Karachaganak

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Executive Summary

This document is a HVAC Philosophy for general use by KPO in the Republic of Kazakhstan.

CONTENTS

1. INTRODUCTION

1.1 Scope

The HVAC Philosophy provides the design basis and operational philosophies for HVAC (Building Services) systems.

The scope of this document includes heating, ventilation, air conditioning, controls and instrumentation.

1.2 Definitions and Abbreviations

COMPANY/OWNER	Karachaganak Petroleum Operating b.v.
CONTRACTOR	The entity which has been contracted to supply goods and/or services to the COMPANY.
SUPPLIER	The party which manufactures or supplies equipment and/or services to perform the duties specified by COMPANY or CONTRACTOR.
SUB-SUPPLIER	Any party which manufactures or supplies equipment and/or services to the SUPPLIER to perform the duties specified by COMPANY or CONTRACTOR
ASHRAE	American Society of Heating and Refrigeration Engineers
Bara	Bar absolute pressure
Barg.	Bar gauge pressure
BS	British Standard
^{o}C	degree Celsius (temperature)
dB(A)	decibels (A scale)
MPC	Maximum Permissible Concentration
F&G	fire and gas
GOST	Commonwealth of independent states Standard
H_2S	Hydrogen Sulphide
HMI	Human Machine Interface,
HVAC	Heating, Ventilation and Air Conditioning
ICSS	Integrated Control and Safety System
IEE	Institute of Electrical Engineers
KPO	Karachaganak Petroleum Operating B.V.
LP	Low Pressure
LPHW	Low Pressure Hot Water
max.	Maximum
min	Minimum
mg/m^3	milligrams per cubic metre
NR	Noise Rating

PIB	Process Interface Building
ppm	parts per million
RH	Relative Humidity
RK	Republic of Kazakhstan
CN RK	Constraction standarts of the Republic of Kazakhstan
SoR RK	Set of rules of the Republic of Kazakhstan
SNiP	Building rules and regulations
SO_2	Sulphur Dioxide
+ve	Positive air pressure
-ve	Negative air pressure
VNTP	Industry-specific norm for technical design
VSN	Industrial construction standard

2. REFERENCES & STANDARDS

Reference documents and standards are included in Attachment 4 at the end of this document.

The Supplier shall comply with applicable International, Federal, State or Local Codes, regulations, ordinances and rules of Kazakhstan unless defined otherwise. Kazakhstan standards shall take precedence in case of conflicting statements contained in this Specification.

3. HVAC DESIGN BASIS

3.1 General

This section identifies the parameters that are to be used for the design of HVAC and building services.
For each project, the CONTRACTOR shall submit a HVAC Basis of Design document to the COMPANY in advance of any other design documents being produced. This is to enable the COMPANY to review proposals and, if required, request amendments thereto.

3.2 External Conditions for HVAC duty calculations

a) Summer
Dry bulb temperature and mean coincident web bulb temperature (or relative humidity) shall selected as values that are not exceeded for 1% of the time annually

b) Winter
Dry bulb temperature shall be selected as a value that is exceeded for 99% of the time annually. Humidity shall be selected as 100%RH for dry bulb temperatures between sub-zero and zero °C.

NOTE: Where applicable, HVAC design shall also allow for any external blast over- and under-pressures as stated in building design documents.

For external temperature conditions refer to the COMPANY specification KPO-00-ENG-PHL-00009-E “Climatic, Environmental and Utility Data”.

The room air conditions for particular facilities shall be as per ATTACHMENT 1- Building Environmental Data and/or equipment operating temperature requirements. Room air conditions for other facilities shall be as per applicable RoK and international standards and rules.

3.3 External Conditions for HVAC Equipment Specification

Externally located HVAC equipment shall be specified to withstand and to remain operating in the most extreme conditions that may occur at the site. This shall include extreme temperatures, wind, precipitation, snow, ice and dust. For ambient temperature for equipment design refer to COMPANY specification KPO-00-ENG-PHL-00009-E, “Climatic, Environmental and Utility Data”.

3.4 Site Utility Services

Utility services such as heating medium or cooling medium which are available on the site may be used for HVAC systems where feasible, taking into account the availability and reliability of such services. Refer also to the project Utilities Specification document KPO-00-ENG-PHL-00009-E. SUPPLER shall submit his required Utility Consumptions with his Tender Bid documents.

3.5 Air Change Rates and Ventilation

Ventilation rates shall be determined for each building in accordance with the requirements listed below. Localised ventilation shall be used where required, e.g. for cooling or control of hazards. Dedicated ventilation systems shall be provided for diesel fire pumps and compressor cooling installations.

Design air change rates shall be based on the most onerous of the following requirements as they apply to each building:

1. Airflow for temperature control during winter and summer where air is used as a cooling and/or heating medium within rooms. Fresh air cooling may be employed where the resultant conditions can be accepted.
2. To provide adequate fresh air supply for areas that are defined as 'occupied'. This is for personnel welfare, comfort and odour control. The fresh air ventilation rates shall be based on ASHRAE 62.1 and shall not allow for smoking (smoking is not permitted at KPO sites).
3. To provide the fresh air necessary to obtain building pressurisation requirements.
4. To provide a supply of make-up fair to supplement process/mechanical equipment exhausts.
5. To dilute and control substances that are toxic or otherwise hazardous to personnel. For such conditions, Local Extract Ventilation may be required along with enclosure of the hazard sources.
6. To provide adequate dilution of flammable gases and vapours in hazardous classified areas and to meet requirements of the applicable hazardous area classification code.

The cooling requirements for electronic equipment shall be based on the equipment manufacturer's heat emissions data. Generic heat outputs based on floor area may be used for lighting but shall not be used for equipment.

3.6 Pressurisation

HVAC systems shall be designed to provide pressurisation for the following situations:

- where required by area classification codes
- to prevent ingress of atmospheric toxic/flammable hazards (where applicable)
- to prevent ingress of atmospheric dust/sand
- to prevent egress of hazardous material (including rooms containing high-gassing batteries)

Refer to Attachment 1 for further details of applicability.

Where pressurisation is required, the CONTRACTOR shall ensure that building construction methodology and details will provide buildings of low leakage that will be able to obtain the required pressurisation levels.

