HSE
Health & Safety
Executive

# Heating, ventilation and air conditioning

## OFFSHORE TECHNOLOGY REPORT

## 2001/066

# Heating, ventilation and air conditioning

**Edited under the HSE Technical Support Agreement by BOMEL Ltd**
Ledger House
Forest Green Road
Fifield
Maidenhead
Berkshire SL6 2NR

**HSE** BOOKS

*First published 2002*

ISBN 0 7176 2519 2

# CONTENTS

# FOREWORD

This document provides technical information previously contained in the Fourth Edition of the Health and Safety Executive's *'Offshore Installations: Guidance on Design, Construction and Certification'* (1990 edition plus amendments)[(1)]. The 'Guidance' was originally published in support of the certification regime under SI289, the Offshore Installations (Construction and Survey) Regulations 1974[(2)]. However, SI289 was revoked by the Offshore Installations (Design and Construction, etc) Regulations, 1996, which also introduced the verification provisions into the Offshore Installations (Safety Case) Regulations, 1992. The 'Guidance' was formally withdrawn in its entirety on 30 June 1998 (see HSE OSD Operations Notice 27[(3)]).

The withdrawal of the 'Guidance' was not a reflection of the soundness (or otherwise) of the technical information it contained; some sections (or part of sections) of the 'Guidance' are currently referred to by the offshore industry. For this reason, after consultation with industry, relevant sections are now published as separate documents in the HSE Offshore Technology (OT) Report series.

It should be noted that the technical content of the 'Guidance' has not been updated as part of the re-formatting for OTO publication, although prescriptive requirements and reference to the former regulatory regime have been removed. **The user of this document must therefore assess the appropriateness and currency of the technical information for any specific application. Additionally, the user should be aware that published sections may cease to be applicable in time and should check with Operations Notice 27, which can be viewed at http://www.hse.gov.uk/hid/osd/notices/on_index.htm, for their current status.**

# 1. INTRODUCTION AND SCOPE

In this Offshore Technology (OT) Report the initials HVAC are used to denote the discipline relating to design and operation of heating, ventilation and air conditioning systems.

HVAC forms part of the essential safety services of the Installation and complements area classification requirements associated with electrical equipment. It is suggested that HVAC systems should be provided to prevent ingress of potentially explosive / toxic gas-air mixtures into non-hazardous areas, such as living quarters, electrical switch rooms and equipment rooms. Dilution ventilation services would need to be provided for all enclosed hazardous areas in order to reduce the risk from build-up of potentially explosive / toxic gases within these spaces. HVAC systems are not intended to control a catastrophic event but to inhibit reaching this situation.

HVAC systems are essential for normal operation of the Installation and may be required to assist with return to normal following an incident.

HVAC services are concerned with enclosed areas of the Installation and with the interface external to enclosures. It is suggested that the integrity of the overall area classification scheme should not be impaired by the HVAC installation. Open, semi-open or partially enclosed areas would need to be assessed to ensure that natural ventilation is sufficient to prevent the build-up of harmful gases. If this cannot be achieved by natural ventilation alone the area concerned would need to be provided with mechanical ventilation to similar design criteria as enclosed areas where explosive / toxic gases may be present from time to time.

In addition, HVAC services tend to be installed to provide for comfort, health and welfare in manned areas and an appropriate operating environment in other enclosures.

The document does not deal with the utilities required to serve the HVAC systems, such as water, drainage, electricity and compressed air supplies.

The information is based on guidance previously contained in Section 47 of the Fourth Edition of the Health and Safety Executive's 'Offshore Installations: Guidance on Design, Construction and Certification'(1) which was withdrawn in 1998. As discussed in the Foreword, whilst the text has been re-formatted for Offshore Technology publication, the technical content has not been updated (except for giving the most recent version of references). The appropriateness and currency of the information contained in this document must therefore be assessed by the user for any specific application.

# 2. DESIGN PHILOSOPHY

It is suggested that the designer should be aware of the need to address and incorporate appropriate detail following appraisal of the various design parameters which are likely to include, but may not be limited to, some or all of the following principles:

- Potential hazardous gases and their likely sources.
- Segregation of hazardous and non-hazardous areas.
- Area classification.
- Installation safety philosophy.
- Fire compartmentation scheme.
- Site weather data and environmental design criteria.
- Orientation of a fixed platform in order to maximise benefit from natural ventilation.
- Pressure differential between segregated areas.
- Fire and gas detection and protection systems.
- Emergency shutdown and emergency power philosophies.
- Equipment redundancy and standby philosophy.
- Equipment selection appropriate to operating conditions.
- Requirements for removal of excess heat.
- Standardisation of components used in HVAC systems in order to provide interchangability between systems.
- Smoke and gas control philosophy (i.e. prevention of ingress of smoke or gas into accommodation spaces, control stations, enclosed escape routes or enclosed muster areas).

