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APPROVED
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Instruction No104
Arrangement of Air Monitoring at CPC Facilities

Revision No 2

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1. PURPOSE

1.2. These Guidelines set forth the minimum requirements for air monitoring, establish the principles to be followed to indicate locations and the frequency of air sampling inside rooms, at outdoor facilities in gas hazardous areas, as well as when conducting hot and gas hazardous work, earthworks, repair and other hazardous work at CPC facilities.

2. SCOPE OF APPLICATION

2.1. The requirements set forth in these guidelines apply to all CPC departments, and compliance is mandatory for all CPC employees and contractors operating at CPC facilities regardless of their organizational and legal form of incorporation.

3. REGULATORY REFERENCES

References on the following regulatory documents are used throughout this document:

Table 1. List of regulatory documents

No	Regulatory documents
1	**External**
1.1	Federal Law On ensuring uniformity of measurements
1.2	Guidelines on sampling and analysis of air samples at enterprises of the USSR Ministry of Oil and Gas Industry
1.3	IBTV 1-087-81. Industrial guidelines on air quality monitoring at oil industry enterprises
1.4	Instruction 542 dated October 15, 2013 Federal norms and rules in the area of industrial safety Safety rules to be followed in work on gas distribution and gas consumption networks
1.5	Instruction N 485 dated November 20, 2017 On approving Federal norms and guidelines in the area of industrial safety Guidelines on safe conduct of hazardous gas, hot and repair work
1.6	GOST 12.1.007-76 The system of labor safety standards. Detrimental substances. Classification and general safety requirements
1.7	GOST 55435-2013 Transporting crude oil and petroleum products using trunk pipelines. Operations and maintenance.
1.8	RD 45.013-98 Guidelines on ranking measuring and monitoring instruments as indicators
1.9	GN 2.2.5.1313-03 Chemical factors present in production medium. The maximum admissible concentration (MAC) of harmful substances in the air of the working area
1.10	GOST 12.1.005-88 The system of labor safety standards. The General sanitary and hygienic requirements to be met by air quality in the working area;
1.11	GOST 12.1.010-76 The system of labor safety standards. Explosion safety. General requirements
1.12	TR CU 012/2011 On safe operations of equipment installed in explosive media
1.13	Guidelines on air quality monitoring. Agreed by the order of the Committee on State Control of Emergencies and Industrial Safety of the Republic of Kazakhstan No 39 dated November 4, 2010
2	**Internal**
2.1	VRD CPC 105 04 2011 Standard of equipment installed in fire and gas detection systems and managing CPC fire extinguishing systems

4. TERMS, DEFINITIONS AND ACCEPTED ABBREVIATIONS

1.1. Terms and abbreviations used in this standard are listed in Table 2.

Table 2. Terms and abbreviations

No	Term/Abbreviation	Term definition /abbreviation meaning
1	**Terms**	
1.1.	**Explosive mixture**	A mixture of combustible gases, vapors, dust, aerosols or fibers with air under normal atmospheric conditions (pressure 760 mm Hg and temperature 20°C) through which when ignited combustion propagates through entire volume developing an explosion pressure exceeding 5 kPa. The explosion hazard of substances released during technological processes should be taken equal to design specifications.
1.2.	**Explosion hazard area**	A part of a confined or open space within which combustible substances constantly or regularly circulate and in which they can be available under routine or unstable (off-spec) process conditions.
1.3.	**Explosive medium**	The medium is ranked explosive if it is capable of making mixtures of air with combustible gases, vapors of flammable liquids, combustible liquids, combustible aerosols and combustible dusts or fibers and if at a certain concentration of fuel in presence of an ignition source it is able to explode
1.4.	**Equipment**	Process equipment containing materials or intermediates required for specific technological process, tools and technological equipment.
1.5.	**Contractor**	A company that executed an agreement with CPC in established manner to provide Services on maintenance, repair and other types of work at CPC facilities regardless of its legal organizational form and form of incorporation
1.6.	**Air composition analysis**	Assessing the content of combustible and toxic vapors and/or gases inside the work area using gas analyzing devices
1.7.	Instrument calibration	A set of operations performed in order to confirm compliance of measuring instruments with metrological requirements
1.8.	**Safe air medium**	The air quality under which the volumetric oxygen content is at least 20%, and the content of harmful vapors and gases does not exceed the maximum permissible concentrations (MAC) of these substances in the air of the working area. At the same time, the possibility of ingress of harmful, explosive and explosive vapors and gases from the outside is eliminated.
1.9.	**Harmful substance**	A substance that in contact with human body in the event of violating safety requirements can cause injuries at workplace, can lead to developing occupational diseases or abnormalities in health status which can be detected using modern methods both in the process of work and over long-term periods of life of the current and future generations.

No	Term/Abbreviation	Term definition /abbreviation meaning
1.10.	**Maximum acceptable concentrations (MAC)**	Concentrations that daily exposure (except weekends) at work site for 8 hours and no more than 40 hours a week should not cause diseases or deviations in health status revealed by modern research techniques during work or in remote periods of life of present and future generations. Effect of a harmful substance at MAC level does not rule out impairing health in individuals having hypersensitivity
1.11.	**Maximum allowable non-explosive concentration**	The concentration of any explosive substance amounting to 5% from the lowest concentration limit for flame propagation.
1.12.	**Flash point**	The lowest temperature of the liquid, at which sufficient vapors are generated that are capable of igniting in air from an ignition source without showing stable combustion.
1.13.	**Gas hazardous areas**	The areas having harmful and fire-hazardous gases and vapors detected or where the harmful and fire-hazardous gases and vapors can be suddenly released in amount above the maximum permissible concentration, as well as the areas featuring insufficient oxygen content (volume fraction under 20%).
1.14.	**Permanent workplace**	The place which the worker is mostly attending during working hours (more than 50% totally or more than 2 hours continuously)
1.15.	**lower concentration limit of flame propagation (ignition) (LEL)**	The minimum content of combustible gas or vapor in the air at which flame can spread through the mixture over any distance from the ignition source
1.16.	**upper concentration limit of flame spread (ignition) (HEL)**	The maximum content of combustible gas or vapor in the air at which the flame can spread through the mixture over any distance from the ignition source
2	**Abbreviations**	
2.1	**FH**	Site manager
2.2	**Work supervisor**	Responsible for the performance of work
2.3	**PWM**	Preparation work manager
2.4	**MAC**	maximum allowable concentration
2.5	**LEL**	Lower concentration limit of flame spread (ignition)
2.6	**HEL**	Higher concentration limit of flame spread (ignition)
2.7	**TPL**	Trunk oil pipeline
2.10	**MPEC**	The maximum permissible explosive concentrations

5. CLASSIFICATION AND PARAMETERS OF HARMFUL SUBSTANCES ACCORDING TO THE CHARACTER AND DEGREE OF IMPACT ON HUMAN BODY

5.1. Acute or chronic poisoning can occur as a result of exposure of human body to harmful substances. Acute poisoning occurs under short-term exposure of human body to high concentrations of harmful substances; chronic poisoning develops as a result of a gradual prolonged effect of the substances entering body in small doses.

5.2. The degree of effect of harmful substances on human body is determined depending on established MAC values and a number of other indicators.

5.3. According to GOST 12.1.007 harmful substances are divided into four hazard classes depending on degree of impact on human bodies:

- class 1 - extremely hazardous substances;
- class 2 - highly hazardous substances;
- class 3 - moderately hazardous substances;
- class 4 - low hazard substances.

5.4. MAC for harmful substances in the air of working areas are determined according to GOST 12.1.005, GOST 305, GOST R 51858, GN 2.2.5.3532-18. In Table 3. MAC and hazard classes of certain substances give information on MAC and hazard classes of certain substances:

Table 3. Certain substances MAC and hazard classes

Name	MAC, mg/m^3	Hazard Class	Name	MAC, mg/m^3	Hazard Class
Oil (aliphatic saturated hydrocarbons C1 - C10 reduced to carbon)	300	4	Nitrogen oxides	5	2
Methane	7000	4	Diesel fuel	300	4
Propane	300	4	Mercury	0.01	1
Bhutan	300	4	Sulfuric acid	1	2
Benzene	5	2	Tetraethyl lead	0.005	1
Ethanol	1000	4	Carbon monoxide	20	4
Acetone	200	4	Dichloroethane	10	2
Kerosene	300	4	Hydrogen sulfide	10	2

5.5. Combustible gases and vapors of flammable liquids are capable of forming explosive mixtures with air.

5.6. Combustible gases and flammable liquids are characterized by the following main parameters: LEL, HEL.

5.7. The concentration from LEL to HEL determines the explosiveness range. There is no risk of explosion at concentrations below LEL or higher than HEL; in the first case due to the low content of gases or vapors, in the second, due to insufficient oxygen content.

5.8. In order to ensure fire and explosion safety for all substances MAC (short term) is established equal to the product of the safety factor by LEL value. The safety factor for petroleum hydrocarbons (products) is 0.05.

