. All non-flammable utilities shall have a main shut-off valve which may be installed on the outside wall of the analyser house.

Headers for liquids (water etc.) and flammable gas utilities shall be installed on the outside wall of the analyser room and branched off via holes in the walls to the analysers requiring that utility supply.

The unconfined release of liquids or flammable utility gases in the event of a line rupture inside the analyser room shall be prevented by the installation of an excess flow check valve in the branch connection before it enters the room. The flow of flammable gas per analyser shall not exceed 100 litres per hour or twice the amount required for the analyser, whichever is greater.

8.5 COMPUTERS AND TELECOMMUNICATION

The means for direct communication with the control room shall form part of the design and shall comply with Zone 1 requirements.

The analyser room and the layout thereof shall be designed to allow the use of personal computers and other, usually general purpose type, microprocessor based equipment that is required for the control and maintenance of analyser systems.

9. INSPECTION AND TESTING

9.1 GENERAL

Inspection and testing shall comply with DEP 62.10.08.11-Gen. Pre-fabricated analyser houses, complete with analysers systems and sub-systems installed, shall be subject to factory acceptance testing (FAT)

9.2 BUILDING

The building shall be inspected to verify compliance with DEP 34.17.00.32-Gen.

9.3 UTILITIES, VENT AND DRAIN SYSTEMS

The utility piping and the drain and vent piping shall be inspected to verify compliance with DEP 31.38.01.11-Gen.

9.4 HEATING, VENTILATION AND AIR CONDITIONING SYSTEMS

The general inspection and testing of HVAC systems shall be in accordance with DEP 31.76.10.11-Gen and DEP 62.10.08.11-Gen (for supporting instrumentation).

Tests shall be conducted on site with portable gas detectors or gas detector tubes to confirm that no flammable or toxic gases are released or are entrained with the ventilation air.

9.5 INSPECTION CHECKLIST

All inspections and tests shall be performed against the applicable specifications and drawings.

The inspection shall include at least the following items:
- area classification of the location;
- documentation and drawings;
- selection of materials, tagging and nameplates shall be inspected during all phases of the inspection;
- dimensions;
- compliance with design of installation (entrance, exits facing in right direction, etc.);
- architecture (location of HVAC unit, analyser room, sample handling area(s), gas and liquid recovery systems;, etc.);
- framing construction;
- insulation of walls, roof and doors;
- wall construction;
- wall penetrations and sealing for ducts and piping;
- roof construction;
- floors;
- doors;
- air intake stacks and ducts;
- exhaust ducts, louvres;
- vents and drains;
- air and water supplies;
- other utilities, including the gas and liquid recovery system, steam supply, nitrogen supply etc.;
- electrical system (capacity, switch boards, power distribution boards, signal termination boxes, alarm signal termination boxes, convenience outlets, wiring termination etc.);
- earthing;
- lighting;
- HVAC unit and/or ventilation system;
- ventilation fans;
- alarm and trip initiation systems;
- gas detectors, if installed;
- alarm beacons;
- cable trenches / conduits;

- any other details forming part of the project;
- functional inspection of ventilation flow pattern on site, e.g. by means of smoke dispersion test.

10. MARKING FOR IDENTIFICATION AND INFORMATION

10.1 ANALYSER HOUSE NAMEPLATE

Nameplates shall be in accordance with the requirements of DEP 32.37.10.34-Gen., but as amended below.

Nameplates shall be screwed or nailed to their supports, not glued.

Similar to the following example, a nameplate showing the analyser house number shall be attached to the outside of both doors:

ANALYSER HOUSE NUMBER - AH 12

The letters in the above notice shall be at least 20 mm high.

10.2 ANALYSER HOUSE WARNING NOTICES

The following notices shall also be displayed at both doors; the second notice shall display only the appropriate statements selected from those which are shown in the example below:

ANALYSER HOUSE PROTECTED BY FORCED VENTILATION

WARNING

Doors must be kept closed

CAUTION : Risk of H_2S

CAUTION : Flammable material may only be introduced into the analyser house if specifically permitted and recorded.