## 2.1 AREA CLASSIFICATION

Classification of areas of the Installation into hazardous and non-hazardous would need to be carried out in accordance with a recognised international standard or code for the protection of electrical apparatus and conductors both inside and outside of enclosed areas. These include:

BS 5345 Part 1, 1976[4]
Part 2, 1983[5]

I.P. Model Code of Safe Practice Parts 1[6] and 8[7]

MODU Code[8]

API RP 500B[9]

Area classification enables all parts of the Installation to be identified as one of the following:

| | | |
|---|---|---|
| Hazardous areas | - | Zone 0, in which an explosive gas / air mixture is continuously present or present for long periods. |
| | - | Zone 1, in which an explosive gas / air mixture is likely to occur in normal operation. |
| | - | Zone 2, in which an explosive gas / air mixture is not likely to occur in normal operation, and if it occurs it will exist only for a short time. |
| Non-hazardous areas | - | manned and un-manned areas in which an explosive gas / air mixture will not occur in normal operation. |

## 2.2 ENVIRONMENTAL HEALTH AND WELFARE

It is suggested that HVAC systems for fixed Installations should provide a minimum of 12 1/s of outside air per person. In addition, the risk of pollution of ventilation air supplies from exhausts or from combustion equipment / process vents would need to be considered and designs or operations adjusted to avoid contamination.

It is suggested that HVAC systems for mobile Installations should comply with the requirements of SI 1978 / 795[10].

Ventilation should be sufficient to prevent personnel being exposed to levels of air-borne toxic substances in excess of the occupational exposure limits as defined in HSE Guidance Note EH 40[11].

For health and welfare, consideration should be given to maintaining space humidity within occupied areas within the range 40 to 70% RH. Space dry bulb temperature should be appropriate to the activity being undertaken.

Due cognisance should be taken of the potential for air and waterborne diseases, such as Legionnaires' Disease, which might develop in HVAC systems and associated utilities. Legionnaires' Disease and precautionary measures that can be taken to minimise its occurrence are discussed in HSE Guidance Note HSG 70[12].

## 2.3 FUNCTIONAL REQUIREMENTS

It is suggested that the HVAC systems should be designed to fulfil appropriate combinations of the following functions:

- Provision of appropriate working environments within hazardous areas.

- Dilution and removal of potentially hazardous concentrations of flammable / toxic gaseous mixtures in hazardous areas.

- Maintenance of a pressure differential between hazardous and non-hazardous areas in order to prevent ingress of flammable / toxic gases into non-hazardous areas.

- Heat removal to protect personnel, electrical plant and process systems from excessively high temperatures.

- The isolation of individual areas and control of ventilation in emergency conditions, through interface with the shutdown logic of the fire and gas detection and alarm safety systems.

- Provision of combustion and ventilation air supplies for equipment and purge systems required for normal operations and during an emergency.

- Provision of comfortable environmental conditions within the living accommodation and normally manned non-hazardous areas.

## 2.4 OPERATIONAL REQUIREMENTS

HVAC services to all areas should normally be fan powered, except where it can be demonstrated that natural ventilation can provide adequate safety protection to the Installation.

It is suggested that during normal operations ventilation systems should run continuously. During an emergency, certain parts of the system may still be required to operate.

Systems would need to be capable of being kept operational by the provision of adequate standby / redundancy.

Separate ventilation / air conditioning systems would need to be provided for hazardous and non-hazardous areas.

It is suggested that HVAC systems should not impair the integrity of fire / watertight bulkhead separation of the Installation. The principle for all areas should be to stop the supply of combustion air and to prevent fire, gas or smoke spreading, or where relevant sea water entry, through the ductwork system.

Local and remote controls, status indication, alarms and interfaces of HVAC services would need to be provided appropriate to operational needs.

Power sources for HVAC systems, controls and their essential components would need to be available as required by the emergency shutdown logic of the Installation.

It is suggested that systems should be capable of handling the differing types of gases and operating conditions likely to be encountered offshore.

The systems would need to be designed so that they can provide adequate HVAC services during partial or phased operations such as hook-up, modification and when the Installation is not in use.

Wind may adversely affect fan performance in all areas and pressure differentials between areas. Adequate operating margins need to be provided to offset such conditions and to maintain performance standards when air filters are in need of cleaning.

Equipment that may require to be purged should be capable of:

- Pre-purge.
- Continuous purging while the equipment is in use.
- Purge, where necessary, after shutdown.

## 2.5 ENVIRONMENTAL WEATHER CONDITIONS

HVAC systems should be appropriate for the environmental data established for the Installation – see OT Report OTO 2001 010.

## 2.6 SYSTEM LAYOUT

It is suggested that the HVAC systems should be laid out with safety aspects in mind. They should be kept clear of areas prone to damage from normal operations. Where practicable, hydrocarbon fuel lines and main power and signal cables would need to be kept clear of HVAC systems.

HVAC systems in hazardous areas would need to be laid out to scavenge the space of gas and heat accumulation, and prevent build-up of pockets of flammable or toxic gases which may be lighter or heavier than air. It should be noted that an even distribution of air within an area / module is as important as the quantity of air supplied. Testing would need to be carried out regularly (see also Section 8.2).

Supply air intakes would need to be located in non-hazardous external zones. It is suggested that the separation between air intakes and extract outlets should be a minimum of 4.5m, but greater where practicable. Care should be taken when siting supply air intakes to ensure that products of combustion from fuel burning equipment or toxic / hazardous discharge from process / equipment vents and similar outlets are not drawn into the HVAC system. Where practicable, ventilation outlets from non-hazardous areas should not discharge into a hazardous area. Where such an extract does discharge into a hazardous area from a non-hazardous area, precautions would need to be taken to automatically prevent backflow of air from the hazardous into the non-hazardous area.

It is suggested that layout of ventilation ducts should avoid passing through areas of differing classification. However, where unavoidable, fire protection of ducts to the same standard as that of the enclosure would need to be provided. Where necessary ducts of welded, gas-tight construction would need to be used. The air pressure differential inside the duct relative to its surroundings should be appropriate to the situation.

It is suggested that air intakes and outlets from the various HVAC systems should be protected from wind-driven rain, snow and wave entry which might inhibit performance or hazard the Installation. Provision would need to be made to protect systems from harmful effects from particulate contaminants and salt aerosols carried by wind / sea spray.

The pressure differential caused by wind blowing across the Installation should be considered at the design stage. Where appropriate, air intake and discharge from the same system would need to be located on the same face of the Installation or in external zones of equal wind pressure in order that wind does not adversely affect HVAC system performance and safety.

Consideration should be given to providing dedicated HVAC systems to serve concrete support legs, steel jackets and similar spaces where personnel access is restricted to entry from one end only, so that dangerous concentrations of flammable / toxic gas do not accumulate. Enclosed access / escape routes should be maintained at a pressure above that of surrounding areas in order to control spread of smoke.

Air supply and removal from normally manned areas should be arranged to avoid discomfort to personnel.

## 2.7 PRESSURE DIFFERENTIALS

It is suggested that the design of HVAC services should provide for a pressure differential, with all access doors closed, of at least 50 Pa in a non-hazardous area above that of adjacent hazardous areas, referenced to outside atmosphere, in order to prevent ingress of flammable / toxic gases into the non-hazardous area.

A safe scheme of pressure relief venting from the space should be provided to ensure that doors can be opened and closed during normal and emergency operations.

Living accommodation should be located in a non-hazardous area. Consideration should be given to maintaining a positive pressure within the living accommodation above that of outside ambient.

It is suggested that the HVAC system provided to maintain pressure differentials within the lower hazard rated area should be capable of ensuring a continuous air flow from the lower hazard rated area to the higher hazard area when doors are open. This may be achieved by the provision of a standby system capable of maintaining the required pressure differential.

Construction of enclosures required to be pressurised would need to ensure low leakage of pressurisation air. Adequate pipe or cable seals and airtight construction are likely to be essential.

It is suggested that access openings between hazardous and non-hazardous enclosures should be avoided. Where this is not possible the opening should be protected by an airlock or gastight door.

Access openings into or between Zone 1 or Zone 2 hazardous areas would need to be protected by an appropriate airlock(s) or gastight door(s). Three alternative situations are possible:

a) Zone 1 area opening into a Zone 2 area.

b) Zone 2 area opening into a non-hazardous area.

c) Zone 1 area opening into a non-hazardous area.

Where such protection is installed, consideration should be given to providing the following features.

Preference should be given to using an airlock for each of the three alternative situations referred to above. However, when an airlock is not practicable, gastight self-closing doors may be used for situations a) and b).