5.9. The scale of explosion and fire hazard of oil, gasoline, and diesel fuel is given in Addendum 5.

5.10. . The values of LEL, HEL and MAC (short term) of some harmful substances are given in Table 4. Values of LEL, HEL and MAC (short term) of certain harmful substances

Table 4. LEL, HEL and MAC (short term) Values Given for Certain Harmful Substances

Name substances	Explosive limits				MAC	
	by volume (%)		by weight mg/m^3		%vol.	mg/m^3
	lower	upper	lower	upper		
Gasoline[1)]	0.7	5.2	32600	212000	0.03	1630
Oil[1)]	1.2	8.0	42000	195000	0.06	2100
Diesel fuel[1)]	1.4	7.5	69200	370000	0.02	3460
Methane	5.0	15.7	33000	104000	0.25	1650
Ethane	2.9	15	36000	186000	0.15	1800
Propane	2.2	9.5	38000	164000	0.11	1900
Bhutan	1.8	9.1	45000	227500	0.09	2250
Hexane	1.2	7.5	42000	262500	0.06	2100
Benzene	1.4	8.11	45000	261000	0.07	2250
Hydrogen	4.1	74.0	3700	67000	0.21	185
Hydrogen sulfide	4.2	46.0	60000	657000	0.22	3000

6. PROCESS DESCRIPTION

6.1. There is a risk of atmospheric gas pollutionby oil vapor and gases in hazardous and explosive concentrations at industrial premises and in open areas of CPC facilities; the risk can develop during the operation, repair and maintenance of the main oil pipeline, tank farms, oil pumping stations, etc. The parameters of hazardous atmosphere are given in Addendum 1.

6.2. One of the main activities to prevent explosions and fires, as well as poisoning personnel with toxic vapors and gases at production facilities deals with air quality monitoring that allows making timely assessment to proceed with eliminating gas emission sources or mitigating risk during work.

6.3. Organizing checking the air quality and developing principles underlying selection of locations and frequency of air sampling inside rooms and at outdoor installations in gas hazardous areas, as well as when engaged in hot and gas hazardous work, in earthworks, in repair and other high-risk work at CPC facilities is carried out in accordance with these Guidelines.

6.4. In the process of air quality monitoring, the facility manager ensures that appropriate gas detecting is carried out and ensures that the content of gases, vapors and substances stays within safe limits.

6.5. CPC or contractor employees who passed special training on using portable gas detectors in training centers or in discipline workshops are permitted to air quality testing; these employees should

have an appropriate certificate, they should prove their competency in using the equipment in practice and the knowledge of the given Guidelines; these employees should have an official authorization to conduct gas quality monitoring stipulated in relevant order(resolution).

6.6. For each region, the facility manager should determine the list of areas not equipped with stationary gas detectors where regular air quality monitoring is required using portable gas detectors. In this case, the attention should be paid to most probable places for releasing and accumulating vapors of oil and petroleum gases (or other hydrocarbons) and/or hydrogen sulfide.

6.7. Procedures to check air quality at facilities are established by instruction issued by the head of the region; the procedures are carried out according to the schedule compiled by the site manager and approved by the Regional Operations and Maintenance Manager (Manager on Maintaining onshore facilities and tank farm at Marine Terminal) (Addendum 2).

6.8. The plan-schedule should be accompanied by a facility survey map showing locations where air quality should be monitored. A number is assigned to each point on the plan. The number is associated with facilities (Example: 1- PS - ..., 2- PS- ....). Sampling points on sites should be marked using the same number.

6.9. The air sampling points at the facilities and at production sites of PS and TF are indicated by sign boards in accordance with the air monitoring schedule and layout plans.

6.10. The schedule should be reapproved at least once a year and be supplemented in cases the changes are introduced into operating mode and process charts of production process at facilities after commissioning equipment having new process parameters, as well as in cases of temporary changes in schedule of repairing individual vessels.

6.11. The date and time of air sampling, the results of analysis, as well as instrument readings are recorded in the air monitoring log (Addendum 3). The log should be kept with the shift supervisor, operating personnel and lab assistantwho is engaged in air quality monitoring.

6.12. It is required to carry out regular monitoring (if necessary) air quality using portable gas detectors in absence of stationary automatic gas detectors and/or alarm devices. General requirements for gas detecting equipment are given in Addendum 4.

6.13. Specialists in each Region should develop the list of hazardous and explosive substances that may be released inside the production premises and in working areas next to outdoor installations in case the process is underway, the repair work is carried out and/or in emergency situations. The list should contain the maximum permissible concentration (MAC) and LEL for vapor and gas expressed in volumetric (%) and mass (mg/m^3) units. The list is approved by the Regional Operations and Maintenance Manager (the Manager on Maintaining onshore facilities and tank farm in case of Marine Terminal).

6.14. The list of portable devices used to monitor air quality at CPC facilities is given in Addendum 7.

6.15. The engineering and technical workers on instrumentation and automation in `CPC Regions should compile lists of stationary and portable devices used to monitor air quality including information on the substances analyzed.

6.16. Air sampling and analysis should be carried out in accordance with the guidelines on using gas detectors, Procedure for conducting mandatory air sampling (Addendum 8) and the Sampling Method (Addendum 9).

6.17. If regular monitoring of gas pollution at PS reveals the presence of oil vapor or other hydrocarbon vapors in air in concentrations exceeding MAC, the shift supervisor should takes steps to eliminate gas sources and provide appropriate PPE to workers. Work should be made only using the respiratory protective equipment (PPE). Upon reaching concentration higher than MAC (short term), all work should be stopped, the workers should be evacuated from the danger area, the hazard zone should

be barricaded and the measures should be taken to reduce concentration of harmful substances to the safe level. The head of the shift informs PS manager and the leadership of the Region.

6.18. Checking accuracy and uninterrupted operation of stationary and portable gas detectors and alarms shall be provided by by field instrumentation engineering in accordance with requirements of internal regulatory norms set forth in CPC within timelines stipulated in the manufacturer's guidelines for this type of instrument.

6.19. Gas detecting devices (alarms and gas detectors) should undergo regular calibration according to the manufacturer's guidelines; this equipment should undergo annual calibration by metrology centers accredited with the government inspectorates in established manner to ensure consistency of measurements.

7. RULES TO MONITOR AIR QUALITY WHEN CONDUCTING FIRE, GAS-HAZARDOUS, EARTH, REPAIR AND OTHER TYPES OF WORK HAVING ELEVATED HAZARD LEVEL.

7.1. The sequence of checking air quality, the locations to take air samples and the frequency of air quality monitoring during gas hazardous work are determined by the facility manager taking into account the requirements set forth in Guidelines herein to be specified in the work permit.

7.2. The primary testing air quality should be carried out by the operations personnel of CPC facility in presence of persons responsible for preparing and executing the work; if testing is carried out when the work is underway it should be carried out in presence of the person supervising work progress. The presence of the person in charge of work is required to make prompt decision about continuation of the work based on results of air quality monitoring.

7.3. Air should be monitored:

- immediately before the start of work;
- after each break in work;
- during the whole time of work made with frequency specified in the work permit, but at least once an hour;
- on request of the person in charge of the work, on request of the representative of the fire department or work executors.

7.4. The frequency of testing air quality at least once every 30 minutes should be established in the following cases:

- during emergency operations inside gas polluted area;
- over the period of work that includes cutting the spool, valve or fittings with using pipe cutting machines;
- when inserting valve spool or fittings;
- when carrying out cleaning of tanks interior;
- when hot work is carried out near an open gas source (oil pit, a tank accepting crude oil, open oil traps, etc.), provided that the wind blows from the side of the gas source towards the work area.

7.5. The frequency of checking air quality: at least once every 15 minutes; it should be established and followed before welding and in the process of welding inside the valve cavity and inside branch pipe when dismantling tapping valves, air escape valves and removing non-designed tapping valves.

7.6. Monitoring air quality should be carried out at locations specified in the work permit and on enclosed schematic diagram.

7.7. The person in charge of performing the work should take into account the current situation and increase the number of points to monitor air quality; in no case the person has the right to reduce the amount air quality monitoring locations specified in the work permit.

7.8. If the clearance work permit does not indicate locations to check air quality the locations should be chosen jointly by the person engaged into air quality monitoring and the persons in charge of the work progress; choosing locations should account for the place and nature of the work, as well as for the places of potential emission or accumulation of vapors and gases.

7.9. The results of testing the air quality are immediately communicated to the person in charge of the work and are entered into an appropriate column in work permit. At the same time the column 'Gas analysis results' should contain a numerical value of concentration expressed in mg/m^3. It is allowed specifying only one result in the work permit (the one showing the highest concentration value) when testing is made in a significant number of air monitoring points. It is prohibited to take an arithmetic average of results of all measurements as a final result.

7.10. Allowable concentrations:

- Hot work is allowed only in cases where there are no combustible vapors and gases present in the work area or they are present in amounts not exceeding the maximum permissible concentration (300 mg/m^3). Hot work is allowed with mandatory RPE when the concentration of flammable vapors and gases exceeds the maximum permissible concentration (300 mg/m^3), but is less than MAC (short term) (2100 mg/m^3). When conducting hot work outside tanks, the gas concentration in gas space should not exceed MAC. When carrying out hot work outside disconnected pipelines, the concentration inside (between sealing devices) should not exceed MAC (short term) (2100 mg/m^3). The measurements should be taken during hot work to prevent sudden release of vapors and gases both inside the work area and inside pipelines and equipment outside which the work is carried out.
- Gas hazardous work is allowed when the concentration of vapors and gases in the work area does not exceed MAC (short term). If the concentration exceeds only MAC the work should be performed using self-contained or hose gas masks.
- Work having elevated risk is carried out subject to the absence of vapors and gases in the work area or in case vapors and gases are present in amount not exceeding MAC.

7.11. If the concentration exceeds the established standards in the process of performing any work it is required to immediately stop the work, evacuate people from the danger area, shut down all working machines and mechanisms, take measures to identify and eliminate the causes of elevated gas pollution. Work can be resumed only in case when the result of air testing does not exceed the permissible concentration values.

7.12. When air monitoring devices are operating under conditions of potential release of hydrogen sulfide they should be kept with the workers or located in specially equipped places directly at the working site.

8. MONITORING AIR MEDIUM FOR SPECIFIC TYPES OF WORK

8.1. MONITORING AIR QUALITY WHEN CARRYING OUT WORK INSIDE REPAIR TRENCHES.

8.1.1. Monitoring air quality is carried out only after cleaning the repair pit and the internal surface of the pipeline from oil and combustible materials.