CAUTION : Do not enter the building when status lights indicate the possible presence of flammable or toxic vapour inside, unless the prescribed precautions are taken.

The capital letters in the above notice shall be at least 20 mm high, with the lower case letters to scale.

10.3 NAMEPLATES FOR VENT, DRAIN AND CONDENSATION SYSTEMS

Drain, vent and, if applicable, condensate systems shall be clearly identified with name plates and by colour coding.

10.4 NAMEPLATES FOR STEAM SUPPLY

Name plates shall indicate the nominal pressure and temperature of the steam.

10.5 NAMEPLATES FOR DETECTION OF LOW-FLOW VENTILATION AIR

The flow detection device on the main inlet ducting shall be clearly marked and its housing should be painted bright red.

11. RECORDS

All relevant details of the analyser house and equipment, including the HVAC system if applicable, shall be suitably recorded.

The records shall contain at least:

- the Local Authority's certificate, if applicable;
- a list of analysers installed inside the building, and their the type of protection;
- a copy of the electrical safety certificates;
- specific records of each analyser, including testing procedures;
- draining procedure for devices, vents and drains;
- Manufacturer's recommended maintenance and test procedures for the HVAC system, if applicable;
- a list of test equipment kept inside the analyser house;
- layout of equipment, piping, cables and drains;
- a copy of ventilation system acceptance tests;
- a copy of the Principal's instructions for testing and test frequency;
- a copy of the latest tests and inspection results;
- a detailed start-up and commissioning schedule for HVAC equipment (if applicable) in accordance with DEP 31.76.10.10-Gen.

12. MATERIALS TO BE SUPPLIED BY THE PRINCIPAL

Accessories for personnel safety should be supplied by the Principal, insofar as required by site regulations. For example:

- an eye wash unit;
- fire blankets;
- fire extinguishers.

13. REFERENCES

In this DEP, reference is made to the following publications:

NOTE: Unless specifically designated by date, the latest edition of each publication shall be used, together with any amendments/supplements/revisions thereto.

SHELL STANDARDS

Index to DEP publications and standard specifications	DEP 00.00.05.05-Gen.
Noise control	DEP 31.10.00.31-Gen.
Instrument air supply	DEP 31.37.00.11-Gen.
Piping - general requirements	DEP 31.38.01.11-Gen.
Heating, ventilation and air conditioning for plant buildings	DEP 31.76.10.10-Gen.
Installation, testing and balancing, and commissioning of HVAC systems	DEP 31.76.10.11-Gen.
Fire, gas and smoke detection systems	DEP 32.30.20.11-Gen.
On-line process stream analysis - sample conditioning	DEP 32.31.50.11-Gen.
Classification and implementation of instrumented protective functions	DEP 32.80.10.10-Gen.
Electrical engineering guidelines	DEP 33.64.10.10-Gen.
Minimum requirements for structural design and engineering	DEP 34.00.01.30-Gen.
Minimum requirements for design and engineering of buildings	DEP 34.17.00.32-Gen.
Inspection and functional testing of instruments	DEP 62.10.08.11-Gen.

STANDARD DRAWINGS:

Typical analyser house for tropical areas	S 17.001
Typical analyser house for non-tropical areas	S 17.002

BRITISH STANDARDS

The Institute of Petroleum Model Code of Safe Practice, Part 15, Area classification code for petroleum installations	IP 15

Issued by:
The Institute of Petroleum,
61 New Cavendish Street,
London W1M 8AR,
United Kingdom

INTERNATIONAL STANDARDS

Electrical apparatus for explosive gas atmospheres:

Part 10: Classification of hazardous areas	IEC 60079-10
Part 14: Electrical installations in hazardous areas (other than mines)	IEC 60079-14
Part 16: Artificial ventilation for the protection of analyser(s) houses	IEC/TR 60079-16
Plugs, socket-outlets and couplers for industrial purposes	IEC 60309

Industrial-process control - safety of analyser houses IEC 61285

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