Situation c) would need to be fitted with a double door airlock whenever possible. If this is not practicable the HVAC system provided to maintain pressure differential would need to be upgraded from a single fan normally used for arrangements a) and b) to include two 100% duty fans, one running and one standby. Controls would need to automatically start the standby fan on failure of the duty fan or upon prolonged loss of pressure differential, when both would run simultaneously.

Where practicable doors should be positioned so that they do not face a source of hazard.

It is suggested that the area of lower hazard rating should be maintained at a minimum pressure differential of 50 Pa above that of the connected higher hazard rated area.

Loss of pressure differential would need to initiate an audible / visual alarm at a normally manned station after a suitable delay period which, it is suggested, should not exceed 30 seconds.

Loss of pressure differential in a non-hazardous space, coincident with the detection of gas at any location, would need to initiate automatic disconnection and de-energising of all electrical equipment that is not certified for operation in a hazardous atmosphere.

It is suggested that all electrical equipment located within an airlock should be certified as suitable for use in a hazardous area of equal or greater hazard rating than that external to the airlock.

Hinged doors for normal access between hazardous and non-hazardous areas should open into the non-hazardous area. Emergency hinged doors should open in the direction of escape. The exceptions to this are sliding doors when fitted.

All doors should be gastight self-closing type without any hold-back device. Gastight doors should be capable of being demonstrated gastight under normal operating conditions.

The practice of re-circulating air in certain areas should be carefully reviewed as this can lead to loss of pressure differential.

## 2.8 PURGE SYSTEMS

It is suggested that electrical equipment located in hazardous areas which is not compatible with the appropriate zone requirements should be provided with a purge system – see operational requirements in Section 2.4 of this document.

Purge systems should use inert gas or air as a purge medium. Flammable gas should not be used. Purge systems should normally be separate from general HVAC systems serving enclosed or open areas.

It is suggested that air for purge systems should be drawn from a non-hazardous source and appropriate controls provided to prevent ingestion of hazardous gases.

The purge medium would need to be treated prior to discharge into the purged equipment to avoid risk of condensation or other forms of contamination.

Adequate standby or redundancy would need to be provided, with purge system controls integrated with the control system of the equipment or space served and overall safety systems of the Installation.

Where appropriate, purged equipment should be maintained at a pressure of at least 50 Pa above that of the surrounding area in which it is located. Loss of over-pressure would need to initiate an audible / visual alarm at a normally manned station after a suitable delay which, it is suggested, should not exceed 30 seconds. Seals on equipment would need to ensure a low rate of leakage of purge medium. A safety relief system would need to be provided so that discharge of the purging medium is direct to the outside atmosphere in a non-hazardous area.

## 2.9 MOBILE INSTALLATIONS

It is suggested that HVAC services for mobile Installations should also be in accordance with the current SOLAS[13] and MODU[8] codes, and SI 1978 / 795[10].

## 2.10 UNMANNED INSTALLATIONS

HVAC services on normally manned Installations would need to be appropriate for the tasks undertaken on the facility – see also OTO Report 2001 067.

## 2.11 STATIC DISCHARGE

HVAC systems and their components should be adequately earthed in order to avoid build-up of electrostatic potential which might cause ignition of a flammable gas / air mixture.

Consideration should be given to controlling humidity in order to minimise the risk of static discharge in any area where flammable gas and a dry atmosphere may be present, such as battery rooms and sick bays.

## 2.12 EMERGENCY SHUTDOWN

It is suggested that facilities should be provided to enable the HVAC systems to respond appropriately to the emergency shutdown of the Installation, and to provide for operation of essential services during an incident.

Fans and electrical components located inside or outside an enclosure that are likely to be exposed to a hazardous atmosphere and are required to operate during an emergency shutdown would need to be suitable for Zone 1 area classification and connected to an emergency power supply. Fans and electrical components located within non-hazardous enclosures, such as living accommodation, need not be rated for Zone 1 provided the HVAC system is arranged to shut down and isolate when gas is detected at the system air intake.

Due cognisance should be given to fire and smoke control requirements of HVAC services during and after an emergency.

# 3. PROCESS AND OTHER HAZARDOUS AREAS

## 3.1 VENTILATION AND HEATING

It is suggested that enclosed hazardous areas should be provided with mechanical ventilation systems capable of continuously providing at least 12 air changes per hour.

Open or partially enclosed hazardous areas would need to be ventilated by natural means to achieve at least 12 air changes per hour for 95% of the time. This may be augmented, where necessary, by mechanical systems to meet the same design criteria as enclosed hazardous areas.

