

DEP SPECIFICATION

HVAC FOR ONSHORE PLANT BUILDINGS

DEP 31.76.10.10-Gen.

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DESIGN AND ENGINEERING PRACTICE

DEM1



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1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for the indoor climate of onshore plant buildings and for the design and engineering of HVAC systems. It takes into account the requirements for safety, operations and personnel.

Buildings that are not part of the process plant shall comply with local planning and building regulations. The principles of this document may be applied to such buildings where relevant but local regulations shall take precedence.

This DEP is applicable only to onshore installations. HVAC systems for offshore installations are covered by DEP 37.76.10.10-Gen.

Local/legal requirement can also be applicable for design of HVAC system.

This DEP contains mandatory requirements to mitigate process safety risks in accordance with Design Engineering Manual (DEM 1) – Application of Technical Standards.

This is a revision of the DEP of the same number dated February 2017; see (1.5) regarding the changes.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

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This DEP is intended for use in facilities related to oil refineries, chemical plants, gas plants and in exploration and production installations. This DEP may also be applied in other similar facilities.

When DEPs are applied, a Management of Change (MOC) process shall be implemented; this is of particular importance when existing facilities are to be modified.

If national and/or local regulations exist in which some of the requirements could 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 with regards to the 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, the objective being to obtain agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

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

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

The **Principal** is the party that initiates the project and ultimately pays for it. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The capitalised term **SHALL [PS]** indicates a process safety requirement.

The word **should** indicates a recommendation.

The word **may** indicates a permitted option.

1.3.2 Specific definitions

Term	Definition
Air handling unit	HVAC equipment that moves air and transforms it by means of filtration, control of temperature and control of moisture content. It typically comprises filters, fan(s), dampers, heating coil, cooling coil (thermal cooling and/or dehumidification). Humidifiers may be included in large AHUs or separately. Note that AHU sizes and configurations can vary widely. The internally located section of a split air-conditioning system is included as an AHU. A 'system' AHU serves multiple areas and is part of a system with distribution ductwork. A 'room' AHU serves only the room in which it is located. An AHU may be designed to work with 100 % fresh air, 100 % recirculation, or a mixture of both fresh and recirculated air.
Chiller	A packaged unit that provides chilled water for use as a cooling medium in AHUs and/or fan-coil units. The water is cooled by refrigerant in a vapour-compression system and heat, thus removed, is rejected via a condenser.
Cold Climates	Locations where the design ambient temperature ranges to below 0°C (32°F) for more than 24 hours.
Condenser	The heat-rejection part of a refrigerant vapour-compression cooling system. It is normally located externally in the form of a heat exchanger that is cooled by means of fans blowing ambient cooling air over it. If liquid cooling medium is available, a condenser can take the form of a shell and tube heat exchanger.
Direct-expansion cooling	A refrigerant vapour-compression cooling system where the refrigerant directly cools a heat-exchanger (also referred to as evaporator) that has room or system air passing through it. The refrigerant is cooled by an external condenser.
Dry Bulb Air Temperature	The temperature of air measured by a thermometer that is not subject to radiation or to moisture.
Fan-coil unit	HVAC equipment through which air is re-circulated from the space in which it is located. The purpose of this re-circulation is to cool or heat this air to the conditions required for the space. This unit is normally connected to the chilled water system.
Human comfort	Defined by the environmental parameters of temperature, radiation, humidity and air movement necessary for thermal comfort and depends on the individual's clothing and activity level.
HVAC system	A heating, ventilation and air-conditioning system which maintains required environmental conditions within rooms or buildings and also fulfils any safety-critical functions such as over-pressure, minimum flow rates and shutdown.

Term	Definition
Interruptible, maintained electrical supply	A source of electrical power which is backed up by a second (emergency) source of power to provide a supply of electricity that may be interrupted for no more than 15 s.
Local Extract Ventilation	Dedicated extract system to contain and remove fumes that are potentially injurious to health, such as welding fumes extract and fume cupboard extract.
Plant buildings	Buildings such as control buildings, field auxiliary rooms (FARs), analyser houses, electrical substations and others (e.g., dedicated flow metering buildings). Such buildings may contain different types of rooms.
Process-critical	Equipment or systems are process-critical if their failure could cause the process to shut down in a safe manner.
Safety critical element	An item of equipment or structure whose failure could lead to the release of a Major Hazard or whose purpose is to prevent or limit the consequences of a major incident, excluding business loss.
Uninterruptible maintained electrical supply	A source of electrical power, which is backed up by a second (emergency) source of power to provide a supply of electricity that may be interrupted for no more than 0.5 ms
Vital Service	Service which, if failing in operation or when called upon, can cause an unsafe condition of the process and/or electrical installation, jeopardise life, or cause major damage to the installation.