8.1.2. Air quality should be monitored in at least 3 points along the entire pit length. If repair pit has a significant length, then at least 1 location should be added (the minimum number of locations should be as follows: 3 locations for a length of the pit up to 10 m, 4 locations for pits having length from 10 to 20 m, 5 points for pits having length from 20 to 30 m, etc.) for every 10 meters of incremental pit length.

The indicated air monitoring points should be located no higher than 0.5 m from the bottom of the pit and as close as possible to potential sources of vapor and gas emissions or to their accumulation areas. Additional check points can be located at random: the locations can be selected at the stage of developing and approving checking schematic diagram at discretion of the person issuing work permits and/or through the process of conducting work at the discretion of the person in charge of the work progress.

8.1.3. It is additionally necessary to monitor air quality around the perimeter when conducting hot work to replace spool, fittings or valve.

8.1.4. When the pipeline section is closed, it is required to ensure air quality monitoring inside the pipeline using holes of 8-12 mm in diameter The holes should be located no closer than 100 mm from the longitudinal and transverse welds and at a distance of 80 - 100 mm from air pressure (“PZU”-type) plugs and 100-150 mm from rubber-cord plugs (“GRK”-type) or from clay pressurizing plugs.

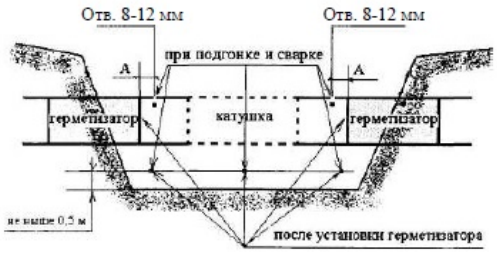

Figure 1

8.1.5. In case there is a repair pit containing oil near the repair pit and a vapor-gas cloud can spread away from the repair pit the work on the site should be suspended and measures should be taken to reduce the oil evaporation rate from the surface (the surface of oil in the pit should be covered with curing foam, emulsion film followed by phlegmatized using foam delivered by fire-fighting trucks i.e. to apply methods impeding evaporation; or oil can be pumped into another pipeline or to another tank located at longer distance from the work site, etc.) or ensure forced dispersing oil vapors at the work site.

8.2. MONITORING AIR QUALITY DURING PREPARATION AND CONDUCTING WORK INSIDE TANKS.

8.2.1. Monitoring air quality should be carried out during work on tank degassing, tank cleaning and repairing. An air monitoring scheme should be developed and approved for each specific case.

8.2.2. Checking air quality during tank degassing (using forced ventilation, natural aeration, or steaming) should be carried out every hour through the hole in the gas outlet pipe installed in the skylight (in the manhole of RVSP-type tanks). Monitoring is carried out during the entire time of degassing until the concentration of oil vapor drops below MAC (short term) (2100 mg/m^3), and will not exceed this value after 1 hour. In addition, it is required to monitor the concentration of oil vapor at adjacent territory every hour inside the tank dyke.

8.2.3. Monitoring air quality using portable gas detectors in tank farms should be carried out around the confinement at a distance of 5–10 m downwind from ethe berm, as well as next to the service platforms and ladders leading to tank roofs inside the dyke of each tank.

8.2.4. The tank is consideredto be prepared for cleaning work if the concentration inside the tank does not exceed MAC (short term) with MAC staying within acceptable limits at adjacent territory.

8.2.5. During tank cleaning operations checking air quality is made in two opposite locations at a distance of 2 m from the tank wall at a height of 0.1 m every 30 minutes after dismantling the manhole cover making sure that concentration of oil vapor inside the tank is under 2100 mg/m^3. In the dyke, next to the manhole of the first ring and in areas of installing pumping equipment with a frequency of at least once an hour.

8.2.6. The results of measuring vapor concentrations are entered into the work permit.

8.2.7. The work should be immediately stopped, the workers should be evacuated into a safe area when concentration of petroleum hydrocarbons inside tank reaches 2100 mg/m^3 (MAC (short term)) or

when an increase in concentration of oil vapor is detected in comparison with previous measurement. CPC operations personnel and contractor (specialized company) employees should take measures to identify the source of ingress of oil vapor and reduce its concentration using additional tank ventilation.

8.2.8. The work should be immediately stopped, the equipment disconnected, people removed from the work area, if the concentration of hydrocarbon vapors inside the tank reaches 300 mg/m^3 (MAC). The work can be resumed after elimination of the causes of gas contamination.

8.2.9. Air quality is monitored in accordance with schematic diagram after finishing tank cleaning to ensure the tank is ready for welding and assembly work.

Figure 2

Figure 3

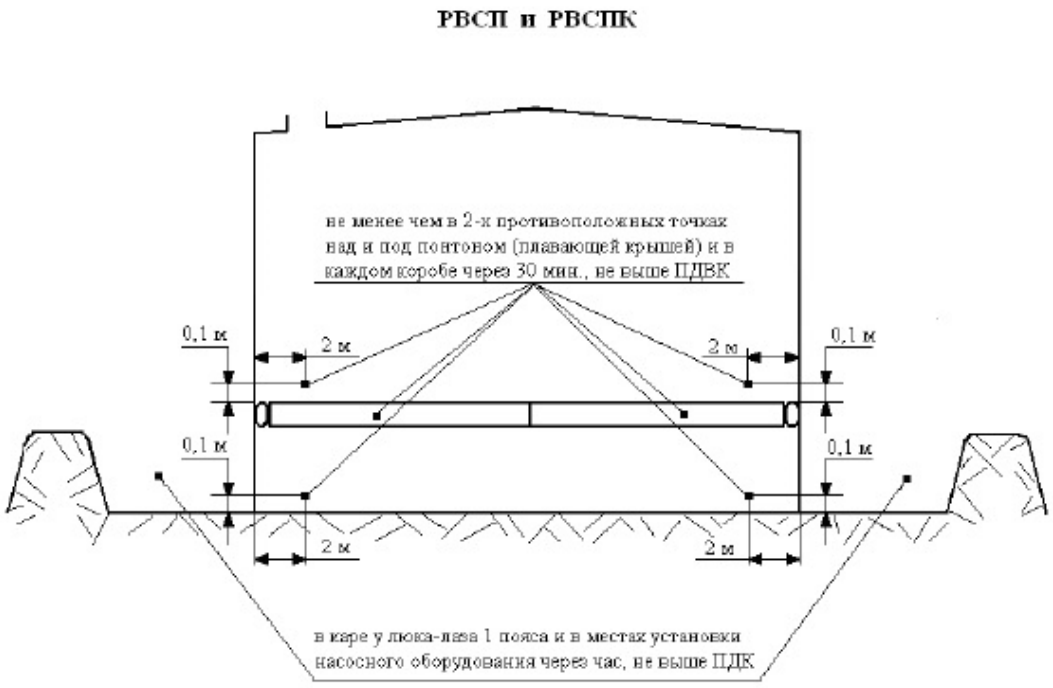
РВСП и РВСПК
не менее чем в 2-х противоположных точках над и под понтоном (плавающей крышей) и в каждом коробе через 30 мин., не выше ПДВК
0,1 м
2 м
2 м
0,1 м
0,1 м
0,1 м
2 м
2 м
в каре у люка-лаза 1 пояса и в местах установки насосного оборудования через час, не выше ПДК

Figure 4

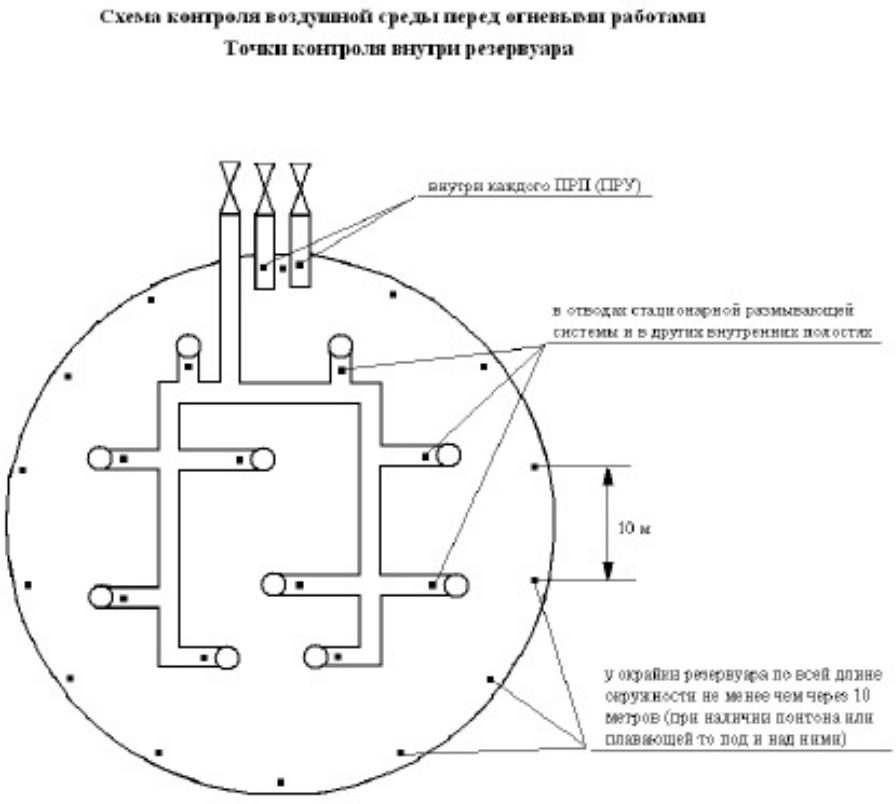
Схема контроля воздушной среды перед огневыми работами
Точки контроля внутри резервуара
внутри каждого ПРП (ПРУ)
в отводах стационарной размывающей системы и в других внутренних полостях
10 м
у окрайки резервуара по всей длине окружности не менее чем через 10 метров (при наличии понтона или плавающей то под и над ними)

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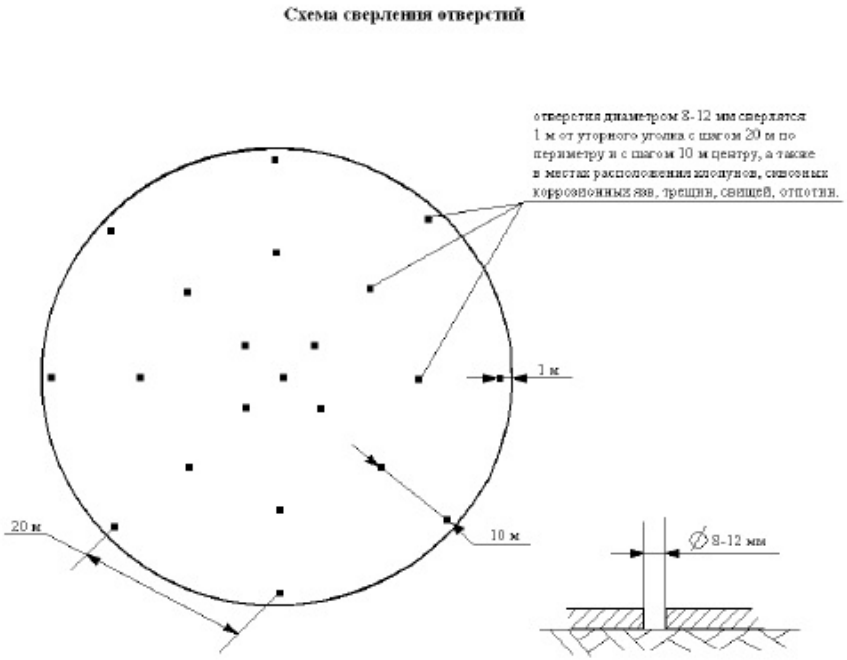


Inside the tank air monitoring is carried out as follows:

- next to the edge of tank along the entire circumference no less than every 10 meters (above and below pontoon or a floating roof);
- in the upper zone: through the gauge hatch;
- inside each inlet - distribution nozzle;
- in branches of a stationary eroding system;
- inside each pontoon box or floating roof;
- in guiding poles of pontoon or floating roof;
- in pipelines of the fire extinguishing system and in other internal cavities.

8.2.10. Monitoring air quality under the bottom of the tank required to estimate the need to develop WEP is conducted through holes having diameter of 8-12 mm; these holes should be drilled at a distance 1 meter from the corner wing having 20 meter spacing along the perimeter and spacing with 10 meter spacing along the radius as well as next to clearance gaps, penetrating corrosion pits, cracks, blowholes and sweat areas. Measuring gas content is carried out at a height of 20 - 30 mm from the bottom level and under the bottom through drilled holes.

8.3. MONITORING AIR ENVIRONMENT IN WELLS

8.3.1. Monitoring air quality in wells is carried out 15 minutes after opening the well hatch followed by its airing.

8.3.2. Air should be monitored at a height no greater than 0.5 meters from the bottom of the well or from the surface of the liquid inside it. The device is lowered into the well using a rope or elongated air intake tube.

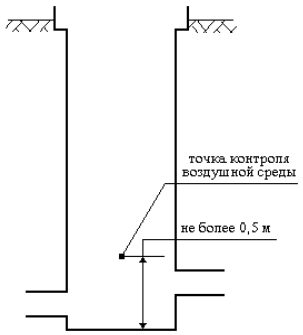


Figure 6

8.4. MONITORING AIR QUALITY INSIDE PUMP HOUSES AND OTHER PS ROOMS.

8.4.1. In addition to regularly monitoring air using portable gas detectors, the pump stations and other PS hazardous areas should have continuous monitoring set up using stationary gas control systems having sensors installed in accordance with the system operating guidelines.

8.4.2. Stationary gas control system should be continuously operating.

8.4.3. The air should be monitored in the work area at the level of breathing level at a distance of 2–3 m from pumps, valves and other equipment at service platforms next to outdoor installations.

8.4.4. Monitoring air quality should be carried out before starting work in outdoor installations where equipment is serviced on a regular basis.

8.4.5. Under adverse weather conditions (high air temperature, no wind) that interfere with dispersing vapors and gases as well as under conditions of insufficient visibility (fog, snowfall, heavy rain, etc.) an employee who monitors the air quality should accompanied by another person (buddy work pattern).

8.4.6. In case it is required to monitor air quality in the dark, the person conducting air monitoring should have an explosion-proof hand-held torch having voltage no higher than 12 V and work with a colleague (back up).

9. RESPONSIBILITY

The distribution of responsibility is listed in Table 5. **Responsibility.**

Table 5. Responsibility

Item No	Facility	Responsible person	Note
Setting up air monitoring			
1	PS, TF, LUT (Loading/Unloading Terminal)	PS, MT Manager	On the basis of Instruction On organizing air quality monitoring
Conducting air monitoring			
When carrying out fire, gas hazard, earthworks, and repair work			
2	PS, TF, LUT	Head of Testing Laboratory	On the basis of Instruction On organizing air quality monitoring
3	PS, TF, LUT	PS operators	On the basis of Instruction On organizing air quality monitoring
4	PS, TF, LUT	Process unit operators	On the basis of Instruction On organizing air quality monitoring
5	PS, TF, LUT	testing laboratory technicians	On the basis of Instruction On organizing air quality monitoring
6	PS, TF, LUT	Instrumentation technicians	On the basis of Instruction On organizing air quality monitoring
7	PS, TF, LUT	TF operators	On the basis of Instruction On organizing air quality monitoring

8	PS, TF, LUT	Work manager, work team leader, outage department manager responsible for conducting gas detecting at the Contractor's work site	Based on Instruction or Resolution of Contractor
Air pollution monitoring			
8	PS, TF, LUT	TF operators	On the basis of Instruction On organizing air quality monitoring
9	PS, TF, LUT	PS operators	On the basis of Instruction On organizing air quality monitoring
10	PS, TF, LUT	Process unit operator	On the basis of Instruction On organizing air quality monitoring

10. LIST OF ADDENDA

The list of appendices for this procedure is given in Table 6.

Table 6. List of Addenda

Addendum	Name
1.	Addendum 1 Parameters of hazardous atmosphere
2.	Addendum 2 Schedule of air quality monitoring in gas hazardous areas (at industrial facilities)
3.	Addendum 3 Air Monitoring Logbook
4.	Addendum 4 General requirements for gas detecting equipment
5.	Addendum 5. Range of explosion and ignition hazard of oil, gasoline, and diesel fuel
6.	Addendum 6. Safe concentrations for the most common types of sampling
7.	Addendum 7. List of portable devices used to monitor air quality at CPC facilities
8.	Addendum 8 Procedures for conducting mandatory air sampling
9.	Addendum 9 Sampling Method
10.	Addendum 10 Safety Measures when monitoring air quality
11.	Revision History sheet

ADDENDUM 1 PARAMETERS OF HAZARDOUS ATMOSPHERE

1. Hazardous atmosphere

1.1. Hazardous atmosphere is an air environment that can result in disability, in inflicting injury or developing health problems of an employee, or can lead to developing acute disease or cause death of workers.

1.2. There are three types of hazardous environment:

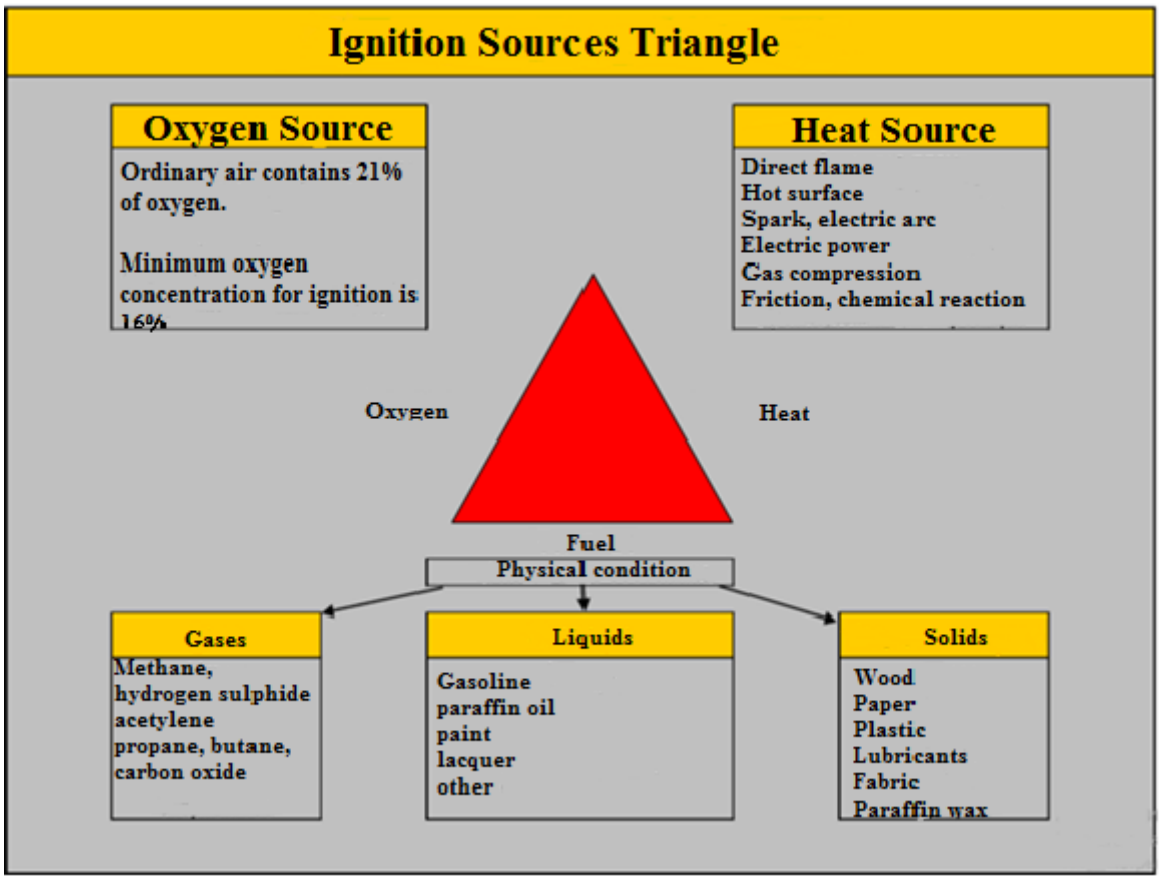
- flammable or explosive gas air environment
- air environment featuring a lack or excess of oxygen
- air environment containing toxic gases