3.7 Environmental Acoustic Criteria

The building services design shall be undertaken using the room acoustic data as provided within the Environmental Data Sheet refer Attachment 1 and shall conform to MCN 2.04-03-2005 – “Noise protection” and Order of the Minister of National Economy of the Republic of Kazakhstan No 169, dated 28 Feb 2015.

Sound level measurements of building services equipment shall be recorded when all other plant is not operating.

The sound levels of building services equipment shall not contribute to room sound levels being exceeded in conjunction with other sources of sound. Therefore, HVAC system sound levels shall generally be at least 5dB(A) below other sound levels.

3.8 Hazard Assessments

Design of the ventilation, pressurisation and air conditioning system shall reflect reliable
operation to ensure the safety of equipment, control systems and personnel in the buildings. All normally manned buildings shall have defined impairment criteria. HVAC systems shall be identified as SCE and have performance standards developed accordingly. The design shall also consider the location of the building to minimise risk from external hazards.

For new buildings all potential external hazards pertaining to building location shall be evaluated through specific hazards assessment or checked within existing studies for hazards derived from existing process equipment.

Ventilation requirements for hazardous locations are detailed in VNTP 3-85, Section 4,

Paragraphs 4.26 to 4.50; for safe areas, the requirements of GOST 12.1.005-88, ‘Air in the Work Zone’, shall be met.

Due to possible presence of toxic gases, all fresh air inlets to continuously occupied and process areas shall be at a minimum elevation of 20m, and all inlets to utilities unmanned areas and offsite unmanned areas shall be at a minimum elevation of 5m above grade and shall be taken into account local conditions such as the topography of the territory, the prevailing wind direction, the absence of gas emissions in the air intake zone.

4. HVAC SYSTEMS AND EQUIPMENT DESIGN

4.1 Air Intakes and Outlets

Air intake locations shall comply with VNTP 3-85, SN RK 4.02-01-2011, SoR RK 4.02-101-2012 and VSN 21-77

Generally:

- To allow for the effects of air-borne particulate matter, filtration chambers shall be installed adjacent to air intakes to remove dust and sand from the air. In areas of sandstorms and intense dust and sand transfer, sand trap louvers at inlet and chambers for the deposition of large particles of dust and sand shall be used. For areas where inlet located at 20m height, protective steel bird mesh screen and louvre shall be installed.
- Air intakes for systems of mechanical ventilation shall be located in non-hazardous areas where no hazardous mixtures can be formed as indicated on relevant Hazardous Area Classification drawings.
- The height of air intake apertures from ground level should be minimum 20 metres for the buildings and structures located in the industrial area with fire resistance category of «А» and «Б», regardless of the whether the building is occupied or not. (Building class according to VNTP-3-85 classification).
- For the buildings and structures located in utilities area, power generation and chemical storage areas (building class according to VNTP-3-85 classification), height of the air intake apertures should be minimum 5m
- The air outlets of industrial areas ventilation systems should be located minimum at 10 m horizontally from the outside air inlets, or 6 m vertically when the horizontal distance is under 10m. In addition to this, the outlets of local toxic substances extract systems should be located a minimum of 2m above the roof of the higher part of the building, if the distance to the brow is under 10m. The outlets of emergency ventilation systems should be located at the minimum height of 3m from the ground to the bottom edge of the vent.
- Air intake stacks shall be used for all buildings at risk of contamination from toxic gas releases. Areas normally continuously occupied shall have inlets located at 20m above grade. The height of the inlet stacks shall be 20m unless it can be proven that a lower height will be adequate for the hazard scenarios associated with the plant.
- Areas not normally continuously occupied shall have inlets located at a minimum of 5m above grade.

Gas detectors shall be installed within all air intakes at the process plant and in accordance with risk of gas ingress. Smoke detectors shall be installed at air intakes in accordance with the fire protection philosophy. Externally located HVAC equipment shall be constructed and classified suitable for a hazardous area where there is risk of it being exposed to undetected flammable gas. Such equipment does not require to be suitable for a hazardous area if the gas released would initially be a H_2S cloud that would be detected and cause equipment isolation prior to the possibility of it being exposed to flammable gas.

Where feasible, air intake ducts, gas detectors and intake fire/gas dampers shall be arranged so that the intake fire/gas damper will be closed before it can be reached by gas that has arrived at the gas detectors. This requires a suitably large air volume between the gas detectors and the damper to compensate for the F&G system operating time and damper closing time.

4.2 Air Filtration Requirements

The following air filtration plant shall be installed as required:

Pre-filter Section:
Panel filter of 85% efficiency under the ASHRAE gravimetric test (or ISO 16890 equivalent). Air velocity through the filter shall not exceed 2.6m/sec or manufacturer's recommendation.

Secondary Filter Section:
Bag type filter of 95% efficiency under ASHRAE opacimetric test (or ISO 16890 equivalent). Air velocity through the filter shall not exceed 2.6m/sec or manufacturer's recommendation.

Filter frames shall be of non-flammable material. Filters shall be installed before air heaters.

4.3 Atmospheric Pollution

The concentration of toxic and any other chemical substances at air intakes shall be calculated taking into account the source characteristics (concentration, quantity, frequency, relative location) and background concentrations.

Concentrations shall not be more than:

1. 30% of maximum permissible concentration (MPC) in the air of operating areas for industrial, administrative and residential buildings and premises
2. MPC in the air surrounding residential and public premises
3. Data on air pollution levels at the construction site

Gas scrubbing filters shall be provided at HVAC air intakes, subject to COMPANY approval, where there is risk of:

- personnel being exposed to concentrations above acceptable levels in accordance with internationally agreed concentration thresholds
- chemical corrosion of electronic (and other vulnerable) equipment that is either safety- or production-critical.

Refer also to the project Environmental specification document.

4.4 Protective Dampers

For buildings where gas ingress is a potential hazard, gas tight shut off dampers capable of being remotely operated shall be installed on inlet and exhaust ducts where they penetrate the building boundary. These dampers shall close upon gas detection and the HVAC system(s) shall continue to operate in full recirculation mode only. For systems without gas tight dampers the HVAC plant shall shut down if gas is detected.