In areas of high process heat gain, the ventilation rate may need to be increased in order to limit the temperature rise in the space to 40°C.

It is suggested that re-circulation of air from the space should not be made except where required during phased, partial or non-production periods.

Air change rates would need to be based upon the empty volume of the space served with no allowance made for equipment.

In order to protect against freezing and condensation, space heating may be provided when waste heat from operations or processing is not present. In normally unheated unmanned areas, temporary heaters suitable for the area classification may be provided.

It is suggested that hydrocarbon gas detectors should be fitted inside ventilation outlets from hazardous areas, and be arranged to either alarm, or shut down and close the HVAC system in accordance with the safety logic of the Installation.

Fire / gas control dampers should be provided at all duct and air transfer penetrations of fire barriers to maintain integrity. On mobile Installations, controls local to these dampers and mechanical indication to the SOLAS(13) and MODU(8) code requirements would need to be provided, as well as facilities for remote control / status indication. On fixed Installations, local, safely located fire / gas damper controls would need to be provided as required by Offshore Installations Regulations on fire fighting equipment(14).

## 3.2 WELLHEAD AREAS

HVAC services to wellhead areas should, where practicable, be separate from those serving other hazardous areas. Layout and design criteria are suggested in Section 3.1 of this document.

## 3.3 DRILLING UTILITIES AREAS

### a) Mud storage, mixing and chemical storage rooms, shale shakers and pumps

HVAC services in these areas should be separate from those of other hazardous areas. Layout and design criteria are suggested in Section 3.1, with the additional features outlined below. Heating should be provided, where appropriate, for personnel and to protect against freezing.

Arrangements would need to be made to enclose the various mud handling processes, such as shale shakers, mud storage tanks and related equipment within hoods, booths or enclosures so as to trap fumes, dust and gas at source and exhaust to a safe point of discharge to the outside atmosphere. Ready access for operators to inspect / control mud handling would need to be provided in ventilation booths and enclosures.

Consideration should be given to the extract from mud processing areas to be cleaned of particulate material prior to discharge to the atmosphere.

Consideration should also be given to ensuring that the atmosphere within mud processing working areas conforms to the standards defined in HSE Guidance Note EH40(11) – see also Section 8.3.

[Note. Chemicals used in the mud would need to be listed on a display board before being used and the Installation Manager informed of any special hazard involved.]

**b) Drill floor**

Normally the drill floor is an open area naturally ventilated to the outside atmosphere. If enclosures are fitted, auxiliary ventilation services would need to be provided in order to protect personnel and the Installation from risk of flammable gas build-up. The layout and capacity would need to achieve the design criteria suggested in Section 3.1 with local heating provided as appropriate.

The HVAC services to the drill floor may be required to have independent local control facilities to enable selective operation separately from general production. Appropriate indication at the Installation control centre would need to be provided.

# 4. NON-HAZARDOUS AREAS

## 4.1 ACCOMMODATION SPACES AND CONTROL ROOMS

Environmental conditions within these manned spaces on fixed Installations should be to the requirements of the Health and Safety at Work Act[15]. Mobile Installations should comply with SI 1978 / 795[10]. Appropriate HVAC standby or redundancy resources would need to be provided for the particular application.

It is suggested that the special HVAC requirements for galleys, radio rooms, other areas and emergency exit arrangements called for in the SOLAS[13] and MODU[8] codes should be provided.

Consideration should be given to the provision of individual temperature controls to each cabin and public area so that differing comfort conditions can be achieved relative to activities undertaken. The sick bay temperature would need to be capable of being raised to 25°C to support the management of patients who may be in shock, chilled or unclothed.

On fixed Installations access corridors and escape routes would need to be maintained at a pressure above that of adjacent cabins and other areas in order to provide smoke control in the event of a fire in occupied areas.

It is suggested that hydrocarbon gas and smoke detectors should be fitted to supply air intakes and exhausts, and be arranged to alarm, shutdown or close the system to prevent ingress of smoke or gas in accordance with the safety logic of the Installation. Ductwork connections to the outside atmosphere and through fire barriers would need to be provided with fire / gas dampers rated to that of the fire barrier penetrated.

## 4.2 POWER GENERATION AND EQUIPMENT SPACES

In order to protect electrical equipment and personnel from high temperatures, HVAC services would need to be provided to limit space temperatures to a maximum of 40°C, unless the electrical equipment and system is capable of operating at higher temperatures and other means of protection for personnel is provided.