1.3.3 Abbreviations

Term	Definition
AHU	Air handling unit
ANSI	American National Standards Institute
CFC	Chlorofluorocarbon
CIBSE	Chartered Institution of Building Services Engineers
CSA	Canadian Standards Association
D&ID	Ducting & Instrumentation Diagram
DCS	Distributed Control System. Also referred to as BPCS (Basic Process Control System)
DX	Direct expansion
EDS	Electronic Data Sheet
EMC	Electromagnetic Compatibility

Term	Definition
FAR	Field Auxiliary Room
FM	Factory Mutual
GWP	Global Warming Potential
HCFC	Hydro-Chloro-Fluoro-Carbon refrigerant
HVAC	Heating, ventilation and air-conditioning
LEV	Local extract ventilation
LSZH	Low Smoke Zero Halogen
MCC	Motor Control Centre
PLC	Programmable Logic Controller
UL	UL LLC (Underwriters Laboratories)
UNS	Unified Numbering System
VSD	Variable speed drive for an electric motor.
WC	Water Closet, toilet, bathroom

1.4 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section or clause number is shown in brackets (). Other documents referenced by this DEP are listed in (11).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a full revision of the DEP of the same number dated February 2017. The following are the main, non-editorial changes.

Section/Clause	Change
2.1.1	The formerly separate sections for Process Safety, Safety-Critical, and Process-Critical have been rationalised and merged.
3.5.1, 1, a	Adoption of EN IEC 62485-2 for battery ventilation.
5.0	Abbreviation of requirements per building type.
8.2, clause 4	Adoption of ISO 16890 for air filtration standard.
9.0, 10.0	Abbreviation of Construction, Commissioning and Handover requirements (which came from former DEP 31.76.10.11-Gen).
Various	Removal of references to Analyser Houses.
General	Removal of duplication and non-value-adding clauses.

1.6 COMMENTS ON THIS DEP

Comments on this DEP may be submitted to the Administrator using one of the following options:

Shell DEPs Online (Users with access to Shell DEPs Online)	Enter the Shell DEPs Online system at https://www.shelldeps.com Select a DEP and then go to the details screen for that DEP. Click on the "Give feedback" link, fill in the online form and submit.
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DEP Standard Form (other users)	Use DEP Standard Form 00.00.05.80-Gen. to record feedback and email the form to the Administrator at standards@shell.com .

Feedback that has been registered in the DEP Feedback System by using one of the above options will be reviewed by the DEP Custodian for potential improvements to the DEP.

1.7 DUAL UNITS

This DEP contains both the International System (SI) units, as well as the corresponding US Customary (USC) units, which are given following the SI units in brackets. When agreed by the Principal, the indicated USC values/units may be used.

1.8 NON NORMATIVE TEXT (COMMENTARY)

Text shown in italic style in this DEP indicates text that is non-normative and is provided as explanation or background information only.

Non-normative text is normally indented slightly to the right of the relevant DEP clause.

2. HVAC PHILOSOPHY

2.1 HVAC FUNCTIONS

2.1.1 Process safety and safety critical requirements

1. HVAC design SHALL [PS] include pressurisation of non-hazardous classified enclosed facilities relative to an adjacent hazardous classified area when the non-hazardous classified area boundary is in contact with the hazardous area and the segregating structure is not gas-tight.

Refer to the applicable area classification code for the level of pressurisation.

Area classification is usually based on normal plant operation, but there might be the possibility of larger hydrocarbon release events spreading beyond the normal hazardous area classification zones, such as major accident hazard events. If the risk of such an event poses a threat to the installation, it is necessary to consider a hierarchy of safety measures that include those mentioned above.

2. HVAC systems for enclosed hazardous classified areas SHALL [PS] be designed to provide the required level of airflow in accordance with the applicable area classification code and to suit the classification requirement of equipment located in these areas.
3. HVAC equipment located in a hazardous area, or potentially handling a flammable air/gas mixture, SHALL [PS] be designed, constructed and certificated in accordance with the governing standard to prevent risk of electrical and mechanical ignition.
Examples of potentially applicable standards include CSA, UL, FM, ATEX or IEC. Refer to installation safety philosophy to check if there is a risk of a major gas release extending outside hazardous areas and which could require HVAC equipment in a non-hazardous area to be classified suitable for a hazardous area.
4. Gas shut-off dampers SHALL [PS] be installed at the air intakes and outlets of non-hazardous classified buildings where there is risk of flammable or toxic gas being present.
5. Gas shut-off dampers SHALL [PS] be installed at the air intakes and outlets of non-hazardous classified buildings that remain occupied and have control/monitoring functions during a credible release of gas.
6. Gas shut-off dampers SHALL [PS] be installed at the air intakes and outlets of mechanically-ventilated hazardous classified facilities where the safety philosophy is based on containment of hazards within the building during abnormal situations.
7. Mechanically-ventilated enclosed hazardous facilities SHALL [PS] be negatively pressurised where the safety philosophy is based on containment of a potential hazard during normal operation.
8. HVAC systems SHALL [PS] shut down (including closure of fire/gas dampers) when required to do so by Fire & Gas or Safety design requirements.
9. Battery rooms SHALL [PS] be ventilated to a level sufficient to prevent accumulation of hydrogen gas
10. HVAC air intakes for non-hazardous classified facilities subject to risk of gas ingress SHALL [PS] be designed to include gas detectors in accordance with the types of gases that can be present from the Principal's installation and any neighbouring installations.
11. HVAC air intakes for manned non-hazardous classified facilities subject to risk of smoke ingress SHALL [PS] be designed to include smoke detectors.
12. The design philosophy shall state whether safety-critical functions are applicable or non-applicable and which facilities they apply to.