Fire dampers shall be installed inside buildings that are not classified as 'plant buildings' where required to comply with local regulations.

4.5 Humidification and Dehumidification

Where required humidification shall be provided by means of evaporating steam type humidifier unit(s) which use either electric heating elements or other heating medium (if available). The water supply shall be purified with reverse osmosis or other treatment system to ensure that the humidifier will not be affected by scale from dissolved particles in the water supply.

Dehumidification shall be obtained by cooling air to below its dewpoint and re-heating as required.

4.6 Hazardous Area Ventilation

The CONTRACTOR may propose to base hazardous area ventilation on the newer area classification code EI15 subject to obtaining COMPANY approval and meeting requirements of RoK standards. The design shall allow for the following issues/requirements:

(a) Typically local regulations require normal and emergency ventilation plants. Normal ventilation shall positively pressurise and provide [typically] 10 air changes per hour (ACH). High and low level extract points to be provided.
(b) The emergency ventilation plant has additional capacity of 8ACH overall based on the full building height and maintain a negative pressure (refer to section 4.14)
(c) Emergency Ventilation shall be suitable for safe operation in flammable environment and shall be designed for Zone 1.
(d) A minimum of 12 air changes per hour based on full building height shall be provided to all enclosed process buildings to ensure the internal area is classified as Zone 2. In case of large buildings this requirement may be impracticable, In no case shall the ventilation flow rates be less than flow rates based on EI15 and IEC 600079 for maintaining Zone 2 inside the building. (Attachment 1, Note 9)
(e) The emergency fans (item b) can be used to provide supplementary cooling during summer conditions.
(f) The normal ventilation plant shall be provided with standby plant.
(g) The philosophy requirement; “The air inlet shall be located at the opposite end of the building to, and upwind of, the exhaust air discharge point.” shall be incorporated.
(h) Ventilation plant shall be located at high level above and clear of any crane facility and within a 2 or 3m high zone.
(i) Extracts shall be ducted at high and low level with fans located at high level.
(j) High-level supply ducts shall distribute air terminating with a series of high velocity jet diffusers, having sufficient throw to reach low level.
(k) All HVAC equipment to be located inside buildings where possible.
(l) low level extract ducts are required to extract heavier-than-air gases.
(m) Generally vertical ducts to be located between building columns or at ends of buildings, where possible, similarly access to HVAC platforms to be at end of building.
(n) Locations of designated safe areas shall be determined in accordance with hazardous area classification drawings.
(o) Equipment located in a hazardous area shall be ATEX classified for hazardous area operation, including mechanical ignition protection.

4.7 Process and Utility Buildings Pressurisation

The following is general only and is subject to specific requirements detailed in Attachment 1 of this Specification and also to any particular project requirements.

1. Enclosed process type buildings that are classified as hazardous (pump houses, compressor houses and utility plant), shall be continuously served by heating and ventilation plant. This shall ensure an appropriate rate of air dilution, and result in a building air pressure that is positive to atmospheric during normal operation. Operation of the emergency ventilation system shall result in a building air pressure that is negative to atmospheric.
2. Non-hazardous classified utility buildings such as substations, control rooms, process interface buildings and instrument rack room require normal operations to be conducted in a relatively “clean” environment. They shall be continuously supplied with air conditioning and/or heating and ventilation, at the appropriate air dilution rate, and maintain a building air pressure that is positive to atmosphere and/or any adjacent hazardous area. There might be circumstances whereby hazardous areas overlap with non-hazardous classified building. Such buildings shall avoid any openings in external walls, such as windows to avoid flammable gas seeping inside unclassified area in the event of HVAC malfunction.

4.8 Noise and Vibration

The building services systems shall be designed to:

1. Limit to acceptable levels the generation of sound within ductwork, ductwork fittings, control devices and air terminal devices;
2. Prevent the transmission of externally generated sound to inside the building via the HVAC System;
3. Prevent sound transmission from one area of the building to another via the HVAC System.

Acoustic insulation material shall not be installed internally within ductwork.

Where acoustic insulation is required to reduce noise break-in, or breakout of a system, this shall be fixed to the outside of ductwork and combined where necessary with thermal insulation.

The insulation shall be produced from materials exhibiting;

1. Resistance to shedding/wicking under normal use.
2. Resistance to smoke, fire and water.
3. Resistance to mould growth and vermin.
4. Low toxic emissions.

Within buildings, ductwork insulation shall be provided with mechanical protection (sheet steel jacket or a suitable composite wrapping) for a height of at least 2.0 metres above floors and adjacent walkways. Other ductwork insulation that is not at risk of mechanical damage shall have a reinforced foil finish or over-wrap.

Ductwork sound attenuators shall be constructed with the acoustic material retained by perforated mesh having a membrane to prevent the acoustic material from degrading and becoming entrained in the air stream. Acoustic splitters shall be designed to minimise airflow resistance and shall include bull-nosed upstream sections on the splitters.

All fans and pumps shall be provided with anti-vibration mountings and flexible connections (bellows) to minimise the transmission of sound and vibration to the building structure.

Anti-vibration mountings shall be of the spring or inertia base type, or a combination of both to suit the vibration frequencies that are to be isolated. Spring mountings shall be of the enclosed type suitable for retaining the spring in the event of failure.

Vibration isolation efficiency shall not be less than 98%.

Building services pipework shall be supported from adjustable spring hangers in plant room areas where necessary to prevent transmission of sound and vibration, as appropriate.

Where terminal grilles and diffusers are in direct contact with walls and ceilings, closed cell neoprene strips shall be inserted between the contact areas.

Where equipment can produce excessive out of balance forces, i.e. water pumps, these shall be mounted on inertia blocks with the anti-vibration mountings supporting these blocks.

All HVAC equipment shall be selected to provide quiet and efficient operation.

4.9 Fire and Smoke Spread

All services entry and exit points shall be gas- and fire-tight in accordance with the hazards applicable to each building and the fire regulations applicable to the building design. Services entry and exit points shall not distort under fire conditions or allow premature collapse of the connected systems. Refer also to the RDS RoK 2.02-11-2001.

Fire dampers should be installed to block the spread of fire and products of combustion to adjacent rooms through air ducts, shafts and channels. Fire resistance of the device shall be not less than degree of fire resistance of a wall construction design. Characteristics of fire dampers must meet the requirements of Project Specification N_0 KPO-00-HVA-SPC-00004-ER HVAC EQUIPMENT.

Air ducts with rated limits of fire resistance should be provided in accordance with applicable regulations. (SN RK 4.02-01-2011 p. 7.8)

For smoke protection of buildings and structures should provide a set of technical means that ensure the prevention of the danger of smoke in buildings in case of fire in accordance with the requirements of the technical regulation "General requirements of fire safety".

4.10 Heater/Cooler battery Sizing

All terminal batteries shall be sized to achieve the required design parameters, refer Attachment 1.

Zone reheaters shall be sized on an “off coil” temperature capable of maintaining the space condition for summer or winter operation.

The cooling requirement shall be sized based on the maximum heat gain from the facility, including any provision for future process plant installation.

The differential between air delivery temperature and room design temperature shall not exceed guidance in ASHRAE. Higher differentials may be used to reduce airflow rates for unoccupied or industrial areas where there would be no consequence.

4.11 Sizing of Elements

In general, each fan, pump or similar fluid flow inducing device shall be capable of continuous fluid delivery at the worst operating conditions i.e. dirty filters or strainers.

Except for electronic/ electrical equipment rooms, a 5% margin shall be added to calculated heating and cooling duties to allow for unforeseen issues and any inadequacies in manufacturers' equipment ratings.

For electronic/electrical equipment rooms, a 15% margin shall be added to cooling duties to allow for possible additional equipment. The margin to be applied for such facilities shall be agreed with COMPANY prior to commencing detail design.

All system components, i.e. filters, cooling/heating coils, fans, attenuators, ductwork and pipework distributions etc.; shall be sized to perform at the increased duties.

4.12 Plant Access and Removal

The Building Services plant and equipment layout shall be designed to ensure adequate space provision for servicing or removal of major plant items without disruption of adjoining plant and allowing full operation of any associated standby unit. Adequate isolation valves shall be provided for ease of removal/replacement/servicing. This shall include, but is not restricted to, pumps, domestic water heaters, sanitary and kitchen fittings and heat emitters.

Duty/standby fan installations shall be provided with shut-off and isolation dampers to enable removal of a faulty fan while the other fan continues in operation.

Ductwork, pipework, valves, controls shall be positioned to enable safe and easy access for inspection and servicing and shall not compromise plant removal.

Services serving more than one area shall allow isolation of each area without affecting operation of the remaining areas.

4.13 Availability of Electrical Power

Electrical power usage shall be kept to a minimum in all areas of the project. Consequently, the use of electricity as a heating medium shall be discouraged. All electric powered equipment, e.g. chillers and fans shall be selected with regard to maximum efficiency. The use of all electrically powered HVAC plant shall be discussed in detail with the COMPANY. The security of power supply for buildings located close to areas with risk of explosion shall be based on the following:

- For buildings classed as category I for electricity supply provision, the electrical consumers must be provided with a stand-by capacity.in accordance with the Regulations on Electrical Installations,
- All air-conditioning and ventilation units serving category I buildings must possess both duty and standby installations, with automatic switchover to the standby if the duty units fail.
- The power supply to the operational and reserve ventilator motors must be provided from independent power sources, or alternatively, power may be provided from a single source, but from different transformers of a twin-transformer substation. In this case the substations must be connected to different feed lines and be equipped with an automatic reserve cut-in, as a general rule on the low voltage side.

All electrically powered plant shall be installed with a local, manual, emergency stop button, of the lock-off, twist to reset type. Changeover of electrical power source may be done upstream of the HVAC panel in accordance with electrical system design.

Electrical installations of heating, ventilation, air conditioning and smoke ventilation systems must comply with the requirements of the Electrical Installation Rules of the Republic of Kazakhstan (EIR) and the standards for electrical installations of buildings, taking into account the requirements of this section.

4.14 Emergency Ventilation

Emergency ventilation shall be arranged as required by SoR RK 4.02-101-2012, CN RK 4.02-01-2011, VSN 21-77, VNTP 3-85.

Emergency ventilation shall be provided for intensive ventilation in areas where large quantities emissions of harmful or combustible gases, vapours or aerosols may suddenly occur as a result of the unexpected emergency of technological process and integrity of process equipment and pipelines.

Emergency ventilation systems shall be automatic and switch on by alarm of 20% lower than exclusivity limit or alarm of maximum allowable concentration in gas detectors. In addition to automatic, for emergency ventilation systems shall be provided manual (remote and local) controls.

For alarm set points refer to KPO F&G Philosophy, document KPO-00-INS-PHL-00003.

Capacity of Emergency Ventilation system shall be:

a) For pump and compressor buildings additional capacity of 8 ACH overall based on the full building height
b) For other buildings capacity of 8 ACH overall based on the full building height together with main HVAC system

To compensate airflow removed by emergency ventilation shall be used following:

a) Additional Air Handling Unit to compensate removed air by Emergency ventilation;
b) Automatic openings.

Air removing by emergency ventilation should be located in the areas of possible inflow of explosive and harmful gases, near process equipment and blind walls, but not near windows and doors.

Standby fans are not required for emergency ventilation.

4.15 Standby Plant and Equipment

The necessity for the installation of standby units serving ventilation and air conditioning systems shall be determined in accordance with SP RK 4.02-101-2012, SN RK 4.02-01-2011

For all heated buildings adequate provision shall be made to ensure that failure of any single heat emitter shall not cause space temperatures to fall below +5°C db. Further reference should be made to VNTP 3-85, Section 4:‘Standards for engineering design of facilities for gathering, transport and treatment of oil, gas, and water in oil fields.’

HVAC systems shall be provided with a standby fan (or fan motor) or provided with two HVAC units. Ventilation systems for industrial, laboratory, warehouse and household facilities continuously occupied, shall be provided with standby supply and exhaust fans, or two supply units and two exhaust fans with a flow rate of 50% of the required total air flow.

4.16 Decentralised System

Generally, separate ventilation systems shall be used per building. The use of centralised or multiple ventilation systems (both supply and exhaust) per building shall be determined in accordance with applicable standards.

According to regulations there are limitations as to establishing the groups of buildings according to their service and fire resistance category. There are no restrictions in the codes as to dividing ventilation systems into several systems, servicing building groups, This states that several ventilation systems for one building, can be designed, only if they are justified by the feasibility study – which shall verify the use of decentralised systems proposed.

4.17 General Ventilation Requirements.

The provision of multiple, roof-mounted, extract fans on the larger volume buildings such as storage, plant and workshops shall be based on the following criteria;

(1) A minimum of two fan units each rated at 50% of the total volume flow.

(2) For larger buildings a fan shall serve approximately 150m². of floor area.

All roof-mounted equipment shall be selected and located to ensure that snow piling shall not affect normal operation.

4.18 Battery Room Ventilation

The requirements for ventilating batteries shall be calculated in accordance with EN-50272-2, EIR RoK (Electrical Installation rules) or in accordance with battery manufacturer's requirements.

Battery Room exhaust fans shall be arranged as 100% duty and standby units and shall have automatic changeover on failure of the duty fan. On mains power failure fans shall be energised from the emergency power supply.

Fans shall be suitable for operation within a hazardous environment (Zone 1, IIC, T6). The battery room area classification shall follow the guidance of the applicable area classification code and EN-50272-2.

A dedicated fan failure signal shall be provided to the Fire and Gas system.

On loss of airflow, the Fire and Gas system shall trip the boost charge facility.

Battery room temperature shall be kept within the values stated in Attachment 1 in order to optimise battery life.

4.19 Toilet Extract Ventilation

Toilet extract fans shall be arranged as 100% duty and standby units and shall have automatic changeover on failure of the duty fan.

Replacement air for toilet extract systems shall transfer from internal areas and shall not be added to the design fresh air flowrate.

4.20 Instrumentation and Controls.

Instrumentation and automation shall be in accordance with COMPANY standard KPO-00-INS-SPC-00009-E "General Instrumentation Specification", KPO-00-INS-SPC-00020-E "Standard Process Control & Safeguarding Functional Specification", KPO-00-INS-SPC-00015-E Specification for Instrument Requirements for Package Units.

The HVAC Supplier shall provide all the instruments and relevant process, pneumatic/hydraulic (if any), and electrical hook-ups.

Field instrumentation shall generally be 24VDC. Solenoid valves shall be 24VDC. Electronic transmitters shall be SMART type suitable for maintenance by dedicate software for HART application. Electronic transmitters shall have an output signal 4÷20mA obtained through a two-wire system, and shall have a local output indicator (digital type). Electronic Transmitter's Supplier has to provide the software library for the HART protocol/maintenance PC in order to allow the remote calibration, maintenance, diagnostic.

Trip function shall be provided with electronic transmitter. Thresholds set-up on analogue signals from transmitters shall be used for trip service. Instrument for trip purpose shall be not used for other functions, such as measurement or control. Any instrument used for safety application shall be compliant to SIL rating class required by project SIL assessment.

All instruments shall be terminated to relevant junction boxes located at skid limits; and wired properly to the relevant cabinets via multi-cables.

Junction boxes and panels shall be designed and constructed in such a way as to segregate the power from electric components, to avoid electromagnetic disturbances to the electronic instrument circuits.

All cables shall be in accordance with KPO-00-ENG-SPE-00033-ER Specification for Power and Control, Instrumentation and Telecommunication Cable. For control and instrumentation duty cabling shall be flame retardant, and comply with IEC 60332-1. For safety applications, ESD/F&G, including Fire Dampers and F&G detection circuits, Fire Fighting system facilities, and beacons flashing lights, the cabling shall be fire resistant and meet the additional fire performance characteristics defined in IEC 60331.

The heating, ventilation and air conditioning systems installed within each building shall be fully automatic and operate on a stand-alone basis. A dedicated HVAC control system located in a dedicate panel/cabinet shall be provided within each plantroom. The HVAC control system shall be selected for high reliability to operate both in normal and emergency modes. It shall house all associated electrical starters, isolators, relays, controllers, etc. and shall provide full status indication of the plant. Refer to BCH21-77 - Section12.

Controls shall enable automatic operation without human intervention but shall include facilities to allow for repairs and maintenance (including function tests).

HVAC control system shall be interfaced via hardware connection with the Safety System (ESD/FGS) associated with each building and the interface shall be of robust integrity to ensure that shut-down and isolation functions will be obtained when required as per project Cause and Effect Matrix.

HVAC control system shal be interfaced via redundant serial link to Control System (DCS) in order to share all the available data (measure, status, alarm) with the main/building control room facilities via dedicated graphic pages on main/building HMI. Hardware connection is acceptable for cumulative alarm/fault, critical status or measure that shall be monitored by control room, but the number shall be very limited.

HVAC control system shall include at least:

- Human Machine Interface (HMI), located on the control panel.
- Control package system (PLC with CPUs, I/O cards, communication cards, Power supply modules, etc.),
- Marshalling cabinets.

The following control functions shall be provided:

1. Building Management System (BMS)

Complex buildings such as Administration Office Building and Control Building shall have fully intelligent, dual language, Building Management Systems (BMS).
Each BMS shall provide environmental control, energy and maintenance management of the heating, ventilation, air conditioning and associated building services. The system shall comprise, but not limited to, the following features; close control, monitoring, data logging, set point change, occupancy rescheduling, space temperature verification, equipment start/stop/change-over.

2. Package Equipment

The air conditioning, refrigerant condenser, water chilling, water pressurisation units and boilers etc shall operate automatically from on/off/automatic controllers positioned local to units. Electrical isolation and operating status shall be indicated at the Building HVAC control panel. Package equipment control panels shall have facility to send alarms to a central control system and to receive shut-down command signals.

3. Toilet Extract Fan Units

Toilet extract fans shall be controlled from time switches. Operation of time switches shall be performed at the building HVAC control panel.

Fan motor on/off status shall be provided at the HVAC control panel.

4. Air Handling Unit and Air Recirculation Fan Unit

The air handling unit and recirculatory fan shall automatically control the quality and quantity of supply air required maintaining rooms at design conditions.

Temperature and humidity sensors located within the extract air ducts, from the rooms, shall control the energy load output from the heating and cooling coils, and humidifier unit.

Air differential pressure switches, positioned across the filters, shall automatically indicate a “dirty” filter condition, i.e. a requirement for filter change that shall be signalled to the HVAC control panel.

Air differential pressure switches, positioned across the supply fan and recirculatory air fan, shall automatically indicate a fan airflow failure status at the HVAC control panel and initiate a standby fan if specified.

Air shut off damper actuators shall be interlocked with their associated fan motor contactors, so that in the event of fan failure, or fire smoke detection, the associated shut off dampers shall close.

5. Ventilation fans

The supply and exhaust air fans that provide mechanical ventilation shall be operated manually from a “timer” located within the Building HVAC control panel.

Fan motor on/off status shall be indicated at the HVAC control panel.

6. Winter Heating

For general design basis see VNTP-3-85, in particular, section 4; ‘Requirements for Heat Supply, Heating, Ventilation and Air Conditioning’, SP RK 4.02-101-2012.

Heating medium parameters shall be monitored in the Internal heat supply systems by control temperature and pressure of heating medium in the supply and return pipelines of the HVAC unit, and temperature and pressure at the outlet of heat exchangers;

Unit heater fans shall be controlled during winter season by air temperature detectors. Low Temperature hot water heating serving the unit heaters shall be controlled automatically from pipeline control valves. Summer operation shall be controlled manually from timed controllers. On/off system status shall be indicated at the building control panel.

All motorised, heating, control valves shall fail safe, in the open position.

All electrical, duct mounted, heating coils shall be interlocked with their associated supply air fan, such that power remains off until airflow has been established.

7. Emergency Electrical Generation Mode

At all times, air handling unit fans or dedicated pressurisation fans shall operate in the positive pressurisation mode, with a maximum allowable power consumption of 3kw. In summer, cooling will not be available until restoration of the normal electrical supply.

In winter, electrical power up to a maximum of 3kW shall power circulating pumps and any fans necessary to circulate warm air for minimum heat circulation purposes.

8. Domestic Hot Water System

The centralised hot water temperature and shower water temperature shall be controlled automatically from an integral water thermostat provided at source. Hot water circulation shall be continuous.

9. Pumps

Where duty and standby circulating pumps are provided a pressure differential detector shall initiate the automatic changeover to the standby pump on duty failure.

4.21 Plant Safety System (ESD/ Fire&Gas) Interface

Each HVAC system shall interface with the building safety protection system (ESD/F&G). The safety system output will provide a volt free contact rated for 24v D.C.

The HVAC systems shall be capable of performing the following general functions on receipt of a signal.

(1) Shut down HVAC plant which does not have gas-tight dampers at air inlets and outlets.

(2) Flammable or toxic gas detection signal connected to plant F&G shall close gas-tight dampers at air inlets and outlets and shall operate HVAC plant on full recirculation. External HVAC plant shall be isolated if required.

(3) Initiate emergency ventilation systems within buildings where such systems are provided.

4.22 Fireman's Panel

Manually operated fireman's switches shall enable on/off control over the exhaust air fan units in the event of a fire. The switch shall be located within an enclosure positioned within a Non-hazardous area.

4.23 Equipment Failure/General Alarm

The HVAC control panel shall be provided with the following 24v DC, volt free contacts;

(1) A common alarm for any fault relayed to the HVAC panel.

(2) System healthy.

(3) Battery extract ventilation failure. On loss of airflow, the Fire and Gas system shall trip the boost charge facility.

4.24 Process Ventilation

The following process equipment ventilation systems shall be incorporated within the building heating and ventilation systems:

- Air Compressor ducted cooling system in plant building;
- Firewater Pump ducted cooling system in Pump House.

4.25 Heating Source

In the rooms with category A and B, Electrical and PIB rooms forced air heating ventilation systems shall be used.
Additional water or steam radiator heating can be considered in following conditions:

a) If room area not more than 150m^2
b) if the surface temperature of heating devices and pipelines does not exceed 80% of the auto-ignition temperature of gases that may be in the room
c) if there are no vapors, gases, liquids or dust in the room that, when interacting with water or water vapor, are capable of exploding, self-igniting or emitting explosive gases.

The coolant input node can be located:

- in the room for the equipment of supply ventilation systems (supply ventilation chamber);
- in rooms with productions of categories G, D if it is allowed under production conditions;
- in a separate room with a separate entrance to it from the outside, from the stairwell or from the premises with the production of categories B, D, D.

In the absence of the rooms specified above the control unit can be located in rooms with productions of categories a, B, C in which water or steam heating is allowed.

ATTACHMENT 1 - BUILDINGS ENVIRONMENTAL DATA

INTERNAL CONDITIONS

Description	Air Temp. °C db.	Relative Humidity % RH	Fresh air Ac/hr	Notional Air Pressure *(Note 2)*	NR Sound *(Note 4)*	Area Class'n
Control Rooms & Centres + PIB's	22 ± 1	50 ± 10	Note 3	+VE	40 - 50	Non-hazardous
Pump Houses & Compressor Houses containing potentially hazardous gases	40 Max 5 Min.	US	12 ac/hr & to suit local regulations Note 9	+VE (Normal) -Ve (Emergency) **See Note 7**	Note10	Zone 2 with 'adequate' ventilation
Utility Buildings Non-hazardous	45 Max. 5 Min.	US	Note 3	-Ve	Note10	Non-hazardous
Chemical & additives store	40/45 Max. 5 Min.	US	Notes 3, 8 & 9.	-Ve	Note10	Hazardous
Electrical Substations + Rackrooms	30 Max. 10 Min.	US	Note 3	+VE	70	Non-hazardous
Battery Rooms	30 Max. 10 Min.	US	Note 12	-VE	70	Zone 1, IIC, T6
Plant Rooms	45 Max. 10 Min.	US	Notes 3 & 5	-VE	75	Non-hazardous
Boiler Rooms	45 Max. 10 Min.	US	Notes 3 & 5	0/-VE (note 6)	75	Non-hazardous
Computer Rooms	22±2	50±10	Note 3	+VE	50	Non-hazardous
Telecom & Radio Rooms	30 Max. 18 Min.	US	Note 3	+VE	40	Non-hazardous
Production & Operation Departments	25 Max. 18 Min.	US	Note 3	0	55	Non-hazardous
Maintenance Rooms	15 Min.	US	Note 3	0/-VE	55	Non-hazardous
Fire Fighting Areas	10 Min.	US	Note 3	0/-VE	Note10	Non-hazardous
Gas Turbine	10 Min.	US	Note 3	0/-VE	Note10	Non-hazardous
Generator Room	10 Min.*	US	Note 3	0/-VE	Note10	Non-hazardous
Toilets/Change Lockers & Showers	30 Max. 18 Min.	US	Note 11	-VE	50	Non-hazardous
Offices	22±2	50±10	Note 3	+VE	40	Non-hazardous
Lobbies and Corridors	30 Max. 18 Min.	US	Note 3	+VE	50	Non-hazardous
Stores	10 Min.	US	Notes 3 & 8	0	65	Non-hazardous
Workshops	15 Min.	US	Notes 3 & 8	0/-VE	55	Non-hazardous

INTERNAL CONDITIONS						
Description	**Air Temp. °C db.**	**Relative Humidity % RH**	**Fresh air Ac/hr**	**Notional Air Pressure *(Note 2)***	**NR Sound *(Note 4)***	**Area Class'n**
Warehouses	10 Min.	US	Notes 3 & 8	0/-VE	55	Non-hazardous
Tea Room (no smoking)	15 Min.	US	Note 3	-VE	55	Non-hazardous
Breakroom / Restroom Lounge	25 Max. 18 Min.	US	Note 3	+VE	50	Non-hazardous
Receptions	22±2	50±10	Note 3	0/+VE	50	Non-hazardous
Cleaners Cupboard / Rooms	15 Min.	US	Note 3	-VE	55	Non-hazardous
Waiting Area	15 Min.	US	Note 3	0/-VE	45	Non-hazardous
Canteen	25 Max. 18 Min.	50±10	Note 3	0	50	Non-hazardous
Kitchen	18 Min. Max :-US	US	Note 13	-VE	55	Non-hazardous
Library	25 Max. 18 Min.	50±10	Note 3	+VE	40	Non-hazardous
Clinic	22±2	50±10	Note 3	+VE	40	Non-hazardous
Laboratories	22±2	50±10	Note 3	-VE	40	Non-hazardous
Bedroom / Showers	25 Max. 18 Min.	US	Notes 3 & 11	+VE	40	Non-hazardous
Truck Bay	10 Min.	US	Notes 3 & 8	0/-VE	75	Non-hazardous
Gatehouse Guardroom	22±2	50±10	Note 3	+VE	50	Non-hazardous
Car Park	+5°		Notes 3 & 8	-VE	US	Non-hazardous

NOTES:

1. US = Unspecified

2. Pressurisation is relevant to adjacent areas within the building. Buildings will be at a positive pressure relative to ambient in order to reduce ingress of dust, sand and gases.
   (+Ve) -denotes positive pressure
   (-Ve) -denotes negative pressure
   (0) - denotes neutral pressure
3. Fresh air flow rates shall be determined by:
   - functional requirements stated in this document and with reference to AHRAE 62.1

- pressurisation (where applicable)

4. Noise ratings measured at centre room positions, with HVAC system in operation and production/area facilities and personnel at rest.

5. To suit cooling and combustion air requirements.

6. Room pressure must not drop below flue pressure.

7. Positive pressure to help reduce ingress of sand and dust. Negative pressure when emergency exhaust system is activated, or order to contain escaping hazardous gases within the building.

8. Design shall allow for non operation of mechanical ventilation in winter but is to assume a minimum building leakage air infiltration of approximately 1 air change per hour (infiltration rate may increase subject to building design/construction).

9. Hazardous area ventilation rates shall be in accordance with the greater of the following requirements:

    - The applicable area classification code. Air changes per hour shall mean a ventilation rate using 100% fresh air.
    - Functional requirements for heating, cooling, pollution control.
    - The ventilation rate must ensure a minimum concentration level below 25% LFL, in buildings congested with equipment and a probability of release of flammable materials. In this case, the actual ventilation rate must be multiplied by the coefficient ε, the resulting figure compared with the rate given in Attachment 2, where the required rates to obtain a concentration below 25% LFL are given. For a moderate level of congestion a factor of 1/2 should be used and for slightly higher levels of congestion a value of 1/3 should be used. If this criterion is met then this indicates that the global ventilation rate is sufficient. Attachment 3 summarises the equivalent hole size distribution for secondary grade releases at vareous release frequency bands (LEVELs) from the items of equipment. Examples of calculations based on Attachment 2,3 are given in 'EI15' and 'RR993'.

10. Noise level shall not exceed 80db(A).

11. The ventilation rate for sanitary areas shall be:
    – extract airflow not less than 3ach (air changes per hour) for the room and not less than 50m^3/h per WC and 25m^3/h per urinal.
    – extract airflow not less than 75m^3/h per shower (extract).
    For sanitary areas the air change rates may be based on air transferred internally.

12. Determined by battery ventilation calculation in accordance with EN-50272-2.

13. Kitchen ventilation rate determined by extract equipment requirements and limitation of temperature.

14. To determine air exchange per hour, following room height values shall be used
    - Actual, if facility height is less than 6m;
    - 6m, if the height exceeds 6m.

ATTACHMENT 2 – VENTILATION FLOW RATE TO DELUTE TO 25% LFL

Fluid category	Release pressure (bar(a))	Ventilation flow rate to delute to 25% LFL (m3/s)			
		Release hole diameter			
		1mm	2mm	5mm	10mm
A	6,8	1,2	4,6	29	(120)
	10	1,5	5,9	37	(150)
	50	3,4	14	86	(340)
	100	4,9	20	130	(490)
B	5	1,0	4,0	25	(99)
	10	1,5	5,9	37	(150)
	50	3,5	14	86	(350)
	100	4,9	20	130	(490)
C	5	1,0	3,8	24	(94)
	10	1,4	5,7	36	(140)
	50	3,3	14	82	(330)
	100	4,7	19	120	(470)
G(i)	5	0,1	0,3	1,7	6,8
	10	0,2	0,6	3,5	14
	50	0,8	3,0	19	(75)
	100	1,7	6,6	41	(170)
G(ii)	5	0,2	0,6	3,3	13
	10	0,3	1,1	6,6	27
	50	1,4	5,4	34	(140)
	100	2,7	11	67	(270)

Notes. 1. The cases in brackets are those for which area classification may not be appropriate for outdoor releases. The hazard radii of these releases may exceed 30 m and therefore are by default also inappropriate for area classification indoors. These should be avoided. The data are provided for information only.
2. At the fluid storage temperature of 20°C the nominal discharge pressure of 5 bar(a) is below the saturated vapour pressure (6.8 bar(a)) was used to calculate the discharge rate and dispersion.
3. The required ventilation flow rate should take account of any primary release within the enclosure.

ATTACHMENT 3 – EQUIVALENT HOLE SIZES FOR A RANGE OF RELEASE FREQUENCIES

Equipment type	Hole sizes (mm)		
	LEVEL I Greater than 1,0E-2-1,0E-3/ release source-yr	LEVEL II 1,0E-2-1,0E-3/ release source-yr	LEVEL III 1,0E-3-1,0E-4/ release source-yr
Single seal with Throttle bush	2	5	10
Double seal	1	2	10
Reciprocating pump	2	10	20
Centrifugal compressor	1	5	30
Reciprocating compressor	2	10	30
Flanges	1	1	5
Valves	1	2	10

Notes.1.At the LEVEL I release frequency, for single seal centrifugal pumps without a throttle bush, use LEVEL II equivalent hole size. 2. It is assumed that the smaller equivalent hole sizes for valves >80mm diameter (when compared to valves <80mm diameter) are due to a higher mechanical integrity of the piping system, which will result in a lower failure frequency.
3. Assumed level III failure are mainly due to the pump/compressor sets and are generally independent of sealing arrangements.

ATTACHMENT 4 - REFERENCES

Standards and Codes of the Republic of Kazakhstan

SN RK 4.02-01-2011	Heating Ventilation and Air Conditioning
SP RK 4.02-101-2012	Heating Ventilation and Air Conditioning
MCN 4.02-02-2004	Heating Networks, with amendments of 12-03-2013
JV 73.13330.2012	Internal Sanitary and Technical Systems of Buildings
SNiP 3.05.03-85	Heating systems (installation specification)
SN RK 2.02-02-2012	Fire Safety Automation Systems for Buildings and Structures
PUE	Regulations on Electrical Installations for Explosive Hazardous Zones
SN RK 4.02-12-2002	Process design codes for gaseous & liquid fuel heating boilers with amendments and additions of 05.08.2015
SN RK 4.02.05-2013	Boiler Installations
GOST 21. 602	System of design documents for construction
GOST 24857-81	Axial Roof ventilators. General specification
GOST 24814	Radial roof ventilators. General specification
GOST 26963-86	Self-contained room air conditioners
GOST 12.1.005-88	General sanitary and hygienic requirements for the air in the work zone
MCN 2.04-03-2005	Noise Protection
CN RoK 2.04-02-2011	Noise Protection
GOST 12.1.003-2014	Noise. General safety requirements
BCH 01-89	Departmental Building Standards – Service Garages

GOST 12.1.005-88	System of standards for safety at work. General sanitary and hygienic requirements for the air of the work zone
VNTP 3-85	Standards for engineering design of facilities for gathering, transport, and treatment of oil, gas, and water in oil fields
VSN 21-77	Instruction on heating and ventilation design of oil-refineries and petrochemical plants
RD 39-00-148317-001-94	Classification of rooms, building, constructions and outdoor installations of oil and gas industry for explosion
SN RK 4.01-02-2013	Internal sanitary – technical systems
SN RK 4.03-01-2011	Gas Supply
RDS 2.02-11-2001	Design Principles for Fire Safety of Facilities at Karachaganak Oil and Gas Condensate Field

International Codes and Standards

ASHRAE	ASHRAE Handbooks (Fundamentals, HVAC Systems and Equipment, HVAC Applications, Refrigeration)
ASHRAE 15	Safety Standard for Refrigeration Systems
ASHRAE 34	Designation and Safety Classification of Refrigerants
ASHRAE 62.1	Ventilation for Acceptable Indoor Air Quality
ASHRAE 52.2	Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size
ASHRAE 154	Ventilation for Commercial Cooking Operations
SMACNA	HVAC Duct Construction Standards - Metal and Flexible
NFPA 90A	Standard for the installation of air conditioning and ventilating systems
NFPA 90B	Standard for the installation of warm air heating and air-conditioning system
NFPA 92A	Standard for Smoke-Control Systems utilising barriers and pressure differences
NFPA 96	Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations

IEC 60654	Industrial process measurements and control equipment; operating conditions Part I: Climatic conditions, Part 4: corrosive and erosive influence.
ISO 1940-1	Mechanical vibrations – Balance quality requirements for rotors in a constant (rigid) state – Part 1: Specification and verification of balance tolerances.
ISO 14694	Industrial fans – Specification for balance quality and vibration levels.
ISO 12499	Industrial fans - Mechanical Safety of Fans - Guarding
ISO 16890	Air Filters for General Ventilation
EN 14986	Design of fans working in potentially explosive atmospheres
EN 1751	Ventilation for buildings – Air terminal devices – Aerodynamic testing of dampers and valves.
EN 1886	Ventilation for buildings – Air Handling Units – Mechanical performance.
EN 50272	Safety requirements for secondary batteries and battery installations – Part 2: Stationary batteries.
IEC 60079-14	Electrical apparatus for explosive gas atmospheres. Part 14: Electrical installations in hazardous areas (other than mines).
EN 13501	Fire classification of construction products and building elements
'IP15'	Area Classification Code for Installations handling Flammable Fluids - Part 15 of the IP Model Code of Practice in the Petroleum Industry. July 2005, 3rd edition.
'EI15'	Model Code of Safe Practice, Part 15. Area Classification for Installations Handling Flammable Fluids. June 2015, 4th edition.
RR993	Technical input on ventilation effectiveness for area classification guidance EI
Local Regulations	Current Local Authority Regulations relevant to type of building and process.

The Supplier shall comply with applicable State or Local Codes, regulations, ordinances and rules of Kazakhstan unless defined otherwise.

All standards shall be latest revisions.