1.3. Combustible or explosive gas-air environment is an air environment consisting of a mixture with air under atmospheric conditions, combustible gaseous substances, vapor or aerosol, which, after ignition, sustains flame propagation.

1.4. Three components should be present in appropriate proportion to make gas-air mixture combustible or explosive:

- heat source
- fuel
- oxygen.

Plot of ignition sources triangle:



1.5. Lack and excess of oxygen

1.5.1. The air environment consists of approximately 21% oxygen and 78% nitrogen, and 1% argon with other gases traces.

1.5.2. A drop in oxygen content inside a confined space can occur as a result of consumption or displacement.

1.6. Lack of oxygen

1.6.1. Oxygen consumption occurs when combustible substances burn, for example, during welding, heating, cutting and brazing. Less profound oxygen consumption occurs when bacteria are active for instance during fermentation process. Oxygen can be also consumed in chemical reactions, for example, when rust (iron oxide) is formed at the surface in a confined space. The rate of oxygen consumption also depends on the number of people working in confined space and the scope of physical work.

1.6.2. The second factor causing the lack of oxygen deals with its displacement by another gas. Helium, argon and nitrogen are gases used to displace air; therefore they reduce the oxygen level. Carbon dioxide can be also used to displace air; carbon dioxide can be generated under natural conditions in sewers, bunkers, wells, and tunnels. In addition to the natural occurrence of such gases or their use in a chemical process, certain gases are used as inert agents to displace flammable substances and to slow down pyrophoric reactions. Nitrogen, argon, helium, and carbon dioxide are often called non-toxic and inert gases, yet they are blamed in many deaths. A complete replacement of oxygen by nitrogen will lead to immediate loss of consciousness and death. Carbon dioxide and argon are heavier than air; these gases can stay inside tanks/near hatches and/or entry ways for a long time (hours/days) after opening tanks. These gases are colorless and odorless, so they pose an immediate health hazard unless measures are taken to estimate oxygen content and ventilation is activated. Lack of oxygen is one of asphyxia causes . Despite the fact that the volume of oxygen in the air should be maintained at a level of 21%, the body can withstand only slight deviation from this value. Given below in Table 7. The impact of the lack of oxygen on the human body showing the response of human body to atmosphere containing less than 21% O2.

Table 7. The impact of the lack of oxygen on human body.

Impact of the lack of oxygen on the human body		
Oxygen content (%)	**Symptoms**	**Physical impact on humans**
19.5 - 23.5	Absent	Physical effects on humans not established
12 -19	Rapid pulse	Loss of finger and hand coordination accuracy
10 -12	Rapid pulse, nausea, headache	Difficult breathing, lack of coordination, tingling, vomiting
6 -10	Rapid pulse, nausea, headache, disorientation	A complete loss of coordination, inability to feel danger or react to danger, the loss of consciousness
0 - 6	Breathing stops, cardiac arrest	Coma followed by death after 40 seconds.

1.7. Excess of oxygen

1.7.1. An excess of oxygen means a gas-air mixture containing more than 23.5% of oxygen. This condition poses a serious danger from the standpoint of fire safety under which, for example, the

static electricity from hair or clothing can become a source of ignition resulting in a fire situation. This gas-air mixture also causes a faster fire propagation. An excess of oxygen does not occur naturally.

1.7.2. Oxygen excess is caused by leaks in cylinders containing oxygen or hoses supplying oxygen.

1.7.3. NEVER use pure oxygen for ventilation. ALWAYS ventilate confined spaces using ordinary, ambient air.

Note:

- *All gas cylinders should be placed outside at a safe distance and secured when work is carried out in confined spaces.*

2. Toxic gases

2.1. Toxic gases (harmful substances) are the gases, vapors or liquids that provide a detrimental effect on human health. At certain levels this can cause death or inflict serious harm to the body.

2.2. The effects of toxic gases on humans depend on the following factors:

- concentration level
- exposure time
- frequency of exposure
- individual characteristics of human body

2.3. Toxic gases enter the body through inhaling.

2.4. Standard norms have been determined and the concept of the maximum permissible concentration has been introduced to monitor air composition.

2.5. The maximum allowable concentration (MAC) of harmful substances is the concentration exposed to daily which (except weekends) during 8 hours but no more than 40 hours a week should not cause diseases or deviations in health status detected by modern techniques methods research during the whole working period or after it for the present and future generations.

2.6. MAC levels in Europe/Great Britain are called OEL, and PEL in the US.

MAC, OEL, PEL are expressed through p/nm (parts per million) or ppm.

In Table 8 below. MAC to give examples of some toxic gases/liquids that can be present at production and processing facilities, in manifolds, at well sites, etc.

Table 8. MAC

Gas/Liquid	Chemical formula	MAC	
		ppm	mg/m^3
Hydrogen sulfide	H_2S	7.06	10
Sulphur dioxide	SO_2	0.75	2
Carbon Oxide (Carbon Monoxide)	CO	17.18	20
Nitrogen dioxide	NO_2	1.05	2
Combustible gases	-	250	300
Oxygen	O_2	180000	-

Hydrocarbons (vapors of oil and oil products)	C_1-C_{10}	250	300

Note:

- *If there are any other substance detected it is required to refer on appropriate material safety data sheet (MSDS)*

3. Gas/Vapor Density

3.1. It is necessary to take into account the density of gases/vapors when carrying out the work on air quality monitoring.

3.2. It is important to remember that some gases or vapors are heavier than air and they tend to accumulate at the bottom of confined spaces.

3.3. Also, some gases are lighter than air, and they can be present in the upper part of confined spaces.

3.4. Many combustible gases and vapors heavier than air tend to accumulate or flow low from the surface level; for example, they can flow through drainage networks, along trenches, through sewers, cable pipes and pipelines, etc.

3.5. When heated they rise and can accumulate in the upper part of confined space, in tank or vessel remaining practically non-detectable in the bottom part.

3.6. Flammable vapors can be emitted by sludge at the bottom of a chamber or vessel.

3.7. It is always necessary to check for the presence of flammable vapors at various levels.

3.8. Methane and ethane are lighter than air.

Note:

- *DENSITY IS REDUCED as temperature increases. For example, in cold weather, vapors tend to stay down; they begin to rise as the temperature increases (as a result of work or heating by sun rays, etc.)*

CH_4 Lighter than air
CO Density is the same as air
Heavier than air H_2S SO_2

ADDENDUM 2 SCHEDULE OF AIR QUALITY MONITORING IN GAS HAZARDOUS AREAS (AT INDUSTRIAL FACILITIES)

List of gas hazardous	Possible sources of	Sampling points (in	Number of	Controlled	Instruments or	Control frequency	
						Under normal conditions	In the most hazardous conditions (calm weather, high temperatures, a sharp increase in process parameters, etc.)

ADDENDUM 3 AIR MONITORING LOGBOOK

Date and time of sampling	Sampling location (sampling point)	Device number	The name of toxic and explosive vapors of oil and gas.	The maximum allowable concentration (MAC)	meter readings	analytical monitoring (in mg/m^3 or volume in %)	Signature of analysis	The cause of air pollution	Measures taken to eliminate air pollution	Signature of facility manager (shift supervisor)
1	2	3	4	5	6	7	8	9	10	11

ADDENDUM 4 GENERAL REQUIREMENTS FOR GAS DETECTING EQUIPMENT

1. Use of equipment

1.1. Devices meeting the following requirements should be used to monitor air quality at main oil pipeline facilities:

- should be certified by the Gosstandart of Russia, have Certificate (those applied at facilities of the Republic of Kazakhstan should be certified and entered into the register of metrology of the Republic of Kazakhstan);
- should have a certificate of explosion protection available complying with TR CU 012/2011;
- should be checked in accredited laboratories and have a Validation certificate which should always be kept together with the device;
- should have legible and indelible marking including the manufacturer's name or registered trademark, the mark of compliance with GOST R 50460, a mark to approve the type of a measuring instrument according to PR 50.2.009, designation of the type, serial number, year of manufacture, type of explosion protection design, degree protection (IP code) according to GOST 14254;
- should have the minimum sensitivity and measuring range that meets requirements set forth in regulatory documents in terms of permissible concentrations.

1.2. Each operating device should have a responsible person from among workers or engineers assigned who is accountable to monitor the accuracy and the running order of the device, its timely maintenance and calibration in inspectorates.

