HVAC for Oil and Gas

An Online Continuing Education Course for Engineers

Course Number: HV-4016

Credit: 4 Hours / 4 PDH / 4 CPD

HVAC DESIGN FOR OIL & GAS FACILITIES

Course Author: A . Bhatia

HVAC for Oil & Gas Facilities

Oil refineries, processing plants, pipelines, storage farms, LPG/LNG plants, and offshore platforms all utilize or produce a wide range of hazardous combustible and toxic gases. In addition, the processes involved in each can produce non-toxic gases which, when accumulated in high concentrations, depletes oxygen causing a hazardous condition to personnel who occupy the area without proper protection.

The first and foremost factor in design and installation of heating, ventilation and air-conditioning (HVAC) services in oil and gas (O&G) facilities is "SAFETY", which overrules any other activity. Two important objectives must be fulfilled:

1. Occupants' survival

2. Continuation of the specific activities carried out in these structures

This aspect is more relevant and important for off-shore platforms as these facilities are prone to toxic gas releases, which can get pumped out along with crude oil or gas, besides the fire hazard, which is relatively easier to comprehend. These two hazards combined together can play havoc with human life besides damaging the costly equipment that will have an effect on operations downstream.

Design Objectives

Considering the occupational hazards, the HVAC systems must be designed, installed and operated with utmost care and thought given to reliability of design and equipment performance. Specific design objectives include:

1. Maintaining environment conditions (temperature and humidity) appropriate to the operating requirements.

2. Maintaining pressurization between hazardous and non-hazardous areas.

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

4. Filtration of dust, chemical contaminants and odours through chemical and carbon activated filters.

5. 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.

Operation Objectives

The HVAC systems should respond appropriately to the emergency shutdown and provide for operation of essential services during an incident. Specific requirements include:

1. 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.

2. HVAC systems should run continuously. During an emergency, certain parts of the system may still be required to operate.

3. HVAC systems serving spaces where area classification depends on ventilation or where operational aspects require extensive ventilation availability shall have back-up capacity/ adequate standby /redundancy.

4. HVAC systems required for operation during emergency situations shall be powered from dual power sources i.e. main supply as well the emergency power system. The changeover between the normal and main supply shall be reliable and automatic during failure.

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

This course will help explain the complexities of designing offshore installations and how to go about carrying out the design and selection of a proper HVAC system and related equipment.

What's so special for Offshore Installation!

Safety Considerations

An offshore platform is uniquely hazardous in that persons are miles out to the sea and surrounded by huge quantities of combustible material and other toxic gases. The size and composition of the crew of an offshore installation will vary greatly from platform to platform. Because of the cost intensive nature of operating an offshore

platform, it is important to maximize productivity by ensuring work continues 24 hours a day. This means that there are essentially two complete crews onboard at a time, one for day shift and the other for night shift. Crews will also change out at regular intervals, nominally two weeks.

The nature of the operation — extraction of volatile substances sometimes under extreme pressure in a hostile environment poses significant risks. To give an idea, in July 1988, 167 people died when Occidental Petroleum's Alpha offshore production platform, on the Piper field in the North Sea, exploded after a gas leak. The accident greatly accelerated the practice of providing living accommodations on separate rigs, away from those used for extraction. The toxicity and the danger of Hydrogen Sulphide (H_2S), which is the most commonly found gas in oil fields, is immense. Even an exposure of 10ppm concentration of H_2S for about an hour will bring about loss of sight and damage to the brain. Exposure to 200ppm concentration for a duration of less than 5 minutes can result in death.

Since HVAC involves handling air, which can get contaminated with gases, monitoring the air quality is crucial. Adequate care has to be taken to prevent gas ingress into accommodation areas, restrict air flows to prevent spread of gas or fire into surrounding areas and to ensure safe evacuation of personnel.

Labour and Logistical Cost

While the rig is drilling nothing can stop it, because depending on the depth being drilled, you can lose all of the drill and that can costs millions. The HVAC downtime can cause a substantial loss in productivity and can result in the loss of millions of dollars in capital investment.

The cost of an offshore installation is prohibitively high in range of 4 to 5 times that of normal work location. The importance of detailed engineering can not be underestimated, prior to taking up the installation. The idea is to reduce offshore work as much as possible, except the final hook-up which can only be done offshore.

Also on the sea, the amount of maintenance possibilities will be limited - and costly. You have to have redundancy, especially with the air conditioning for critical areas such as main control room, switchgear rooms and areas like that.

Space Constraints

The space is at a premium on any offshore installation, due to the high cost of structural, protective coating and other requirements. Since HVAC is only one of the services required for the installation, the HVAC engineer will usually find himself on the defensive on the space aspect as well. Most of the time, the equipment manufacturer's space requirements cannot be made available in a straight forward manner. The HVAC engineer will be required to justify the space requirements for installation and maintenance with proper documentation. In most of the cases, adequate drawings will have to be made to prove that requir pace will be available. Since all services are virtu proper engineerin be

se found c he e e st

Th the haz

Eng

Offsh y agen g practi ult in cos extren import quipment shall be identifiable with tag nur with the design and engineering philosophy of the project. These tag numbers should appear in all drawings and documents to facilitate easy and fast reference.

A comprehensive documentation of HVAC systems is essential for a proper and complete evaluation. The documentation should cover design, operation and performance qualifications of the system. The design documentation is likely to include, but may not be limited to following: