###### Technical Specifications

(Annex to the Invitation)

#### Name of Event: Supply of TEG regenerators for Štramberk UGS

|  |  |  |
| --- | --- | --- |
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1. introduction

The purpose of the contract is the supply of two packaged triethylene glycol (TEG) regeneration unit for two drying lines of wet natural gas at Štramberk UGS.

All the volume units, unless otherwise stated, are quoted in this specification under standard reference conditions: *t* = 15 ° C and pressure *p* = 101 325 Pa.

1. scope of the works
   1. Subject-Matter of the Contract

The subject-matter of the contract is the supply of two pieces (A and B) of packaged unit PA01A/B according to marking (outlining with black broken line) as stated in the Mechanical designs and technological diagrams of TEG regeneration 1 and 2, see drawings nos. 0755-CF-0132-102/0 and 0755-CF-0132-103/0, prepared by Intecha within the construction completion documents, 01/2017, included as annexes nos.2 and 3 of this technical specifications (TS).

In consistence with the designation arising from the mentioned construction completion documents (CCD), the packaged unit PA01A/B consists of the following parts:

A01A/B – flue

C02A/B – regeneration column, E02A/B- TEG regenerator

E03A/B – regeneration columns condenser

E04A/B/C/D –TEG economizer

F01A/B – TEG filter

V01A/B – air fan

Z01A/B – burner with flue gas burning chamber

The packaged unit has to contain additional components necessary for its functioning, which are further itemized in these TS. These include e.g. a control system of burner with flue gas burning chamber unit (PLC) and instrumentation elements necessary for measurement and control of the unit (management system of technological processes), valves, piping and cabling.

The parameters of the TEG regeneration technology are based on the operational requirements on the drying technology. The required parameters of the drying technology are shown in Table 1 for seven working points.

Table 1 – Required drying parameters for Štramberk UGS

|  |  |  |  |
| --- | --- | --- | --- |
| Point No. | Maximal Gas Flow Rate (mcm/day) | Input Pressure (MPag) | Input Gas Relative Humidity (rel. %) |
| 1 | 10.0 | 3.3 | 70 |
| 2 | 9.2 | 3.1 | 80 |
| 3 | 8.8 | 2.8 | 90 |
| 4 | 7.6 | 2.1 | 100 |
| 5 | 6.2 | 1.4 | 100 |
| 6 | 4.2 | 1.1 | 100 |
| 7 | 3.0 | 1.0 | 100 |

The temperature of the input gas in the drying technology is 15 °C.

The minimal gas flow has been defined for working point no.7 and should be 0.5 mil.m3/day.

The used documents from CCD are cited at the appropriate places in this TS and form its part in the form of annexes; the lists of the Annexes in the last chapter

.  
All these documents are part of this TS and are listed as its Annexes.  
  
The desired range of individual parts supplied is specified in the following chapters.

* 1. Description of the Technology

The regeneration technology includes two packaged units PA01A/B including regenerators with burners and combustion chambers, heat exchangers, filters and TEG piping and cabling within the unit and the relevant part of instrumentation.

Mechanical design and technological diagram (P&ID) is shown in the Intecha drawings nos. 0755-CF-0132-102 / 0, 0755-CF-0132-103 / 0 and 0755-CF-0131-101 / 0 included in the annex to this TS.

After passing oriented filling in C01 columns (A / B), TEG enriched with water is captured in the absorber, from which it is discharged by a tube into the bottom portion of the column below the surface of TEG. The level is maintained at a constant level, since there is a continuous bleed through the control valve LV 4RT001AA001 / 4RT002AA001 and the respective packaged units PA01 / B.

After this relief valve, safety valve 4RT001AA302 / 4RT002AA302 is fitted in the TEG piping, which closes the TEG flow when:

1. the level of TEG in the column drops below the minimum threshold
2. the pressure in the piping after this valve increases beyond a set limit
3. there is an outage of the control voltage
4. there is a loss of the control air pressure in the instrumentation network.

This ensures that gas cannot enter the TEG pipe and prevents the pressure increase in the line above a specified value.

The pipe connection allows for operating the drying column A / B both with regeneration unit A and with regenerative unit B. The desired route can be remotely set by pneumatic valves with a secure closed position. Because TEG could be trapped between two valves, and then, with increasing surface temperature due to solar radiation to pressurizing of the various closed sections, all shut-off valves are equipped with TER (TERV) valves of the smallest possible diameter. The increased pressure can be relieved into the next section, and finally released after the column C02A / B over PCV regulation and blown off.

Then, TEG flows into spiral wound capacitor E03A / B at the head of the rectification column of C02A / B regenerator. Here, on the outer side of the pipe coil, the vapours condense and drip down to the filling, forming a “reflux”. The reflux quantity depends on the temperature or the flue gas leaving the rectification column, which should be about 100 to 110°C (will be resolved in detail with the supplier of the packaged regeneration units).

The temperature is achieved by means of control valve 4RT001AA002 TV / 4RT002AA002 in the by-pass capacitor on the TEG pipeline.

TEG in the condenser is heated by single-digit values of °C and passes through filter F01A / B to remove any impurities and particles of corrosion. Then, TEG enters the cross heat exchangers E04A / C, B / D, where it is heated by the counter-flow hot TEG leaving the regenerator to a temperature of about 115 to 125 °C. The preheated TEG is then fed through the distributor to the rectification column of regenerator C02A / B. Here, TEG flows down the filling down to the boiler section of the regeneration boiler E02A / B itself. The mixture of TEG-water is distilled on the filling of the rectification column, and in the boiler section, TEG is stripped of the remaining water at the temperature of max. 205 °C. The water content in TEG before regeneration is about 5 wt % and about 1 wt % after regeneration. The regenerated TEG from the regenerator boiler goes to the economizer E04A / B, where it transfers heat to TEG entering regeneration. At the outlet of the exchanger E04C / D, the regenerated TEG temperature is of about 90°C. The TEG is then transported by means of a metering pump P01A / B and C / D to heat exchanger E01A / B, where TEG is cooled to max. 25°C and then to the absorption column C01A / B.

The TEG regenerator must be positioned so that the suction head to the TEG pump P01A / B / C / D was about 1.5m.

The released gas and boiled water from TEG – “exhaust vapour” – leave through the head of the rectification column C02A / B of the regenerator. Flue gas of a temperature of 100 to 110°C is further preheated in a tube which passes through boiler regenerator E02A / B. The preheated flue gas is fed into the combustion chamber Z01A / B of the regenerator, where they are completely burned together with natural gas. This will cause the destruction of harmful substances contained in the evaporating flue gas. Combustion chamber Z01A / B with a burner is equipped with instrumentation system, which controls not only the performance but also the necessary amount of air sucked into blower V01 (A / B) required for excess air of a exhaust vapour combustion or one air fun is a part of the burner and it is for the addition of air to the burned natural gas, and the second fun V01 (A/B) is for the addition of air to burn exhaust vapour. The burner operation is blocked due to the level drop in the regenerator below the set limit and due to exceeding the maximum temperature of the regenerated TEG.  
The pumps are blocked due to the TEG level drop below a set limit in the boiler part of TEG in packaged regeneration unit PA01A/B.

Between the two lines of gas drying piping interconnections will be installed so that it is possible to add any TEG regeneration technology to any absorption column.

A “small circuit” is included in the TEG regeneration technology, which allows for heating of the TEG circuit to about 75 °C and thus shortens the time of the start-up of the entire drying technology following a withdrawal request. In the small circuit, TEG is not injected into any of the columns C01A / B.

* 1. List of Apparatuses and Accessories

In consistence with the designation arising from the mentioned construction completion documents (CCD), the packaged unit PA01A/B consists of the following parts:

A01A/B – flue

C02A/B – regeneration column, E02A/B- TEG regenerator

E03A/B – regeneration columns condenser

E04A/B/C/D –TEG economizer

F01A/B – TEG filter

V01A/B – air fan

Z01A/B – burner with exhaust vapour burning chamber

The packaged unit has to contain additional components necessary for its functioning, which are further itemized in this TS. These include e.g. a control system of the burner and burning chamber (PLC) and instrumentation elements necessary for measurement and control of the unit, valves, piping and cabling.

The limits of the supply of the packaged units PA01A/B are marked in the Mechanical designs and technological diagrams of TEG regeneration 1 and 2, drawings nos. 0755-CF-0132-102/0 and 0755-CF-0132-103/0, by Intecha by black broken lines and marked as PA01A and PA01B.

The stated parameters are based on preliminary offers, on the basis of which the CCK projects documents were prepared by Intecha.

Expected max. capacity 250 kW

Temperature of the boiler part: 160 ÷ 205 °C

Volume of rich TEG: 1350 ÷ 3250 kg/h

Expected flue gas flow rate: 0 ÷ 300 kg/h

Determination of external factors specified in report no. AE 075500/0130 / R0, on determining external effects according to CSN 33 2000-5-51 ed.3 and the related drawings Determination of dangerous zones č.0755-CZ-0130-101.

The characteristics of the individual parts of the packaged units in the following chapters B.3.1 to B3.4 are purely instrumental, specific parameters depend on the suppliers.

#### *B.3.1 TEG Regenerator*

The regenerator consists of one rectification column E03A/B, E02A/B and one chamber for after- burning with burner Z01A/B.

Parts of the regenerator:

* Rectification column E03 is a vertical vessel of 350mm diameter and 4000mm height.

The internals is made of filling (oriented, such as Mellapak Plus – for this, the column diameter should be 350 mm and the height 4000 mm), vapour condenser E03A/B and demister.

* Regeneration boiler E02A/B is a horizontal vessel of 1 600 mm diameter and 7 500 mm length.

The boiler is divided into the boiler and reservoir parts. The boiler part is made of fame tube furnace and flame piping.

* An integral part of the boiler is a metal-sheet flue A01A/B of 300 mm diameter and 6 000 mm height..

Design pressure: 0.49 barg

Working pressure: 0.3 barg

Design temperature: 220 °C

Working temperature: max. 205 °C

Weight: 8 800 kg

Material: CS, SS

The regenerators will be thermally insulated.

#### *B.3.2 Burner with equipment and with chamber for after-burning of flue gas Z01A/B*

The present gas regulation station will be used for the natural gas supply for the burner – pressure of 10 kPa.

The proposed solution assumes after-burning of the working gas (flue gas) from the TEG regenerator and waste gases in a special burner (Kromschröder BIC 125or BIO 100 with a secondary element, max. output power of 230 kW and min.25 kW) intended for heating the regenerator. After-burning will take place directly in the flame of the burner with a double burner fitting which allows the addition of gas from the regenerator (flue gas) when mixed with a controlled amount of air into the flame as a secondary step. The staged adding of combustion air to the burner partly reduces the flame temperature, thereby reducing the risk of thermal degradation of TEG at the inlet of the combustion products into the regenerator. After the burner, afterburner chamber will be fitted with a maintained temperature of about 750 °C, to achieve a perfect afterburning of hydrocarbon fractions from the process gas. Flue gases from the afterburner chamber are then fed into the regenerator. The afterburner chamber will be equipped with a bypass so that any portion of the flue gas could be discharged directly into the flue, if the consumption of heat in the regenerator is lower.

Due to the design of the regenerator and the need for maintenance, the whole device is placed on the regenerator flange with the possibility of disassembly.

Scope of the supply for one regenerator:

1 pcs complete burner (natural gas 10 kPa, max 20m3/h.) with electrical ignition and flame regulation and air fun, safety and control elements and gas meter

1 pcs afterburning air fan (V01 A/B)

1 pcs PLC for regulation of the generator temperature and chamber for after-burning due to regulation of the burner output and the volume of the afterburning air (burner control unit)

1 pcs working gas flow meter

1 pcs lambda probe in the combustion products discharge

1 pcs documents (electrical and gas inspection, operations instruction, declaration of conformity)

1 pcs communications with the superior control system, visualizing of the measured values

1 pcs after-burning chamber with temperature regulation

1 pcs duct systems

1 pcs isolation of combustion chamber and combustion products distribution

1 pcs check-valve in the by-pass

The flue gas from the burner and combustion chamber must meet the requirements of Decree no. 415/2012 on the permissible levels of pollution and their identifying and on implementing certain other provisions of the Air Protection Act.

#### *B.3.3 Heat Exchangers TEG-TEG, E04 A/C a B/D*

Heat exchangers E04 (A/B a C/D) are 2 separate exchanger with the same tubing bundle.

type of heat exchangers: direct flow, double pipe

The outer jacket of the exchanger: TR ø 508 x 16 mm

Number of tubes in a heat exchanger: 224

Pipe size: TR ø 18 x 2, length 7 m

Ribs spacing: 250 mm

TEG inlet and outlet flanges: DN65, PN16

Design pressure: 6 barg

Design temperature: 200 °C

Total weight of both heat exchangers: 4 500 kg

Material: CS

#### *B.3.4 TEG Filter F01*

TEG filter F01 (A/B) is a vertical cylindrical vessel with three tips.

* Apparatus diameter: 406 mm
* Height of the apparatus incl. feet: 1 990 mm
* Filter tip length: ca 900 mm
* Material: CS
* Design pressure: 4 barg
* Design temperature: 100 °C
* Weight: 280 kg
* Local measuring of pressure drop:
* TEG inlet and outlet flanges: DN50 PN16
* Internals: 3 pcs of filter tips

#### *B.3.5 Valves*

The number of valves which have to be contained in one packaged unit:

1. 2 pcs BV DN50, PN16- with pneumatic actuation (AA104, AA105),
2. 2 pcs safety valve TERV – spring acting (AA301, AA307),
3. 1 pcs safety relief valve PCV (not designated, on the outlet of the flue gas from the column),
4. 1 pcs shut-off/control valve – with pneumatic actuation (AA002),
5. 19 pcs ball valve DN50, PN16 (AA509, AA510, AA511, AA513, AA514, AA515, AA516, AA517, AA519, AA520, AA521, AA531, AA532, AA533, AA602, AA603, AA604, AA609, AA610),
6. 4 pcs ball valve DN25, PN16 (AA902, AA903, AA904, AA905),
7. 1 pcs ball valve DN15, PN16 (AA901),
8. 2 pcs ball valve DN10, PN16 (AA905, AA906).

The valves must be supplied in compliance with the requirements specified in the files: 0755\_PS\_0161\_240\_0\_List of manual valves.xls (14),

0755\_PS\_0161\_241\_0\_Shut-off valves specification.xls (Annex no.15),

0755\_PS\_0161\_242\_0\_List of new remote valves.xls (Annex no.16),

0755\_PS\_0161\_243\_0\_List of safety valves.xls (Annex no.17).

#### *B.3.6 Piping*

The pipes must be supplied in compliance with the requirements specified in the files: 0755\_PS\_0161\_210\_0\_List of pipes and equipment.xls– see Annex no.18.