1.3. It is prohibited to use gas detectors that have not passed the state calibration, or have overdue validation term, or do not have a passport (certificate).

1.4. To monitor air quality CPC departments/facilities and contractors should use appropriate gas detecting equipment with established levels of alarm set off as indicated in Table 9. Thresholds of device alarms.

Table 9. Thresholds of setting off device alarms.

Chemical formula	The level to set a warning alarm	
	A1	A2
H_2S	5 ppm (7 mg/m^3)	10 ppm (14 mg/m^3) (7 ppm for the Republic of Kazakhstan)
CO	17 ppm (19 mg/m^3)	43 ppm (50 mg/m^3)
CH_4	10% LEL	20% LEL
O_2	19.5%	23.5%
C_1-C_{10}	0.7% LEL	5% LEL

1.5. Departments/facilities that are the owners of air monitoring equipment are responsible for the following:

- nonregular checking gas detecting equipment before use
- untimely provision of portable gas detecting equipment to the Production Laboratory for

inspection, repair and maintenance

- submission of inaccurate information entered into the database on all equipment to monitor air quality that is available at the facility/in the department.

- failure to ensure availability of manuals for air monitoring instruments for workers at the facility/in department involved in air monitoring.

2. Use and maintenance of equipment

2.1. Gas detectors

2.1.1. Only models of multi-component gas detectors approved by CPC can be used at the territory of CPC facilities. The list of instruments used to monitor air quality at CPC facilities is given in Addendum 8.

2.1.2. Procedure for handing out and managing gas detectors owned by CPC

- CPC gas detectors can be used by CPC personnel and/or by personnel of contracting companies.

- Receiving gas detector starts with generating request which is submitted for approval to the Regional Operations and Maintenance Manager (to the Maintenance Manager of Onshore Facilities and tank farm at Marine Terminal) to register the application form in the database.

- All submitted applications are reviewed by the Regional Operations and Maintenance Manager (by the Maintenance Manager of onshore facilities and the tank farm at Marine Terminal). The application is submitted to CPC central warehouse with a copy sent to the party requesting gas detector.

- After receiving approved application from the Regional Operations and Maintenance Manager (from the Maintenance Manager of onshore facilities and the tank farm at Marine Terminal) the customer generates the final requisition to obtain the material.

- Upon receiving an approved application the Central Warehouse issues new gas detector to be handed out from CPC warehouse to the lead engineer on instrumentation and automation systems for entering the device into the database.

- The lead engineer on instrumentation and automation in the region should organize the initial verification, calibration and adjustment of gas detector before handing it over to the customer.

- Handing over gas detector to the customer is carried out after executing the Acceptance Delivery Certificate.

- CPC facility and/or contractor receiving gas detectors ensures the timely validation, calibration, and maintenance of gas detectors and accepts responsibility for any damage inflicted to gas detectors.

- Gas detector operators should have the vendor operating guidelines available as well as the original certificate of validating each device.

2.2. Procedure on managing gas detectors owned by contractors

- Contractors are purchasing gas detectors only from suppliers approved by CPC. See the list of gas detectors permitted for use in Addendum 8.

- Contractors should use the services of accredited laboratories to carry out validation, calibration, and repair of gas detectors.

- Contractors are responsible for ensuring timely validation, calibration, and maintenance of gas detectors in laboratory approved by CPC; contractors are also responsible for any damage inflicted to gas

detectors.

- Gas detector operators should have the vendor operating guidelines available as well as the original certificate of validating each device.

2.3. Maintenance, repair and calibration

- All users of gas detectors in CPC and in contracting companies should check for presence of a calibration sticker and verification mark in order to ensure timely calibration and validation of gas detectors.

- An extraordinary calibration of a gas detector should be carried out if the device is exposed to high concentrations of gases and/or after setout of a high level alarm.

Note:

- *It is prohibited to use gas detector if there is no calibration sticker, verification mark or verification certificate.*

- Validation and calibration of stationary gas detectors is carried out once every 6 months; portable gas detectors are validated once every 12 months (for facilities in the Republic of Kazakhstan once every 6 months), according to the Plans of validation and calibration of measuring instruments deployed at CPC facilities approved and agreed in accordance with requirements set forth by CPC policy.

- Calibration gases having known concentration should be used in accordance with the manufacturer's recommendations to verify the accuracy of portable gas detectors.

2.4. Checking equipment before use

- Before each use, the person in charge of checking air quality should inspect working condition of device using a safe air medium that does not contain gases monitored or other toxic gases.

2.5. Filters

- Filters are designed to protect gas detectors from minor residues of moisture, particulate matter and dust.

- Filters should be checked before each use and replaced if necessary.

2.6. Sampling hose

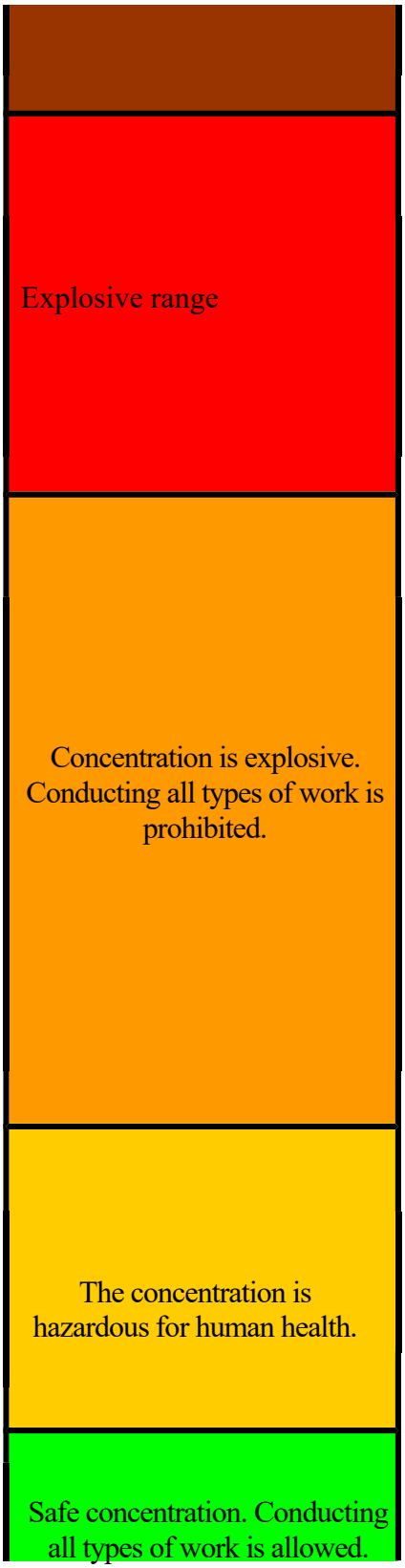
- Hoses should be used for remote sampling. The hose length should be sufficient for sampling at the lowest point of the equipment/vessel. The maximum hose length should not exceed 20 meters.

- It is required to provide additional time to allow gas passing the entire length of the hose (at least 3 seconds for every 30 cm of the hose) to ensure the accuracy of measurements when a sampling hose is used.

2.7. Extensible sampling probe

- A sampling probe can be attached to a gas detector to monitor air quality inside a closed vessel or tank or to access hard-to-reach areas. In accordance with recommendations of the manufacturer, the use of extension piece requires additional time to allow gas propagate the sampling probe.

ADDENDUM 5 RANGE OF EXPLOSION AND FIRE HAZARD OF OIL, GASOLINE, AND DIESEL FUEL



HEL	Oil: 195,000 mg/m³ (volume fraction 6.5%). Gasoline: 212,000 mg/m³ (volume fraction 5.2%). Diesel fuel: 370,000 mg/m³ (volume fraction 7.5%)
LEL	Oil: 42 000 mg/m³ (volume fraction 1.4%). Gasoline: 32,600 mg/m³ (volume fraction 0.8%). Diesel fuel: 69,200 mg/m³ (volume fraction 1.4%)
5% LEL - MAC (short term)	Oil: 2,100 mg/m³ (volume fraction 0.07%). Gasoline: 1,630 mg/m³ (volume fraction 0.04%). Diesel fuel: 3,460 mg/m³ (volume fraction 0.07%)
0.7% LEL - MAC	Oil: 300 mg/m³ (the volume fraction is 0.010%). Gasoline: 100 mg/m³ (volume fraction 0.002%). Diesel fuel: 300 mg/m³

ADDENDUM 6 SAFE CONCENTRATIONS FOR THE MOST COMMON TYPES OF SAMPLING

Safe concentrations for the common types of sampling carried out before approving work permit for hot work or work in confined space

The following tables list safe concentrations for common types of sampling carried out before approving the work permit to proceed with hot work or work in confined spaces.

Oxygen (O2)

Respiratory protection is not required	20% - 23.5%
It is necessary to use an insulating or hose gas mask when working in a confined space.	16.1% - 20%
Additional restrictions apply when working in a confined space	*Entry into a confined space is prohibited if the oxygen content is lower than 16.1% or higher than 23.5%. See note at the end.

Hydrogen Sulfide (H_2S)

Respiratory protection is not required	< 7 ppm (10 mg/m^3)
It is necessary to use an insulating or hose gas mask when working in a confined space.	7 ppm - 100 ppm (10-140 mg/m^3)
Additional restrictions apply when working in a confined space	*Entering confined space is prohibited if the content is above 100 ppm (140 mg/m^3) See note at the end.

Sulfur dioxide (SO_2)

Respiratory protection is not required	* < 2 ppm (5 mg/m^3)
It is required to use a respirator having a filter element.	2 ppm - 10 ppm (5 - 26 mg/m^3)
Filter mask should be used	10 ppm - 50 ppm (26 - 133 mg/m^3)
It is necessary to use an insulating or hose gas mask when working in a confined space.	50 ppm -100 ppm (133 - 266 mg/m^3)
Additional restrictions apply when working in a confined space	*Entry into confined space is prohibited if SO_2 content exceeds 100 ppm (266 mg/m^3). See note at the end.