Air supplied for ventilation and combustion air to engines and fuel burning equipment would need to be provided separately from general HVAC services. Ventilation required to dissipate residual heat from the equipment after shutdown should be provided from a safe source or by safe procedures. Appropriate fire / gas dampers would need to be provided to protect the facility.

## 4.3 BATTERY ROOMS

It is suggested that the special requirements for HVAC services required in the SOLAS[13] and MODU[8] codes and IEE Recommendations for Offshore Installations[16] should be provided.

The risks from hydrogen evolving from certain types of batteries should be recognised, and the HVAC systems arranged to reduce the hazard from this source. Consideration should be given to addressing whether low humidity levels could be present during differing weather conditions with the risk of ignition by static spark.

## 4.4 OTHER NON-HAZARDOUS AREAS

It is suggested that areas such as laboratories, offices, workshops, stores and other manned and unmanned areas should be provided with HVAC services which maintain environmental conditions and safety standards as described earlier in this section. Where requirements are not specified in SOLAS[(13)] / MODU[(8)] for these areas, current land based or marine practice should be followed as appropriate.

# 5. HVAC EQUIPMENT AND MACHINERY

## 5.1 DESIGN, MANUFACTURE AND INSTALLATION

HVAC equipment and machinery should be suitable for operation or standing at rest in a marine saline atmosphere with high relative humidity continuously present and risk of condensation on metal surfaces. In addition, some systems may be subjected to wide temperature variations from freezing conditions to high ambient and radiant heat. Equipment would need to be capable of withstanding wind loadings defined in OTO Report 2001 010. The HVAC systems would need to be designed to withstand these variations as well as differing weather conditions for the specific location, so that the requirements for continuous operation and safety services are achieved.

Consideration should be given to using components and materials for the initial installation and later replacement that have been specifically developed for the application. Where possible, materials inherently resistant to marine corrosion should be used and coatings, where applied, would need to be heavy duty marine standards. Items likely to suffer damage from corrosion prior to being made operational would need to be suitably protected. Further corrosion sources on the Installation may arise from chemicals used during drilling and products of combustion.

It is suggested that ductwork should be constructed to at least HVCA Specifications DW142[17] and DW143[18]. When located external to an enclosure or in production areas subjected to a marine saline atmosphere, ductwork would need to be of welded robust construction adequate to withstand likely damage and corrosion.

## 5.2 FANS AND FAN DRIVES

It is suggested that fans used on the Installation should have non-overloading, non-stall performance characteristics. They would need to be provided with anti-sparking tracks for all HVAC systems. Adequate performance margins to cope with adverse design wind speed would need to be provided.

Fans would normally be electrically driven. However, compressed-air-driven fans and ejectors may occasionally be employed for emergency use or as a means of overcoming electrical zoning or power supply constraints. Such arrangements would need to include a pressure / air flow switch local to the fan or ejector to alarm on loss of ventilation air.

## 5.3 HEATER ELEMENTS

Consideration should be given to ensuring that the surface temperature of heater elements used in HVAC systems and unit heaters is below 200°C, or the ignition temperature of any flammable gas likely to be present in the area.

Controls would need to be provided to ensure safe surface temperatures when air flow over the heater elements is restricted or stopped.

## 5.4 FIRE / GAS AND WATERTIGHT DAMPERS

It is suggested that selection of appropriately robust equipment suitable for the particular application should be made. Dampers would need to be capable of withstanding temperatures and pressures for the rating of the barrier, and also of responding automatically to alarms, with provision for local and remote operation and indication to meet the emergency shutdown logic of the Installation.

Dampers would need to have the minimum leakage practicable for the particular application involved.

Dampers required to control supply of combustion air to engines (rig savers) would need to be of the same robust construction as fire / gas dampers.

Controls and damper actuators should be inherently non-sparking and appropriate to the area classification. Actuators would need to be capable of rapidly closing and opening the dampers against airflow pressure within the duct. Controls would need to be arranged to 'fail safe' in the event of loss of power or breaking of fusible or frangible link(s). These links should be positioned where they will be able to detect fire or over temperature. The arrangement of links required to provide adequate protection would need to be analysed for each application to ensure that the barrier is correctly protected.

## 5.5 MAINTENANCE REQUIREMENTS

Careful consideration should be given to the selection, location and layout of HVAC systems and associated plant and components to enable adequate routine inspection testing and preventative and breakdown maintenance to be carried out without prejudicing safety of the Installation.

Suitable access platforms and routes for entry and removal of expendable components or failed equipment should be provided.