The scope of weld testing must comply with 0755\_PC\_0161\_202\_0\_Scope of weld test.xls (Annex no.19).

The scope of supply of the profiles must comply with 0755\_PS\_0132\_091\_0\_List of profiles.xls (Annex no.20).

The list of piping branches is included in 0755\_PS\_0161\_201\_0\_List of branches.xls (Annex no.21).

#### *B.3.7 Management System of Technological Processes*

Within the packaged regeneration unit, the following signals are included in the control system at Štramberk UGS:

- from the level gauge to the reservoir part of TEG regenerator

- LI TEG level signal

- LAH,L high/low TEG level signal

- LBL signal for blocking pumps P01, P02

- from the level gauge to the boiler part of TEG regenerator

- LZ blocks the burner at the level drop

- LIA starts alarm in the control system at the level drop

local indication of the level

- remote temperature measurement

- TC measuring flue gas temperature, maintaining their constant temperature using a valve in TEG pipelines

- TI reading TEG regenerator temperature

- TZ, TA blocking the burner due to high temperature of TEG and sending an alarm to the control system

- TIC for regenerator burner devices

- valves using instrumentation

- total number of valves: 22 pcs

(1 pcs control, 21 pcs open-close)

- signals from the automatic burner

- off - on  
- failure  
- current temperature  
- possibility to change the desired temperature  
- possibility to reset burner on failure

Requirements to the PLC of the burner – burner control unit:

- The control system will be in non-redundant design.  
- PLC, I/O cards and interface cards must be manufactured by Bernecker and Rainer, product series X20 or robust X90 series with respect to the protocol of external influence.

- MODBUS TCP / IP is the preferred communication for the communication of the control system of the generator and the existing control system.

- The contracting body requires supply of control algorithms as a documentation for the application of the control system.  
- The contracting body requires source codes for the control systems of the regenerator to be supplied.  
- The contracting body requires a list signals of the control system to the regenerator and MODBUS signal map for communication with superior control system ZAT Sandra.

Supply of wiring covers parts that fall into packaging units PA01A/B. Electric cables will be ended in a electric junction box, measurement and control cables wil be ended in a measurement and control junction box. The junction boxes will be placement on the delivered unit (skid).

The list of circuits in provided in file: 0755\_ME\_0171\_201\_0.xls. (Annex no.22)

Function logic and block diagrams must be according to: 0755\_MH\_0171\_101\_04\_0.pdf (Annex no.23), 0755\_MH\_0171\_101\_05\_0.pdf (Annex no.24), 0755\_MH\_0171\_101\_06\_0.pdf (Annex no.25), 0755\_MH\_0171\_101\_07\_0 (Annex no.26).

List of cables is provided in the file: 0755\_MK\_0171\_101\_201.pdf (Annex no.27).

Mounting sketch of the on/off valve with shut-off valve is provided in the file:C010CZ.pdf (Annex no.28).

Mounting sketch of the control valve with E/P positioning is provided in the file: C001CZ.pdf (Annex no.29).

Mounting sketch of the on/off valve is provided in the file: C012CZ.pdf (Annex no.30).

Mounting sketch of the local pressure measurement is provided in the file: P126CZ.pdf (Annex no.31).

Mounting sketch of the local temperature measurement is provided in the file: T009CZ.pdf (Annex no.32).

## B.4 Layout

TEG regenerators, combustion chambers, filters and TEG-TEG heat exchangers are placed on the concrete surface of the original TEG regeneration technology. A shed will be built over this area (not included in the supply) with ground plan dimensions of about 13 x 19 m and a height of about 6 m. Pent rafters with overhang is considered.

The flue of the regenerator and rectification column at the regenerator will go through the roof. Along the edge of the concrete surface, a plinth will be made of concrete, which together with the floor will form a drip pan for a possible leak of glycol. The sump will be equipped with a mudpan to drain the contents.

The dimensions of appliances in the bid must be in accordance with the defined space for the regeneration technology, which is shown in the drawings: 1. Machinery layout - Regeneration - layout and "Q", "R" views, Doc.No. 0755-CD-0132-101 / 0, Intecha 01/2017 2. Machinery layout - Regeneration – ISO view, Doc.No. 0755-CD-0132-102 / 0, Intecha 01/2017 and 3. Pipe disposition - Regeneration - ISO view, Doc.no. 0755-PD-0161-204\_0, Intecha 01/2017.

* 1. Material and Thermal Balance

The balance calculations of the flows of wet and dry gas and TEG for the operating points nos. 1, 5 and 7 are shown in the following working schemes of the drying technologies (see Annex no. 10-12):

Technological Working Scheme of Drying, Working Point 1, drawing no. 0755-CB-0000-101 / 0, Intecha, 01/2017.  
Technological Working Scheme of Drying, Working Point 5, drawing no. 0755-CB-0000-102 / 0, Intecha, 01/2017.  
Technological Working Scheme of Drying, Working Point 7, drawing no. 0755-CB-0000-103 / 0, Intecha, 01/2017.

* 1. Operating Conditions

**B.6.1 Media**

**B.6.1.1 Natural Gas**

Natural gas composition:

Component mol. %

methane min. 85

ethane max. 7

propane max. 3

butanes max. 2

pentanes and higher hydrocarbons max. 0.5

oxygen max. 0.02

CO2 max. 3

N2 max. 5

Hydrogen sulphide max. 6 mg/m3

Total sulphur max. 30 mg/m3

Calorific value 33.8 to 42.5 MJ/m3

Density 0.56 to 0.7

Wobbe Index 45.7 to 52.2 MJ/Nm3

At the time of withdrawal, the gas will be saturated with water.

Natural gas is unbreathable and flammable, and forms an explosive mixture with air in the range of about 5 to 15%, depending on the composition. It is a gas lighter than air, with a specific density of approximately 0.7 kg / m3 (at 15 ° C and 101 325 Pa).

Natural gas contains liquid hydrocarbons, condensation and mineralized water, glycol, methanol and mechanical admixtures containing:

liquid hydrocarbons ……… up to 2cm3/m3

methanol …………………… up to 50 mg/m3

mechanical admixtures ……… up to 2mg/m3 with max. particle size 5 mm harder than the soft seal material.

For the purposes of thermal balances calculation consider the following natural gas composition: (mol. %): methane 97.010; ethane 1.718; propane  0.340; iso-butane 0.052; n-butane 0.066; iso-pentane 0.008; n-pentane 0.010; C6+ 0.014;  CO2  0.129; N2 0.647; O2  0.007.

**B.6.1.2 Triethylene glycol (TEG)**

CAS Nr.:[112-27-6](http://www.sigmaaldrich.com/catalog/search?term=112-27-6&interface=CAS%20No.&N=0&mode=partialmax&lang=en&region=CZ&focus=product),  Beilstein reg.no. 969357, EC Nr.:[203-953-2](http://www.sigmaaldrich.com/catalog/search?term=203-953-2&interface=EG/EC%20No.&N=0&mode=partialmax&lang=en&region=CZ&focus=product)

Linear formula: HO(CH2CH2O)2CH2CH2OH  
Molar mass: 150.17 g/mol  
It is a colourless highly viscous liquid, odourless, with high boiling point (285°C at the pressure of 100 kPa), highly hygroscopic, with a density of 1126 kg/m3 at 20°C and the pressure of 100 kPa.  
TEG irritates the skin and eyes. Inhaling TEG mist causes irritation to the nose, mouth and respiratory tract.  
When exposed to high temperatures, it decomposes to products (aldehydes, ketones and organic acids) which can be toxic and explosive.

**B.6.2 Operating Temperature of the Media**

The operating temperature of the medium is within the range from +4°C to 210 °C. Specific values are listed in the Annexes to this Technical Specification.

**B.6.2.1 Ambient Temperature**

The ambient temperature ranges from -20°C to +50°C.

**B.6.3 Operating Pressure**

Operating and design pressure of the apparatus, valves and pipelines in the frame of the packaging unit are listed in chapter B.3 and in the Annexes.

## B.7 The Supply Includes

For each required components, links are included to the designation from Mechanical designs and technological diagrams of regeneration by Intecha – see Annexes no. 1, 2 a 3).

1. Packaged TEG unit with rectification column PA01A/B – equipment ensuring water from TEG enabling its recirculation, incl. a burner with after-burning chamber incl. control unit - see Z01A/B), including air fans (see V01A/B), Heat exchanger TEG-TEG – (see E04 A/B+C/D), TEG filter – (see F01 A/B) – 2 pcs (A and B), piping and cabling; the outline of the supply is black broken line on the drawings in Annexes 2 and 3.
2. Normative and legislative tests and inspections of equipment at the manufacturer’s incl. subcontractors.
3. Final coating
4. Thermal insulation of all parts - apparatuses and pipelines, whose temperature is higher than 60 °C.
5. The apparatus must be placed on a skid and equipped with support structures that enable fixation to the floor.
6. Instruments and tools for installation and commissioning.
7. Spare parts for 3-year operation.
8. Accompanying documentation in the Czech language (number of copies will be determined by the client
9. Protection of the equipment for transporting and handling.
10. Loading and transport of the supply to the site (Štramberk UGS).
11. Master assembly and commissioning of the unit
12. Training of the operators for the operation and maintenance of the supplied equipment in Czech language.
13. Participation of the client’s representative on factory testing and pressure tests of the individual apparatuses.
14. Participation of the representatives of the supplier on the guarantee tests on site.
15. Control algorithms such as the documentation to the control system application.
16. Source codes of the control systems of the regenerator.
17. The list control system signals of the regenerator and MODBUS map signals for communication with superior ZAT Sandra.

B.8 Technical Specifications to be Included in the Bid:

1. List and parameters of the offered components including the data-sheet with technical specifications.
2. Dimensional drawings of the regenerator with a rectifying column, a combustion chamber with burner + their mutual layout, heat exchangers, filters and dampers with indication of all included parts of the supply (instrumentation, valves, piping and cabling) and the main dimensions.
3. Weight of each apparatus.
4. Internal volume of each apparatus
5. Requirements for the foundations
6. Special requirements for installation on site.
7. Material specifications of the major part of the apparatus.
8. Specification of each component of the device (data sheet).
9. Safety coefficients for the compressive stresses of each apparatus.
10. Max. allowed pressure loss of each apparatus.
11. Max. pressure loss of each apparatus for operating points # 1, 5 and 7 according to the technology working schemes of the drying from Intecha.
12. Table with guaranteed levels of water content in the regenerated TEG for a given flow rate according to Tables 2 and 3.
13. Tables 4 and 5 with the guaranteed gas, TEG, water flow rates, gas consumption, flue gas including their gross calorific values ​​for a given flow rate of the withdrawn gas.
14. Schedule of tests and inspections for the offered apparatuses.
15. A list of individual parts of appliances, which are part of the offer.
16. A list of recommended spare parts for 3-year operation.

**Table 2 – Guaranteed values of the offered unit of TEG regeneration**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| TEG flow (kg/h) | Max. flow | 2000 | 1500 | 1000 | 500 | Min.flow |
| H2O content in TEG on the input (wt %) | 8,0 | 8,0 | 8,0 | 8,0 | 8,0 | 8,0 |
| H2O content in TEG on the output (wt %) |  |  |  |  |  |  |
| Consumption of natural gas in the burner (m3/h)1) |  |  |  |  |  |  |
| H2O content in TEG on the input (wt %) | 6,0 | 6,0 | 6,0 | 6,0 | 6,0 | 6,0 |
| H2O content in TEG on the output (wt %) |  |  |  |  |  |  |
| Consumption of natural gas in the burner (m3/h)1) |  |  |  |  |  |  |
| H2O content in TEG on the input (wt %) | 4,0 | 4,0 | 4,0 | 4,0 | 4,0 | 4,0 |
| H2O content in TEG on the output (wt %) |  |  |  |  |  |  |
| Consumption of natural gas in the burner (m3/h)1) |  |  |  |  |  |  |

*Note: 1) consumption in relation to reference pressure 101325 Pa, reference temperature 15 °Ca and gas composition (mol. %): Methane 97.010; Ethane 1.718; Propane 0.340; iso-Butane 0.052; n-Butane 0.066; iso-Pentane 0.008; n-Pentane 0.010; C6+0.014; CO2 0.129; N20.647; O2 0.007.*

**Table 3 – Guaranteed values of the offered TEG regeneration unit according to the working scheme of the drying**

|  |  |  |  |
| --- | --- | --- | --- |
| TEG flow (kg/h) | Working Point no. 1 | Working Point no. 5 | Working Point no. 7 |
| H2O content in TEG on the input (wt %) |  |  |  |
| H2O content in TEG on the output (wt %) |  |  |  |
| Consumption of natural gas in the burner (m3/h)1) |  |  |  |

*Note: 1) consumption in relation to reference pressure 101325 Pa, reference temperature 15 °Ca and gas composition (mol. %):*

*Methane 97.010; Ethane 1.718; Propane 0.340; iso-Butane 0.052; n-Butane 0.066; iso-Pentane 0.008; n-Pentane 0.010;*

*C6+0.014; CO2 0.129; N20.647; O2 0.007*

**Table 4 – Guaranteed volumes of water, TEG and gas (Working Points – according to Table 1)**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **New situation** | | **Water volume** | **Flow** | | | | **TEG flow** |
| point | input pressure | rel. humidity | 1 line | total 2 lines | 1 line | 1 line | 1 line | 1 line |
| rich | rich | rich | lean |  |
| No.. | MPag | % | kg/h | mio m3/day | m3/h | kg/h | kg/h | kg/h |
| 1 | 3,3 | 70 |  | 10 |  |  |  |  |
| 2 | 3,1 | 80 |  | 9,2 |  |  |  |  |
| 3 | 2,8 | 90 |  | 8,8 |  |  |  |  |
| 4 | 2,1 | 100 |  | 7,6 |  |  |  |  |
| 5 | 1,4 | 100 |  | 6,2 |  |  |  |  |
| 6 | 1,1 | 100 |  | 4,2 |  |  |  |  |
| 7 | 1 | 100 |  | 3 |  |  |  |  |

**Table 5 – Guaranteed volumes of gas consumption (Working Points – according to Table 1)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Energy to the combustion chamber (1 line)** | | | | | |
| natural gas flow for burner | natural gas flow for burner | | natural gas flow for burner | | calorific value |
| exhaust vapour (*t*ref = 15 °C, *P*ref = 101325 Pa) |
| No. | kg/h | m3/h | kg/h | m3/h | MJ/m3 |
| 1 |  |  |  |  |  |
| 2 |  |  |  |  |  |
| 3 |  |  |  |  |  |
| 4 |  |  |  |  |  |
| 5 |  |  |  |  |  |
| 6 |  |  |  |  |  |
| 7 |  |  |  |  |  |

*Note: 1) consumption in relation to reference pressure 101325 Pa, reference temperature 15 °Ca and gas composition (mol. %): Methane 97.010;*

*Ethane 1.718; Propane 0.340; iso-Butane 0.052; n-Butane 0.066; iso-Pentane 0.008; n-Pentane 0.010; C6+ 0.014; CO2 0.129; N2 0.647; O2 0.007.*

The values from Tables 2, 3, 4 and 5 will be confirmed during guarantee testing of the devices

after their installing commissioning

1. REGULATIONS AND STANDARDS FOR making the apparatus and piping

Pressure vessels the columns and coolers (due to stricter national regulations) must be designed,

constructed and manufactured under the following standards:

1. CSN EN764-2 Pressure equipment - Part 2: Quantities, symbols and units
2. CSN EN764-3 Pressure equipment - Part 3: Definition of parties involved
3. CSN EN764-7 Pressure equipment - Part 7: Safety systems for unfired pressure equipment
4. CSN EN764-5 Pressure equipment - Part 5: Documents for material inspection and compliance with the material specification
5. CSN EN764-4 Pressure equipment - Part 4: Preparation of technical delivery conditions for metallic materials
6. CSN EN764-1 Pressure equipment - Part 1: Pressure, temperature, volume, nominal size
7. CSN EN13445-5 unfired pressure vessels - Inspection and testing
8. CSN 690010-4.1 Stable pressure vessels. Technical rules. Calculation of strength. Introductory part.
9. CSN 690010-4.5 Stable pressure vessels. Technical rules. Calculation of strength. Cylindrical portions of containers.
10. CSN 690010-4.7 Stable pressure vessels. Technical rules. Calculation of strength. Rounded bottoms of containers.
11. CSN 690010-9.1 Stable pressure vessels. Technical rules. Conservation and coatings. Basic Provisions.
12. CSN 690010-6.1 Stable pressure vessels. Technical rules. Production. Part 6.1: Basic requirements for production.
13. CSN 690010-6.3 Stable pressure vessels. Technical rules. Production. Part 6.3: Coefficient of weld joint values.
14. CSN 690010-7.1 Stable pressure vessels. Technical rules. Testing and documentation. Part 7.1: Building and first pressure test.
15. CSN 690010-7.2 Stable pressure vessels. Technical rules. Testing. Part 7.2: Passport.
16. Regulation of the Government 219/2016 Coll.
17. CMO Decree no. 392/2003 Coll.
18. Certification according to PED 2014/68/EU complemented by CSN 69 0010-7.2
19. TPG 201 01 Gas equipment for underground gas storage facilities.

For the future operation of the pressure vessels, i.e. if the columns and coolers, additional requirements of technical standards CSN 69 0012, Stable pressure vessels, must be complied with; operational requirements and any other related regulations.

Platforms and ladders CSN ENISO14 122.

* 1. Piping

Must be constructed according to:

PED 2014/68 / EUA Decree no. 219 / 2016 Coll.

CSN EN1594 Gas supply systems - Pipelines for maximum operating pressure over 16 bar - Functional requirements.

TPG 201 01 Gas equipment for underground gas storage facilities.

All the pressure and safety equipment, if within the scope of the supply (i.e. in particular the closing/exhaust valves, relief valves, etc.) must meet PED 2014/68/EU, or NV 219 / 2016 Coll.   
Note to Chapters C.1 and C.2: the above provisions shall be applied as amended.

1. Coating system and colour scheme

The coating system will be similar to the existing system, i.e. high solid coating based on epoxy or polyurethane will be applied in three layers on the blasted surface of the pipes and equipment (grade Sa 2.5 according to ISO 8501-1), free of dust and grease, in thickness according to the manufacturer of the paints, while the minimum life expectancy of the paint is 15 years. The paint must be designed for corrosive environments - category 4 according to ISO 12944-2.

The guaranteed lifetime is 8 years.

For inspection reasons, it is suitable to use a different colour for the intermediate layer.

The colour of the outer coating will be RAL 9006 for gas pipes with yellow stripes according to TPG 201 01.

TEG piping will be brown according TPG 201 01.

The list of pipe coatings must comply with 0755\_PS\_0161\_204\_0\_Coatig system.xls (Annex no.33)

1. Thermal Insulations

The parts of the packaged TEG regeneration unit will be insulated according to the design laid down in the PCA by the winner of the tender for the installation and commissioning of drying technologies at Štramberk UGS. Within the scope of the supply, the columns and coolers must be fitted with bases for installing insulation, wiring and assembly of lightning protection - see Annex No. 7.

The piping insulations must comply with 0755\_PS\_0161\_280\_0\_Soupis izolací.xls (Annex no.34)

1. Quality Certificate Requirements

Pressure vessels, which are subject to this Technical Specifications (i.e. within the scope of the supply which is tendered), must be designed, manufactured, tested by the manufacturer, equipped with technical documentation and delivered in accordance with the requirements of PED 2014/68 / EU, or of NV 219 / 2016 Coll. Technical (accompanying) documents for each pressure vessel shall be in accordance with the requirements of CSN 690010-7.2 and PED 2014/68/EU, or NV 219/2016 Coll.

The quality of the work performed will be monitored and controlled in the course of work. This will include namely the compliance with the technological processes for welding, painting, etc. proposed by the supplier and agreed by the client.

The quality of welding works will be confirmed by a 100% visual and non-destructive inspection of all welds (RT-I) and subsequent compression strength and tightness test according to EN13 445-5.

The design of the pressure vessels must allow performing periodic internal audits in accordance with CSN 690012 and in accordance with Decree no. 392 / 2003 Coll. and it must allow for the safe conduct of the initial inspection with water pressure test and periodic revisions with water pressure test in accordance with the requirements of CSN 690012 and in accordance with the requirements of Reg. 392/2003 Coll.

The construction and first pressure test shall be conducted in accordance with CSN 690010-7.1. These tests are carried out in accordance with CSN 690010-7.1 by the manufacturer of the pressure vessels.

All the work during installing the piping must be performed in accordance with CSN EN1594 and TPG G 201 01. Only water pressure test is permitted. It is forbidden to perform a pressure test with a gaseous medium.

All technological procedures during installation must be approved by the client.

The quality of the paints will be checked visually and by measuring the thickness of coatings and by tear-off tests of each coat of paint.

It is also necessary to ensure the cleanness of the internal surfaces of the apparatuses, and after the assembly works, all the inner spaces of the apparatuses must be flushed and dried.

**All the conducted inspections will be recorded by means of a report and an initial inspection will be conducted before letting gas into the device.**

1. Annexes
2. Mechanical designs and technological diagrams Gas Drying, drawing no. 0755-CF-0131-101/0, Intecha, 01/2017.
3. Mechanical designs and technological diagrams TEG Regeneration 1, drawing no. 0755-CF-0132-102/0, Intecha, 01/2017.
4. Mechanical designs and technological diagrams TEG Regeneration 2, drawing no.. 0755-CF-0132-103/0, Intecha, 01/2017.
5. Technological diagram Drying, Working Point 1, drawing no. 0755-CB-0000-101/0, Intecha, 01/2017.
6. Technological diagram Drying, Working Point 5, drawing no. 0755-CB-0000-102/0, Intecha, 01/2017.
7. Technological diagram Drying, Working Point 7, drawing no. 0755-CB-0000-103/0, Intecha, 01/2017.
8. Packaged TEG regeneration unit PA01A/B, Doc.No.: 0755-CT-0132-PA01, Intecha 9.01.2017.
9. Mechanical design – Regeneration – ground plan and “Q“, “R“ views, Doc.No. 0755-CD-0132-101/0, Intecha 01/2017.
10. Mechanical design – Regeneration – ISO view, Doc.No. 0755-CD-0132-102/0, Intecha 01/2017.
11. External influences determination, Report no. AE 075500/0130/R0 on external influences determination according to CSN 33 2000-5-51 ed.3, Intecha, 01/2017.
12. Dangerous zones identification, Drawing no.0755-CZ-0130-101, Intecha, 01/2017.
13. Fire protection solution, Intecha, 12/2016.
14. Piping layout – Regeneration – ISO view, Doc.no. 0755-PD-0161-204\_0, Intecha 01/2017.
15. 0755\_PS\_0161\_240\_0\_List of manual valves.xls.0
16. 0755\_PS\_0161\_241\_0\_Specification of shut-off valves.xls.
17. 0755\_PS\_0161\_242\_0\_ List of new remote valves.xls.
18. 0755\_PS\_0161\_243\_0\_List of safety valves.xls.
19. 0755\_PS\_0161\_210\_0\_List of piping and euipment.xls.
20. 0755\_PC\_0161\_202\_0\_Scope of weld testing.xls.
21. 0755\_PS\_0132\_091\_0\_List of profiles.xls.
22. 0755\_PS\_0161\_201\_0\_List of branches.xls.
23. List of circuits is provided in the file: 0755\_ME\_0171\_201\_0.xls.
24. Function logic and block diagrams must be according to: 0755\_MH\_0171\_101\_04\_0.pdf.
25. Function logic and block diagrams 0755\_MH\_0171\_101\_05\_0.pdf.
26. Function logic and block diagrams 0755\_MH\_0171\_101\_06\_0.pdf.
27. Function logic and block diagrams 0755\_MH\_0171\_101\_07\_0.pdf.
28. List of cables is provided in file: 0755\_MK\_0171\_101\_201.pdf.
29. Mounting sketch of on/off valve with blocking valve is provided in file: C010CZ.pdf.
30. Mounting sketch of control valve with E/P positioning is included in file: C001CZ.pdf.
31. Mounting sketch of on/off valve is included in file: C012CZ.pdf.
32. Mounting sketch of local pressure measurement is included in file: P126CZ.pdf.
33. Mounting sketch of local temperature measurement is included in file: T009CZ.pdf.
34. 0755\_PS\_0161\_204\_0\_Coating system.xls

0755\_PS\_0161\_280\_0\_List of isolations.xls.