Carbon monoxide (CO)

Respiratory protection is not required	< 17.5 ppm (20 mg/m^3)
It is necessary to use an insulating or hose gas mask when working in a confined space.	17.5 ppm - 1200 ppm (20-1400 mg/m^3)
Additional restrictions apply when working in a confined space	*Entering confined space is prohibited if CO content is above 1200 ppm (1400 mg/m^3). See note at the end.

Oil hydrocarbons

Respiratory protection is not required	< 85 ppm (300 mg/m^3)
It is required to use a respirator having a filter element.	85 ppm - 850 ppm (300 - 3000 mg/m^3)
Filter gas mask should be used. It is necessary to use an insulating or hose gas mask when working in a confined space.	850 ppm - 1000 ppm (3000 - 3530 mg/m^3)
Additional restrictions apply when working in a confined space	*Entry into a confined space is prohibited if the content of light hydrocarbons is higher than 1000 ppm (3,530 mg/m^3). (See comment). In addition, elevated concentration can affect flammability limits.

Benzene (C_6H_6)*

Respiratory protection is not required	< 1 ppm (3 mg/m^3)
It is required to use a respirator having a filter element.	1 ppm - 10 ppm (3 - 32 mg/m^3)
Filter mask should be used	10 ppm - 50 ppm (32 - 160 mg/m^3)
It is necessary to use an insulating or hose gas mask when working in a confined space.	50 ppm – 500 ppm (160 -1600 mg/m^3)
Additional restrictions apply when working in a confined space	*Entry into confined space is prohibited if the content of C6H6 is above 500 ppm (1600 mg/m^3). See note at the end.

***Note:**

- *Additional restrictions on the work inside a confined space do not apply to cases when the rescue work is underway. The same pertains to cases when permitting documents are issued for carrying out work in areas having concentrations in excess of the levels indicated in the tables. In these cases, a mandatory use of air-breathing gas masks as well as presence of a backup SCBA and presence of observer is required.*

ADDENDUM 7 LIST OF PORTABLE DEVICES USED TO MONITOR AIR QUALITY AT CPC FACILITIES

The list of portable devices used to monitor air quality at CPC facilities is given in Table 10

Table 10. The list of portable devices used to monitor air quality at CPC facilities

Item No	Name of equipment	Components detected
1.	ANT-3M	CO_2
		NO_2
		SO_2
		HCl
		O_2
		H_2S
		CO
		Cl_2
		acetone, gasoline (reduced to decane), gasoline-solvent (nefras) (reduced to hexane), benzene, butanol, butyl acetate, vinyl chloride, dimethylformamide, diethylamine, isobutylene, kerosene (reduced to decane), xylene, methyl tertiary-butyl ether, methyl ethyl ketone, propane butane (per butane), propanol, propylene, turpentine (per xylene), styrene, tetrachlorethylene, toluene, trichlorethylene, white spirit (reduced to decane), aliphatic hydrocarbons (C4-C10) (reduced to hexane), phenol, cyclohexane, cyclohexanone, ethanol, ethyl acetate, ethylbenzene, ethylene and ethyl cellosolve.
1.	Calyon-1B	Ammonia, Aniline, Acetaldehyde, Acetone, Gasoline, Benzene, Butadiene-1,3, Butane, Butyl Acetate, Vinyl Acetate, Vinyl Chloride, Hexane, Heptane, Diesel Fuel, Diethylamine, Diethyl Ether, Isobutylene, Kerosene, Xylene, Methylamine, Methyl Acetate, Methyl Acetate, Methyl Acetate, Methyl Acetate, Dimethyl Acetate Methylcyclohexane, Methyl ethyl ketone, Naphthalene, Nefras, Nitrobenzene, n-Octane, Pentadiene-1,3, Pentane, Propylene, Hydrogen Sulfide, Carbon Disulfide, Styrene
1.	Draeger X-am 2500	H_2S
		CO
		SO_2
		NO_2
		Combustible gases
		O_2
2.	Drager X-am 7000	H_2S

		CO
		SO_2
		NO_2
		Combustible gases
		O_2
3.	Dräger X-am 5000	H_2S
		CO
		SO_2
		NO_2
		Combustible gases
		O_2
4	Dräger X-am 5600	H_2S
		CO
		SO_2
		NO_2
		Combustible gases
		O_2
5	Drager Pac 3500	H_2S
6	Drager Pac 3500	CO
7	Drager Pac 3500	O_2
8	Drager Pac 5500	H_2S
9	Drager Pac 5500	CO
10	Drager Pac 5500	O_2
11	Honeywell BW GasAlert MicroClip Series (XL/X3)	Combustible gases
		CO
		H_2S
		O_2
12	Honeywell BW Clip 4	Combustible gases
		CO
		H_2S
		O_2

13	Honeywell BW GasAlert Max XT II	Combustible gases
		CO
		H_2S
		O_2
14	Honeywell BW GasAlert Quattro	Combustible gases
		CO
		H_2S
		O_2
15	Honeywell BW GasAlert Micro 5	Combustible gases
		CO
		H_2S
		O_2
		Dual H_2S + CO
		SO_2
		PH_3
		NH_3
		NO_2
		HCN
		Cl_2
		ClO_2
		O_3
		PID (LOS)
		CO_2
16	Multichannel gas detectors MultiRAE	Ammonia (NH_3)
		Carbon monoxide (CO)
		Carbon monoxide (CO), extended range
		Carbon monoxide (CO), H_2-compensated.
		The combination of carbon monoxide (CO) +
		+ hydrogen sulfide (H_2S)
		Chlorine (Cl_2)
		Chlorine dioxide (ClO_2)
		Ethylene oxide (EtO-A)
		Ethylene oxide (EtO-B)
		Ethylene oxide (EtO-C), extended range
		Formaldehyde (HCHO)

		Hydrogen (H_2)
		Hydrogen Cyanide (HCN)
		Methyl mercaptan (CH_3-SH)
		Nitric Oxide (NO)
		Nitrogen dioxide (NO_2)
		Oxygen (O_2)
		Phosphine (PH_3)
		Phosphine (PH3), extended range
		Sulfur dioxide (SO_2)
17	Single-channel gas detectors ToxiRAE Pro	Ammonia (NH_3)
		Carbon monoxide (CO)
		Carbon monoxide (CO), extended range
		Carbon monoxide (CO), H_2 compensated*
		Chlorine (Cl_2)
		Chlorine dioxide (ClO_2)
		Ethylene oxide (EtO-A)
		Ethylene oxide (EtO-B)
		Ethylene oxide (EtO-C), extended range
		Hydrogen (H_2)*
		Hydrogen chloride (HCl)*
		Hydrogen Cyanide (HCN)
		Hydrogen fluoride (HF)*
		Hydrogen sulfide (H_2S)
		Hydrogen sulfide (H_2S), extended range
		Methanethiol (CH_3-SH)
		Nitric Oxide (NO)
		Nitrogen dioxide (NO_2)
		Oxygen (O_2)
		Phosgene (COCh)*
		Phosphine (PH_3)
		Phosphine (PH_3), extended range*
		Sulfur dioxide (SO_2)
18	Gas detectors QRAE 3	Carbon monoxide (CO)
		Hydrogen Cyanide (HCN)
		Hydrogen Sulfide (H_2S)
		Sulfur dioxide (SO_2)
		Oxygen (O_2)*
19	MicroRAE Gas Detectors	Carbon monoxide (CO)
		Carbon monoxide (CO)
		Hydrogen Cyanide (HCN)
		Oxygen (O_2)

		Hydrogen Sulfide (H_2S)
		Hydrogen Sulfide (H_2S)
20	Wireless Gas Analysis System MeshGuard	H_2S
		CO
		CO
		O_2
		NH_3
		CL_2
		SO_2

ADDENDUM 8 PROCEDURE FOR CONDUCTING MANDATORY AIR SAMPLING

1. Mandatory air sampling

1.1. The equipment and control panels should be isolated before starting the initial air sampling.

1.2. The frequency of air sampling given below is considered standard.

1.3. The frequency can vary depending on the situation.

2. Initial air sampling

- The initial sampling of air quality should be carried out before entering (from outside) confined space. After initial sampling of the air quality it is required to carry out testing at the bottom part of confined space using a sampling hose. Air quality monitoring is carried out in accordance with Sampling guidelines.

3. Continuous sampling

- Continuous air quality monitoring is carried out in cases where the air environment can become flammable as a result of the work carried out, or in cases when the level of toxic vapors or gases becomes excessive presenting an immediate danger to the personnel's life and/or health.

Note:

- *The person responsible for conducting air monitoring should enter results of sampling made into the work permit.*

4. Control sampling

- This sampling is necessary to verify the accuracy of measurements made by the gas detector during initial sampling.

5. Checking gas detecting equipment before use

5.1. The following steps should be made before using the equipment:

- Perform a visual inspection to detect damage.

- Get clean reading through taking the device to fresh air and zero it out so that the readings obtained are consistent with fresh air, i.e. 20.9% for oxygen (O_2), 0% LEL for combustible gas (CH_4), and 0 mg/m^3 (ppm) for toxic gases: hydrogen sulfide (H_2S) and carbon monoxide (CO).

- Make sure that an appropriate air monitoring device is used for a certain gas.

- Check that the instrument battery is charged.

Note:

- *It is prohibited to change the instrument battery inside the gas hazardous area.*

- Check filters for cleanliness.

- Check hose and probe to ensure correct connection, lack of clogging and damaging. Using a damaged hose or probe can result in erroneous readings.