13. The design shall enable management of the HVAC systems safety-critical elements during the operating phase.

Rationale: Management of HVAC systems during the operating phase includes testing to demonstrate the continuing suitability of HVAC safety-critical elements.

14. The HVAC design philosophy document shall state how process and safety-critical functions apply to the design with reference to the process safety requirements in this DEP and any other safety- or operationally-critical requirements.

2.1.2 Human requirements

1. HVAC systems shall be designed to provide suitable conditions for human occupation, the type of activity and in accordance with local regulations.
2. HVAC systems shall protect personnel from exposure to potentially harmful substances which can arise from occupational activities.
3. Dedicated systems shall be provided to extract from facilities such as fume cabinets and welding areas.

2.1.3 Operational requirements

1. HVAC systems shall provide a suitable environment for equipment operation based on equipment vendors' requirements and heat emissions.
2. The system configuration shall take into account the criticality of equipment operation and availability of electrical power sources.

3. DESIGN REQUIREMENTS

3.1 INTERNAL DESIGN CONDITIONS

1. Refer to (Appendix A, Table A.1) for normative internal design conditions:
2. Humidification shall be provided for occupied areas if humidity levels would otherwise fall below the minimum requirements for 50% of the occupied times during one-week period.
3. HVAC design shall prevent the formation of moisture from condensing on the surfaces of the building fabric and equipment.

3.2 EXTERNAL DESIGN CONDITIONS

1. External design conditions for HVAC systems shall be based on historical weather data (e.g., Meteorology data) that allows for the possibility of climate change on accordance with ASHRAE or CIBSE guidance.
 - a. Design dry-bulb temperatures shall be based on the following:
 - i. the upper temperature defined as the highest temperature that is exceeded for 1% of the year;
 - ii. the lower temperature defined as the lowest temperature that is exceeded for 99% of the year.
 - b. Design relative humidity values shall be based on a review of data for typical coincident values of humidity and dry-bulb temperatures so that the range of conditions is covered.

HVAC design temperatures are likely to be different from project/process design temperatures.

3.3 AIR QUALITY

3.3.1 Fresh air

1. HVAC systems shall provide fresh air for the following situations:
 - a. buildings classed as occupied (e.g., control building);
 - b. buildings where pressurisation is required;
 - c. for battery rooms, workshops and laboratories that have dedicated extract systems: to replace air extracted and to ensure the extract function is not impaired by air starvation;
 - d. for toilets, to make-up for extracted air (fresh air can be supplied to other areas and transfers to toilets);
 - e. for enclosed hazardous-classified facilities where air-change rates are required to meet particular requirements for adequate dilution ventilation in accordance with the applicable area classification code.
2. Fresh-air should be used for cooling where feasible in terms of temperatures and flowrates.
3. The fresh air flow rate shall be kept to a functional minimum to reduce the energy required to heat, cool or dehumidify outside air, except for situations where fresh air cooling is feasible.
4. Refer to ASHRAE 62 for guidance on the rates of fresh air required to provide acceptable indoor air quality.

3.3.2 Airborne particulate contamination

1. Fresh and recirculated air systems shall comply with the grades shown in (Table A.1).
2. Fresh air filters shall be bag-type in order to extend maintenance intervals.
3. In regions which are subject to dust or sand storms:
 - a. air intakes shall include protective measures such as sand louvres, traps, and high capacity filters;
 - b. condenser units shall be protected from sand/dust or be designed so that they will not be adversely affected by it.
4. Supply fan design duties shall include an allowance for higher resistance of filters in the 'dirty' condition, in accordance with filter Manufacturer's/Supplier's recommendation.

3.3.3 Chemical contaminants

1. Refer to standards IEC 60654-4 or ANSI/ISA S71.04 for contaminant classifications.
2. The risk of chemical corrosion shall be minimised by locating fresh air intakes away from sources of contamination or minimising fresh air ratio for equipment rooms.
3. Chemical filtration/absorption shall be provided where there is a proven risk of chemical corrosion (of electronic equipment) and where equipment reliability would be compromised.

3.3.4 Cold climates

1. In areas subject to freezing, the design shall include pre-heating if there is risk of filters becoming blocked by frozen moisture.