Access doors into plant and ductwork would need to be of sufficient size to enable servicing to be adequately carried out. Belt guards should provide for frequent visual inspection of the drive.

It is suggested that all plant, leading components and utility supplies should be clearly labelled / tagged with appropriate unique identification.

# 6. CONTROLS, ALARMS AND INTERFACES

## 6.1 CONTROLS AND ALARMS

It is suggested that controls for the HVAC systems should provide for the following operations:

- Start-up under normal conditions.
- Control of environmental temperature and humidity conditions.
- Controlled shutdown.
- Emergency shutdown and facilities for safe re-start after an incident.
- Emergency operation of selected HVAC systems.
- Control, as above, under partial or differing operating modes.

It is suggested that development of an integrated HVAC control and alarm strategy for normal and emergency operation should be made in conjunction with guidance to SI 1978 / 611(14) and SOLAS(13) / MODU(8) codes. The extent of executive action taken after loss of ventilation or pressurisation differential would need to be considered and appropriate arrangements made to avoid compromising the safety of the Installation.

Facilities for either local or remote manual control in addition to emergency stop or local isolation would need to be provided. Where appropriate, central status monitoring and control of the HVAC systems should be considered. In general, status indication should prove that ventilation is performing its intended function, in particular air flow and fire / gas damper operation.

Where standby plant is provided, it would need to be arranged to change over automatically and alarm or indicate on changeover.

## 6.2 INTERFACES

In order to reduce the risk of pollution, consideration should be given to terminating drains, vents, cold vents and engine and fuel burning exhausts well away from air intakes and discharges of HVAC systems and open areas where personnel normally work. The possible adverse effect on HVAC systems from flaring would need to be considered.

Hazardous vent piping should not cross or pass through ducts or openings to the outside nor should they terminate inside HVAC systems.

Particular care would need to be taken to ensure that HVAC systems do not destroy the fire protection provided by gaseous extinguishing media which may be used in certain areas. Appropriate controls, interfaced with the fire extinguishing system, should be considered with local and remote control facilities provided to enable the HVAC system to help with recovery and removal of pollutants after an incident. Locations where gaseous extinguishing media are stored should be ventilated.

Where foam fire protection systems are provided, provision should be made for venting the protected space whilst foam is being introduced.

Fuel lines should not pass through or adjacent to HVAC systems.

# 7. DOCUMENTATION

## 7.1 COMMISSIONING

It is suggested that HVAC systems should be provided with readily accessible test facilities to enable them to be commissioned in accordance with the BSRIA Application Guide to Commissioning[19].

It is suggested that utilities be tested simultaneously with the HVAC system they serve, and the relevant data recorded.

Where onshore or other pre-commissioning prior to full operation is carried out, consideration should be given to simulating actual working conditions in order to assist with appraisal and adjustment of HVAC system performance. Suitable tests would need to be carried out to demonstrate that the provisions of Section 2.6 paragraph 2 are being achieved.

## 7.2 DOCUMENTATION

Consideration should be given to providing permanent records of initial testing and commissioning at the time of first setting the HVAC systems to operate, and after modification of the system. Records are likely to include the following data:

- Flow diagrams, ducting and instrumentation diagrams and data sheets showing test points and design and actual values achieved during testing.
- Ductwork index and branch resistance head design calculations.
- Equipment schedules listing components and performance data.
- Set of ‘as built’ record drawings.
- Utilities data schedule for supplies to HVAC systems.

# 8. SURVEYS

## 8.1 POINT-OF-RISK SURVEY

The Installation needs to be examined from time to time to identify points of potentially high risk of flammable / toxic gas accumulations occurring as pockets which might prove dangerous. Air movement in hazardous areas, as indicted in Section 2.6, would need to be tested periodically and remedial action taken where necessary.

## 8.2 ENVIRONMENTAL HEALTH SURVEY

It is suggested that contamination of fresh air intakes by engine exhausts and other pollutants should be frequently monitored and, where appropriate, corrective measures taken when needed.

The atmosphere in working spaces within mud processing areas would need to be monitored frequently, particularly when oil-based muds are in use. Appropriate remedial action would need to be taken if health standards referred to in Section 3.3 a) are not achieved.

# 9. REFERENCES


1. Department of Energy. Offshore Installations: Guidance on Design, Construction and Certification, 4th Edition. HMSO, Consolidated Edition, 1993 (plus Amendment No. 3, 1995). [Withdrawn 1998 by Operations Notice 27].

2. SI 1974 / 289 – The Offshore Installations (Construction and Survey) Regulations 1974, HMSO, 1974. [Revoked and has been replaced by SI 1996 / 913 – The Offshore Installations and Wells (Design and Construction etc.) Regulations, 1996 – ISBN: 0 110 54451 X].

3. Health and Safety Executive. Status of Technical Guidance on Design, Construction and Certification. Operations Notice 27. Revised and Reissued, August 1998.

4. British Standards Institution. BS 5345 – Code of Practice for Selection, Installation and Maintenance of Electrical Apparatus for Use in Potentially Explosive Atmospheres (Other Than Mining Applications or Explosive Processing and Manufacturing). Part 1 – General Recommendations. 1989. [Withdrawn and Replaced by BS EN 60079-14 – Electrical Apparatus for Explosive Gas Atmospheres. Electrical Installations in Hazardous Areas (Other Than Mines). 1997.]

5. British Standards Institution. BS 5345 – Code of Practice for Selection, Installation and Maintenance of Electrical Apparatus for Use in Potentially Explosive Atmospheres (Other Than Mining Applications or Explosive Processing and Manufacturing). Part 2 – Classification of Hazardous Areas. 1983. [Withdrawn and Replaced by BS EN 60079-10 – Electrical Apparatus for Explosive Gas Atmospheres. Classification of Hazardous Areas. 1996.]

6. The Institute of Petroleum. Model Code of Safe Practice for the Petroleum Industry. Part 1 – Electrical Safety Code. 7th Edition. 2000.

7. The Institute of Petroleum. Model Code of Safe Practice for the Petroleum Industry. Part 8- Drilling and Production Safety Code for Offshore Operations. 3rd Edition. 1999.

8. International Maritime Organisation. Code for the Construction and Equipment of Mobile Offshore Drilling Units. 1989. [Plus 1991 amendments.]

9. American Petroleum Institute. API RP 500B – Recommended Practice for Classification of Areas for Electrical Installations at Drilling Rigs and Production Facilities on Land and on Marine Fixed and Mobile Platforms. [Now RP 500 Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class 1, Division 1 and Division 2. 2nd Edition. November 1997.]

10. SI 1978 / 795 – Merchant Shipping (Crew Accommodation) Regulations. 1978. [Revoked by SI 1997 / 1508 – Merchant Shipping (Crew Accommodation) Regulations. 1997.]

11. Health and Safety Executive. Guidance Note EH40 – Occupational Exposure Limits. 2000.

12. Health and Safety Executive. Technical Guidance HSG 70 – Legionnaires Disease. [Replaced by Legionnaires Disease: The Control of Legionella Bacteria in Water Systems – Approved Code of Practice and Guidance. HSE Books. January 2001.]

13. International Maritime Organisation. International Convention for the Safety of Life at Sea (SOLAS). Consolidated Edition. 1997.

14. SI 1978/611 – Offshore Installations (Fire and Fighting Equipment) Regulations, 1978. [Plus all subsequent amendments.]

15. Health and Safety at Work Act. 1974.

16. Institution of Electrical and Electronic Engineers. Recommendations for the Electrical and Electronic Equipment of Mobile and Fixed Offshore Installations. 1992. [Includes First Amendment issued in 1995.]

17. Heating and Ventilating Contractors Association. DW142 – Specification for Sheet Metal Ductwork, Low, Medium and High Pressure. [Replaced by DW144 – Specification for Sheet Metal Ductwork, Low, Medium and High Pressure / Velocity Air Systems. 1998.]

18. Heating and Ventilating Contractors Association. DW143 – A Practical Guide to Ductwork Leakage Testing. 5th Edition. 2000.

19. Building Services Research and Information Association. The Commissioning of Air Systems in Buildings. Application Guide AG 3/89. March 1998.

Printed and published by the Health and Safety Executive
C0.50 07/02

HSE
BOOKS

**MAIL ORDER**
HSE priced and free
publications are
available from:
HSE Books
PO Box 1999
Sudbury
Suffolk CO10 2WA
Tel: 01787 881165
Fax: 01787 313995
Website: www.hsebooks.co.uk

**RETAIL**
HSE priced publications
are available from booksellers

**HEALTH AND SAFETY INFORMATION**
HSE InfoLine
Tel: 08701 545500
Fax: 02920 859260
e-mail: hseinformationservices@natbrit.com
or write to:
HSE Information Services
Caerphilly Business Park
Caerphilly CF83 3GG

HSE website: www.hse.gov.uk

**OTO 2001/066**

**£10.00**

ISBN 0-7176-2519-2

9 780717 625192