5.2. Dehumidifier and/or filter

5.2.1. A moisture-catching device is usually installed between the probe and instrument to remove moisture and trap liquid that can damage the instrument. The filter catches only a micro quantity of moisture and dust particles.

5.2.2. The trap and filter should be checked before each use and replaced as necessary.

5.3. Retractable probe

5.3.1. If necessary, a hard extension can be fixed at the end of the hose to test air quality inside confined spaces.

5.3.2. The probe allows a person taking measurements of air quality to remain outside the confined space. When using a retractable probe, the readings are delayed with delay equal to the time of sample passing the probe.

ADDENDUM 9 SAMPLING METHOD

1. Sampling method

1.1. Sampling should be carried out at all sites, inside tanks or equipment where the permit towork requires hot work, work in a confined space or work using breathing air equipment.

1.2. All branch sewers, drainage holes and wells within a radius of 15 meters from the site of hot work should be tightly closed before sampling. They should additionally be filled with sand having height no less than 15 cm. Vents inside the same radius should be checked for gas presence.

1.3. Sampling should be carried out in all tanks or pits having depth more than 1.0 meter (for facilities in the Republic of Kazakhstan more than 1.2 m) before allow in workers to enter:

- Before entering the tank or enclosure air sampling should (if possible) be carried out outside the hatch (manhole, entrance).
  - Sampling should be carried out at serpentine pipeslocations, next to pipes, next to drainage and spillway openings, as well as next to any cracks or holes at the bottom section of tanks or vessels. Sampling inside tanks should be also carried out at the maximum possible height.

1.4. If the results of sampling show presence of excessive concentration and/or an alarm signal is set off then all persons staying inside the hazardous area should take the following actions:

- Stop work immediately.
- Arrange for evacuation of workers from the hazardous area.
- Assess the degree of hazard of air quality, find out the cause of developing unsafe conditions and establish measures to reduce the risk (for example, provide for tank ventilation).
- Perform corrective actions.
- Re-sample.
- Do not enter confined space until the test confirms the safe status of the air quality inside the tank.
- Revise work permits accounting for changed conditions.

2. Precautionary measures

2.1. Gas detectors can only be used to determine the content of vapors and gases which it is intended to measure.

2.2. Do not allow liquid entering the sampler.

2.3. Do not take samples in vessels, tanks, columns, etc., containing hot water vapor or hot hydrocarbon vapors to avoid the following:

- Moisture will overload the filter and will interfere with pump operations.
- Hot hydrocarbon vapors will condense inside the hose or sampler without contacting gas detector sensors. As a result, the instrument can erroneously indicate an underrated flammability level.

Note:

- *The maximum temperature inside a confined space should not exceed 40°C (forty degrees Celsius).*

2.4. Sampling carried out at very low temperatures (-18 ° C and below) can be inaccurate for the following reasons:

- Evaporation of flammable liquids can be insufficient to allow gas detector detecting them.
- Generated vapor can condense and when frozen it can clog the detector(sensor).

2.5. Samples that do not contain 10% or more oxygen (but contain flammable vapors) usually give underrated LEL readings since the oxygen content is not sufficient to mix with flammable vapors in the sample.

2.6. When sampling is conducted inside tank, a controllable ventilation should be switched-off at least 30 (thirty) minutes before the sampling in order to get the most accurate results.

2.7. If there is a possibility that the area is contaminated, the reading of gas detector should be taken approaching the area (for example, the area featuring spill/release of hazardous materials, etc.).

3. Interpretation of readings

3.1. Portable multi-component gas detectors provide audible, visual, and vibration alarms indicating high levels of oxygen, flammable gases and vapors, and/or toxic gases (Addendum 7). The gas detector can also react on insufficient oxygen content.

3.2. In case the results of regular sampling differ significantly from results of initial sampling the work should be stopped until safe conditions are developed to resume the work. It is necessary to check the working conditions next to the work site to make sure that the situation did not change and cannot adversely affect the working conditions.

ADDENDUM 10 SAFETY MEASURES WHEN MONITORING AIR QUALITY

1. Permit to engage into air monitoring

1.1. CPC or contractor employees who passed special training on using portable gas detectors are admitted to engage into air quality testing; these employees should have an appropriate certificate, they should prove the ability of reliable using the equipment in practice and the knowledge of the Guidelines herein; these employees should have an official authorization to engage into gas quality monitoring stipulated in relevant resolution (instruction).

2. General precautions to be observed in air quality monitoring

2.1. The following precautions should be taken:

- If you do not rely on current instrument readings compare them with readings of another instrument.
- Before checking air quality it is required to turn off ventilation for at least 10 minutes before taking measurement to ensure getting more accurate readings in case the work is carried out in confined space using forced mechanical ventilation.
- Gas detectors can be only used to detect vapors and gases for which they are designed
- It is strictly prohibited to charge/change the device battery inside a gas-hazardous area
- Avoid getting liquid inside the probe.
- Avoid sampling in vessels, tanks, columns, etc. that still contain hot steam and/or hot hydrocarbon vapor

Note:

- *The filter can be clogged by moisture resulting in interference with the pump operations.*
- *Hot hydrocarbon vapor will condense inside the probe without contacting the sensor which will lead to erroneously low flammability readings.*

2.2. Persons engaged in air quality monitoring should be provided with personal protective equipment (clothing, safety shoes, hard hat, gloves, and gas mask); they should be trained on design of gas masks and on techniques of gas mask application.

2.3. Gas masks should be used and the work should be carried out in the buddy work manner to monitor air quality in especially hazardous areas where release or accumulation of hydrogen sulfide is possible or when gas hazardous work is underway with a risk of accumulation of hydrogen sulfide.

2.4. Ventilation should be turned on before monitoring air at regularly serviced industrial premises where a sudden release of hydrogen sulfide can occur. After airing (for 10–15 min) the area can be accessed by operator wearing gas mask and equipped with portable device to check presence of hydrogen sulfide in the air. The observer at this time should stay outdoors being ready to provide necessary assistance.

2.5. If it is required to monitor air quality next to outdoor installations at night, an employee monitoring the air quality should have an explosion-proof hand-held torch with a voltage not exceeding 12V and have an assistant company (buddy).

2.6. Sensors in stationary warning devices and in gas detectors, alarm equipment, portable gas detectors should have an explosion-safe design.

3. Special requirements on air quality monitoring when conducting hot works:

- The air should be monitored for presence of flammable gases/vapors before the start of gas hazardous/hot works.
- The initial analysis of air quality should be carried out by the person in charge of checking air quality (CPC employee) and always witnessed by the work manager and work team leader. At sites where the

work is made using contractor personnel the head of facility can assign both CPC personnel and contractor employees responsible for air quality monitoring during the work. The special training and an instruction (resolution) on appointing an employee responsible for air quality monitoring is obligatory.

Note:

- *Under other circumstances, for example, when the work site is located outside CPC facilities (TPL line-pipe) the facility manager can hinge the responsibility to conduct the initial checking air quality check with contractor personnel. The instruction should be made in writing and only for a specific scope of work.*

- Hot work is prohibited inside the working area featuring flammable vapors or gases.

- It is necessary to monitor air quality in all sewage and drainage networks, and in drain sumps located near the site where the hot work should be carried out; these objects should be tightly closed, if necessary, it is also required to close the vent holes.

- Remove all sources of ignition (combustible and flammable materials) within a radius of up to 14 meters from the hot work site (in accordance with requirements set forth in Addendum 3 of the Fire Protection Regulation in the Russian Federation).

- Ensure that there is no debris on the site, and that combustible materials are removed and there is no risk of setting fire from sparks or hot metal.

- It is required to provide an appropriate fence or cover to prevent ignition from sparks, scale or heat if it is impossible to eliminate all causes of fire or it is impractical to relocate the work site.

- Indicators of safe concentrations for the most common types of sampling carried out before approving work permit to engage into hot work, Addendum 6.

4. Special requirements to monitor air quality before entering confined space

4.1. Air monitoring should be conducted before admitting persons to a confined space work area.

- Employees are prohibited to enter confined spaces until the initial air analysis is taken and access requirements are determined.

- The initial air quality analysis should be carried out by personnel authorized to conduct air quality testing from among CPC personnel; the activity should always be carried out in the presence of foreman and persons in charge of conducting the work.

- It is necessary to monitor air quality in all areas (at the top, in the middle, and at the bottom) of confined space using appropriately calibrated instruments to determine presence of gases. The gas-air mixture can be different in different compartments of the same vessel.

Note:

- *If possible, use a retractable probe for taking air samples from outside the confined space; in this case it is required to use a full set of personal protective equipment and to issue work permit for gas hazardous work.*

- Under certain circumstances it can be required to monitor air quality entering confined space; in this situation it is required to use a full set of personal protective equipment and issue a clearance work permit to enter the confined space.

- Indicators of safe concentrations for the most common types of sampling carried out before approving the work permit inside engineering equipment are given in Addendum 7.

5. Special precautions for air monitoring under winter conditions

5.1. The air quality testing equipment should be only used accordance with the manufacturer's guidelines; it is prohibited to use this equipment below admissible temperatures.

5.2. At very low temperatures (starting with around minus 18°C and below) air measurement can be inaccurate for the following reasons:

- Flammable liquids may give insufficient vapor for detection.
- The steam generated in this section can condense/freeze and clog the sensor.

Note:

- *The equipment should be used only within the temperature limits for which it is intended (for detailed information refer to the manufacturer's guidelines).*

ADDENDUM 11 - REVISION HISTORY SHEET

REVISION HISTORY SHEET							
Chng. No	Description of change	Enactment date	Sheet numbers			Total sheets	Full name of person introducing change
			Chng.	New	Cancel led		