

Proposal

Biogas plant using maize silage
Project electrical output: 6.9 MW
Installed CHP capacity: 7.2 MW



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OVERVIEW

Zorg Biogas proposes a plant processing 324 tonnes of maize silage per day. Three high-load digesters operate as parallel process lines, each receiving 108 tonnes per day through its own solid feeder and screw conveyors. Controlled feeding, vertical mixing and temperature regulation support stable biological conversion.

The feedstock calculation gives approximately 74,080 m³ of biogas per day at 52% methane. Four containerised CHP units - three rated at 2,000 kW and one at 1,200 kW - provide a total installed electrical capacity of 7,200 kW. The project electrical output remains 6,900 kW, governed by the available biogas. Recovered heat is available for site use and the plant heating circuits.

Iron hydroxide is dosed together with the silage at 240 kg per feeder per day. Each digester receives 2.4 litres of microelements per day. Gas storage, cooling, compression and activated carbon filtration prepare the biogas for the engines. The specified H₂S concentration is 80 ppm upstream of the carbon filters and 0 ppm at their outlet.

Digestate is mechanically separated into solid and liquid fractions. The liquid fraction, containing 1.5% dry matter, passes to the filtrate tank for recirculation and onward management. The solid fraction is collected for storage and agricultural use in accordance with the site's nutrient management plan.

The supply includes process engineering, equipment, automation, construction supervision, commissioning and operator training. Central controls provide operating measurements, alarms and local or remote access. The four-unit CHP arrangement allows output to be distributed between engines and provides flexibility for maintenance and operation.

Raw material potential

Substrate	Quantity (tonnes/day)	Quantity (tonnes/year)	DM content: (%)	ODM content (%)	DM quantity (tonnes/ day)	ODM quantity (tonnes / day)	Biogas yield (m ³ / tonneODM)	Biogas (m ³ /day)	Methane content (%)	Biogas (m ³ /year)
Maize silage	324	118 260	36	94.8	116.6	110.6	670	74 080	52	27 040 295

Biogas plant technical performances

Characteristics	Values	Figures
Number of digesters	units	3
Digester		
a) volume:		
Work	m ³	3 433
Overall	m ³	3 776
b) Organic load	kgODM/ m ³	10,76
c) Hydraulic retention time (gross)	days	35
d) Overall dimensions of the digester (diameter / height)	m	27,0/6,6
e) Temperature	°C	+48
Gasholder		
a) Volume	m ³	800
b) Number of gasholders	units	1
c) Dimensions of the gasholder (diameter / height)	m	12,6/9,7



WORKING PRINCIPLE

Biogas plant working principle

The technology is based on the biochemical conversion of organic materials from high molecular weight compounds to low molecular weight compounds. The first stage of this process is hydrolysis. Hydrolysis produces organic acids and alcohols.

Organic compounds + $H_2O \rightarrow C_5H_7NO_2 + HCO_3$.

Further conversion of obtained dissolved compounds like organic acids and alcohols ($C_5H_7NO_2, HCO_3$) into gases - CH_4, CO_2 . $C_5H_7NO_2 + HCO_3 + H_2O \rightarrow CH_4 + CO_2 + NH_4$.

Biological process of consecutive (phasic) conversion of organic compounds take place in anaerobic environment i.e. in oxygen-free tank (biological reactor). At the first stage of fermentation, substrate hydrolysis take place under acidogenic bacteria influence. At the second stage, elementary organic compounds come through hydrolysis oxidation by means of hetero-acidogenic bacteria with production of acetate, carbon diox-

ide, and free hydrogen. The other part of the organic compound including acetate forms C_1 compounds (elementary organic acids). Produced substances are the feedstock for methanogenic bacteria of the third type. This stage flows in two processes of A and B type the character which depends on caused by different bacteria type. These two types of bacteria convert the compound obtained during the first and second stages into methane CH_4 , water H_2O and carbon dioxide CO_2 . Methanogenic bacteria are more sensitive to the living environment compared to acidogenic bacteria. They require a complete anaerobic environment and a longer reproduction period. The speed and scale of anaerobic fermentation depends on bacteria metabolic activity. That is why the biogas plant chemical process includes hydrolysis stage, oxidation, and methanization stage. For that kind of substrate, these processes take place in the same reactor

Technological process of biogas production

Maize silage is delivered to three solid feeders and metered into the digesters by screw conveyors throughout the day. Each line receives 108 tonnes of silage per day. Iron hydroxide is added through each feeder at 240 kg/day; total dosing is 720 kg/day.

Each digester receives 2.4 litres of microelements per day, giving 7.2 litres/day for the plant. Controlled air addition is 100 litres/minute per digester.

The digesters operate at +48°C. Vertical agitators mix the substrate periodically, while temperature regulation maintains the process conditions. The design digestion period is approximately 35 days.

Digestate is pumped to the separator platform. The solid fraction is collected for storage, and the liquid fraction is directed to the filtrate tank for recirculation or transfer to storage. The specified dry matter content of the filtrate is 1.5%.

Biogas is collected in the external gasholder, which buffers production and consumption. Pressure relief equipment protects the gas system against excessive and insufficient pressure.

The specified H₂S concentration is 80 ppm after the digesters, in the gasholder and throughout cooling and compression. The compressor delivers gas at 200 mbar to the activated carbon filters. The filter pressure drop is 5 mbar, leaving 195 mbar downstream; the specified outlet H₂S concentration is 0 ppm.

Cleaned biogas supplies four CHP units: three rated at 2,000 kW and one at 1,200 kW. The units generate electricity and recoverable heat. Total installed electrical capacity is 7,200 kW; the process energy balance remains based on the available biogas.

The automation system monitors process measurements and equipment status, displays alarms and allows the operator to select automatic or manual control locally or remotely.

MAIN EQUIPMENT





Solid feeder

Solid feeder machines have been proven in various situations. Solid feeder has the solid design, which guarantees a maximum functionality and less maintenance, combined to a low energy consumption. Because of the vertically oriented walls, there is no change for the material to get stuck or build bridges. The conveyor chains and the milling-unit allow continuous dosing by various types of materials. Furthermore, the material is loosened by this dosing process. The user is able to control the material flow up to 20m³/h or more, regarding to the own consumption of electrical power by the machine. In addition, the corrosion protection, wear resistance and high quality allow customers to use our product for a long period of time.

Specifications

Length:	13,8 m
Width:	2,5 m
Height	3,6 m
Volume:	50 m ³
Quantity:	3 pcs.



Digesters

Digester is a tank of cylindrical form (for better mixing during the fermentation). It is built of cast-in-situ reinforced concrete based on sulphate-resistant cement with thickness of walls and bottom - 0,25m. In the center of the digester there is a column with chapter. Overlap of digester is reinforce concrete plate. On the tank's wall and in the bottom there is to be installed pipelines for heating, intended for assurance and maintenance of the optimal fermentation process temperature at thermophilic conditions. For heat conservation and reduction of heat energy con-

sumption, the digester walls, overlap and bottom are insulated outside with 100 mm slabs of extruded polystyrene foam. Over the heater, the substructure walls and bottom are insulated with roll damp proofing. Superstructure and substructure heat insulation is protected by shaped sheet from the outside mechanical damages and rodents. The digester bottom has a slope 1%.

Specifications

Height:	6,6 m
Diameter:	27,0 m
Overall volume:	3776 m ³
Quantity:	3 pcs



Window with spotlight

Inspection windows are designed for visual control of processes inside the fermenter and post-digester. Spotlights were made in explosion-proof with automatic disconnec-

tion. Inspection windows are equipped with a cleaning washing system.

Specifications

Inspection windows Ø300
Spotlight VISULUX UL50 -G -H
230V, 50W, IP65



Digester vertical mixer

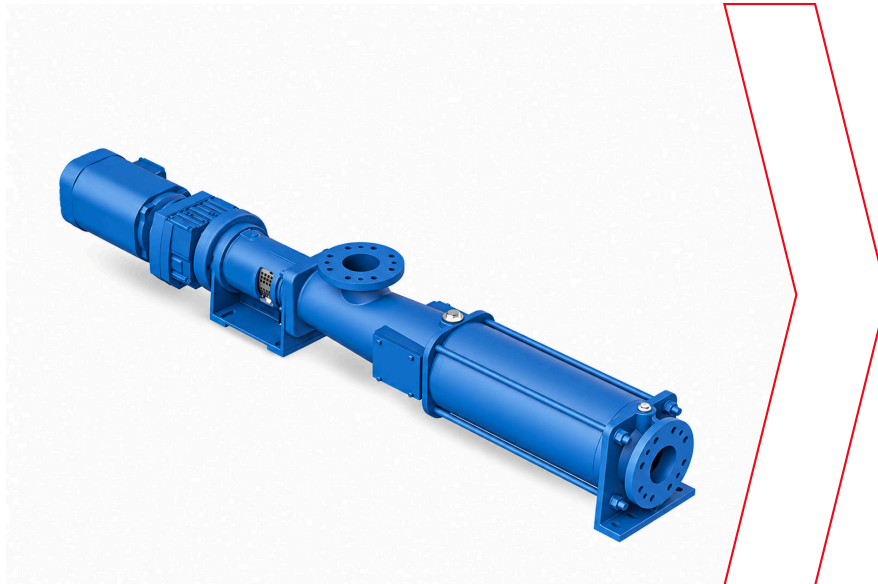
Mixers are designed and engineered to guarantee high energy efficiency. We use gear units and motors from respected European manufacturers.

This guarantees the long life of our mixers. All motors and gear units are available with ATEX certifications.

Agitators are designed for mixing substrates with a high solids content of 13-18%. The blades of the mixers are set at an optimum angle, and the external motor of the mixer is mounted on a special support.

Specifications

Nominal power	N=15 kW
Quantity per digester:	6 pcs
Quantity total:	18 pcs



Pump equipment

Pumps are used to transport substrate to the equipment and facilities in the biogas plant and away. Kinematic viscosity is a real physical factor that influences pump curves, and thus the choice of pump. Viscosity is essentially resistance to flow and this has implications for pumps. Fluid viscosity or thickness will affect how it will behave in a pump. Screw pumps are used for pumping flowable thin sludge, - excess sludge and mechanically thickened sludge and conveying the substrates with their mostly high dry substance contents (DS) containing up to 10% dry matter. Optimum pumping results are guaranteed by the flow-optimized suction housing and a constant joint diameter which prevents the plaiting of long fibers.

Specifications

Substrate feed pump

Flow rate:	30 m ³ /hour
Engine power:	11 kW
Pressure:	4 bar
Quantity:	1 pcs

Substrate pump to separator

Flow rate:	30 m ³ /hour
Engine power:	11 kW
Pressure:	4 bar
Quantity:	3 pcs

Filtrate pump

Flow rate:	30 m ³ /hour
Engine power:	11 kW
Pressure:	4 bar
Quantity:	1 pcs



Separator

Separator separates water from solids. It operates continuously and automatically according to the press screw separator principle and separates thin and viscous compounds. Solid matter / liquid compound is pumped from the inlet chamber by the press screw into the horizontal screen. Some of the water flows due to the force of gravity through the screen. Press screw conveys the rest of the water with solid particles (also smallest particles) into the press zone in the last section of the screen. Here a permanent regenerative, compact solid matter is generated and is then pressed out through the outlet of the machine, which can be easily filled into containers. Separated fluid flows through outlet underneath the machine. On the grounds of narrow tolerance the inside of the screen is permanently kept clean.

Specifications

Engine power	5,5 kW
Flow rate	up to 30 m ³ / h
Quantity	3 pcs
Equipment	
Frame	
Screw	
Sieve for the filtration	
Counterweights	
The design of the protective room	



Submersible mixer

The submersible motor agitator serves for mixing renewable raw materials (RRM), liquid substrate as manure, poultry dung and similar substrates. The electro-motor driven submersible agitator is designed for submersion operations in potentially explosive environments of Ex zone 2 and complies with Directive 94/9 EC. The submersible agitator can be attached to most sliding masts by means of the motor support. A mounting option for a hauling cable is provided on the motor support for height adjustment purposes.

Due to the 4-roller guidance of the motor support, the agitator can be lifted and lowered without friction and the square mast, even if the pull of the hauling cable is slightly angular. The motor support is designed for a 100 x 100 mm square sliding mast as standard, but can also be used for an 80 x 80 mm sliding mast by changing the

rollers. The strain relief of the connecting cable can be positioned in the extension of the motor or towards the top on the motor support, depending on the requirements. This enables universal utilization with the most various installation kits.

The geared motor is made of spheroidal graphite iron (GGG40) and painted, the propeller is galvanized and the motor support is made of stainless steel. The submersible motor agitator is designed as a water pressure-tight monoblock unit for driving the three-vane propeller. The submersible agitator is of modular design, submersible electro-motor with flange-mounted planetary gear and bearing flange for holding the propeller. The conical shaft in the bearing flange is mounted in the oil bath by two angular roller bearings and sealed off from the agitating substrate with a mechanical seal.

Specifications

Filtrate tank

Nominal power

Quantity:

N= 3,0 kW

1 pcs

Height:

adapted to the height of digester

Material: stainless steel 8 mm



Gasholder

The gasholder provides for biogas storage and for equalizing pressure and biogas composition. The gasholder system has a two-layer construction. The external material consists of a weather-proof film of PVC-coated polyester fabrics with UV protection. Both sides are finished with an external N/5cm, internal membrane PELD (gasholder) membrane.

The gasholder has a methane permeation maximum of $260 \text{ cm}^3/\text{m}^2 \cdot 1 \text{ bar}$ biogas resistance. The gasholder film temperature range allows operation from -30°C to $+60^\circ\text{C}$.

The internal film is stretched under normal biogas pressure. Air is blown into the space between the external and internal membranes to pressurize the internal membrane and form the shape of the external membrane.

The biogas pressure in the gasholder is 2-5 mbar. The membranes are designed and cut out on NC machines. Welding is executed by high frequency currents. These steps yield substantial improvements for quality and service life compared to hand-made membranes welded by standard welding equipment.

To prevent damage to the gasholder as a result of overpressure conditions, a safety valve is installed. To survey the internal membrane, an inspection window is installed on the external membrane.

Specifications

Height :	9,7 m
Diameter :	12,6 m
The total volume :	800 m ³
Quantity:	1 pcs



Biogas dryer and cooling

Biogas dryer and cooling are provided with special equipment as GAS COOLER and AIR-COOLED LIQUID CHILLER. Biogas plants thanks to an extensive range of dedicated Biogas solutions, low pressure heat exchangers, a comprehensive range of water chillers and RWD Dry Coolers. Designed as one-way shell-and-tube heat exchanger. Process gas inside of the tubes; cooling water in the shell. All parts in contact with the process gas made of stainless steel 316Ti or 316L; heat exchanger shell made of stainless steel/ Designed with gas outlet chamber outlet connection radial; inspection opening axial Official acceptance according to PED 2014/68/EU in accordance with ADMerkblätter and factory pressure test.

Specifications

Gas volume flow	1600 m ³ / h
Gas inlet temperature	+48 C
Gas outlet temperature	+10 C
Engine power	75 kW
Quantity	2 pcs



Biogas compressor

Biogas blower is a device used to move gas and increase pressure thanks to a rotating impeller within a toroidal channel, so there is a progressive increase of energy. Blower is used to transporting biogas from gasholder storage to consumer.

Specifications

Flow rate	3100 m ³ /h
Pressure	200 mbar
Engine	36,0 kW
Quantity	1 pcs



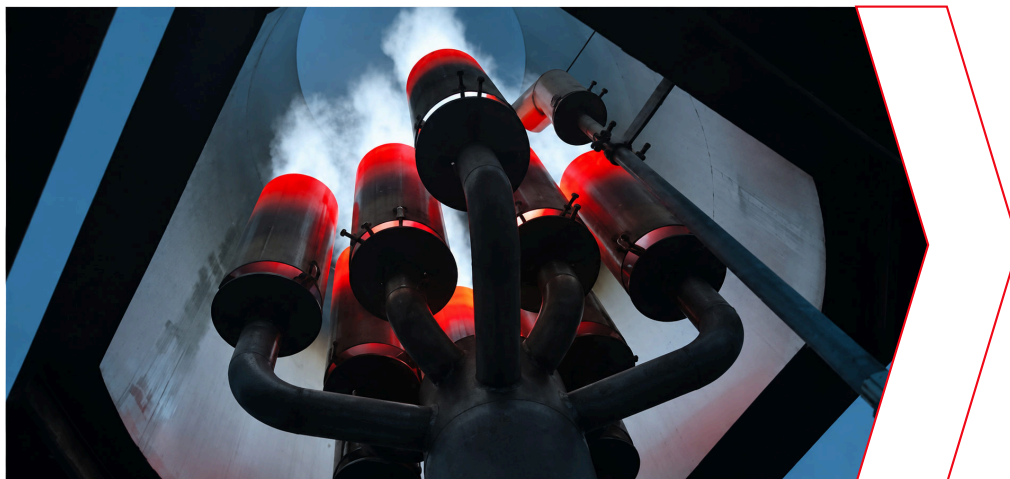
Activated Carbon Filter

Activated carbon provides final gas polishing before the CHP units. The filter media adsorb residual hydrogen sulphide after upstream treatment in the digesters, gas cooling and compression.

The specified H₂S concentration is 80 ppm at the inlet and 0 ppm at the outlet. A 5 mbar pressure drop reduces the gas pressure from 200 to 195 mbar. Gas analysis is used to monitor performance and determine carbon replacement.

Specifications

Activated carbon charge	3,000 kg
Carbon filter vessels	3 units
H ₂ S inlet / outlet	80 / 0 ppm
Pressure drop	5 mbar



Flare

The flare is designed for the temporary or periodical complete combustion of the biogas produced by biogas plants without the possibility of its use as an energy source. The burn system consists of a burner and additional equipment. The burner is designed on the principle of injection and consists of a combustion nozzle with an injector with an air supply control system, flame protection tube, fitting and burner control system. The biogas combustion system is made of stainless steel.

The supporting structure holds the burner and vertically mounted socket. The burn control system is installed in a case, which is mounted on the supporting structure of the combustion system and contains all the elements for monitoring and controlling ignition and flame.

Specifications

Flow rate

31 00 m³/h

Quantity:

1 pcs



Containerised cogeneration units

The CHP package converts conditioned biogas into electricity and recoverable heat. Each container houses the gas engine, generator, controls, ventilation and cooling equipment. Heat recovery connects the engine circuits to the site heating system.

Automatic controls monitor engine operation, electrical protection and alarms, with communication to the plant control system. Four units allow production to be distributed between engines and support flexible maintenance scheduling.

Specifications

CHP units - group 1	3 x 2,000 kW
CHP units - group 2	1 x 1,200 kW
Total installed electrical capacity	7,200 kW
Rated frequency	50 Hz
Rated speed	1,500 rpm
Fuel	Conditioned biogas
Total quantity	4 containerised units

CHP container and engine compartment



External view



Engine compartment and maintenance access

The enclosure provides weather protection, ventilation and access for inspection and maintenance. The engine and generator are mounted on a common base, with service connections arranged inside the container.

The control panel displays operating measurements and alarms and manages protective functions. Photographs show typical container execution for the CHP package.



Gas analyzer (CH₄, CO₂, H₂S, O₂) (GA-01)

Gas analyzer - a measuring device to determine the qualitative and quantitative composition of the gas mixture. In a biogas plant's installed absorption gas analyzers, biogas mixture components are absorbed sequentially with various reagents. Automatic gas analyzers continuously measure any physical or physicochemical characteristics of the gas mixture or its individual components. Operation is based on physical methods of analysis, including auxiliary chemical reactions.

Specifications

Set includes

- Device for wall mounting
- LCD display menu
- Flow meter / control valve
- Sensors

Defined gases methane % (CH₄), carbon dioxide % (CO₂), hydrogen sulfide ppm (H₂S)



Heating system

Heating equipment is using for biogas plant heating and for sustaining constant temperature in the fermenter. Heating equipment includes circulation pumps, heat exchanger, heating manifold and pipes. The heat from the boiler is transferred to the biogas plant by using heat exchanger, and then is pumped through of biogas plant by circulation pumps. A heat carrier prepares water with an additive of ethylene glycol. Inlet temperature in the fermenter is 60C, the outlet is 40C.

Specifications

Circulation pump for supplying network water and electric boiler

Flow 7,8m³/h, ,
Pressure 6 m
Electric power 0,37 kW;

Circulation pump of heat carrier

Flow rate 0,4 m³ / h;
Pressure 0,3m
Electric power 0,04 kW;

Circulation pump for supplying heat carrier to CHP

Flow 31 m³ / h;
Pressure 8 m ,
Electric power 1,5 kW;

The pumping station feeding propylene glycol

Flow 1,0 m³/h;
Pressure 4 bar,

Circulation pump for mains supply to the digester

Flow 11 m³ / h;
Pressure 10m
Electric power 0,75 kW;

Diaphragm expansion tank with volume V = 500L

Propylene glycol storage tank with volume V = 300L with overflow line and float shut-off valve

Electric hot water boiler with temperature limiter and safety valve

Electric hot water boiler with temperature limiter and safety valve



Dry cooler (digester cooling)

The device is designed to cool the reactor. When using highly loaded technology, there is a chance of uncontrolled self-heating.

The cooler is connected to the heating pipes, and when active, the same lines are used.

Specifications

Power	100 kW
Engine power	4,0 kW
Quantity:	3 pcs

Water supplying and sewerage system

Water supplying system provides biogas plant feed water, water for network circuits, the domestic water and fire safety systems. As used centrifugal single stage pumps as main pumping elements. These pumps are designed for pumping waste water, household / domestic water and sewage. Pressure Boosting Systems are designed for pure water pressure boosting in industrial plants. The booster comprises 2 to 3 (connected in parallel pumps) installed on a common base frame, and provided with all the necessary fittings.

Specifications

Water supply pump station (drinking water)

Pressure 28 m

Flow 9 m³ / h

Engine 0,75 kW

Water fire extinguishing pump station

Pressure 28 m

Flow 51 m³ / h

Engine 7.5 kW

Drain pump

Pressure 5 m

Flow 4.5 m³ / h

Engine 0.37 kW

Equipment

Pump case control

Stove-base

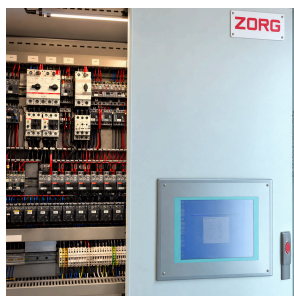
gauges

Air supply system

Air supply system ensures retention of the protective dome digester. This is achieved by installing a pneumatic lock and maintain the required pressure therein.

Specifications

Flow rate	200l/min
Max. Pressure	8Bar
Speed	2850 rev/min
Receiver capacity	9,5l



Automation and electrical equipment

Process control equipment is used for supervision and regulation operation of the plant and for the limitation of damage. In case of emergency (for example, breakdown of the electrical power supply) the biogas plant is automatically transferred to safe operating conditions by the process instrumentation. Critical electrically driven devices are supplied with emergency power. An automatic system allows the supervision of the plant in real time and to recognize and correct aberrations immediately; to run the plant at its optimum saving resources and costs; and to record for the electronic database operation parameters. The automatic system consists of a control cabinet and sensors for parameter control of technological processes and execution devices.

The control cabinet is designed based on the industrial controller Siemens CPU315-DP2, using periphery distributing system Simatic ET200S, and operator panel OP277 Touch with touch-sensitive controls. Communications is executed by PROFIBUS and MPI with physical interface RS-485. The control program is designed based on the Simatic Step7. The control cabinet is a modular design. The upper part has a power box with central and front-end processor. The periphery distributing system, Simatic ET200S, is installed with input - output units. The lower part with interface relay and clips is installed for connecting execution devices. The entire plant is controlled by a single operator.

Specifications

Incoming control case with automatic set ASE-1, 2, 3

Base Siemens CPU315-DP2 controller

Peripherals Simatic ET200S

Control panel OP277 touchscreen

Communication PROFIBUS and MPI

Interface RS-485

Control system Simatic Step7



Sensors

Sensors are used to measure physical quantities (temperature, pressure, level of moisture) data collection.
installation kits

Specifications

Conductometric sensor
Pressure Sensor / level
Ultrasonic sensor
Gas Pressure Sensor
Temperature converters with protective sleeves
The moisture sensor and the gas temperature

SPECIFICATION LIST



Nº	Equipment	Characteristic	Q-ty
2	Loader	N=50 m3	3
2.1	Container bunker		3
2.2	Feeding screws	set.	3
3	Vertical mixer (digester)	N=15,0 kW	18
3.1	Airtight motor gearbox		18
3.2	Hydraulic screw (wear-resistant steel)		18
3.3	Mixer control mechanism (high-quality structural galvanized steel)		18
3.4	Electric motor mount (high-quality structural galvanized steel)		18
3.5	Set of fasteners (coating - hot dip galvanized)		18
4	Safety valve of digester		3
5	Window with a searchlight, complete, disassembled	set	3
5.1	Inspection window RD300 (mounts and sealant included)	Ø300	6
5.2	Spotlight (mount system bundled) VISULUX UL50 -G -H	230V, 50W, IP65	6
6	Substrate pump to Separator with Frequency converters	30m3/hour N=11 kW	3
7	Separator	N=5,5 kW, Q=30 m³/h	3
7.1	Body		3
7.2	Substrate Supply Pipe 4 ''		3
7.3	Engine - Gearbox	N=5,5 kW	3
7.4	Frame		3
7.5	Screw		3
7.6	Sieve for filtration		3

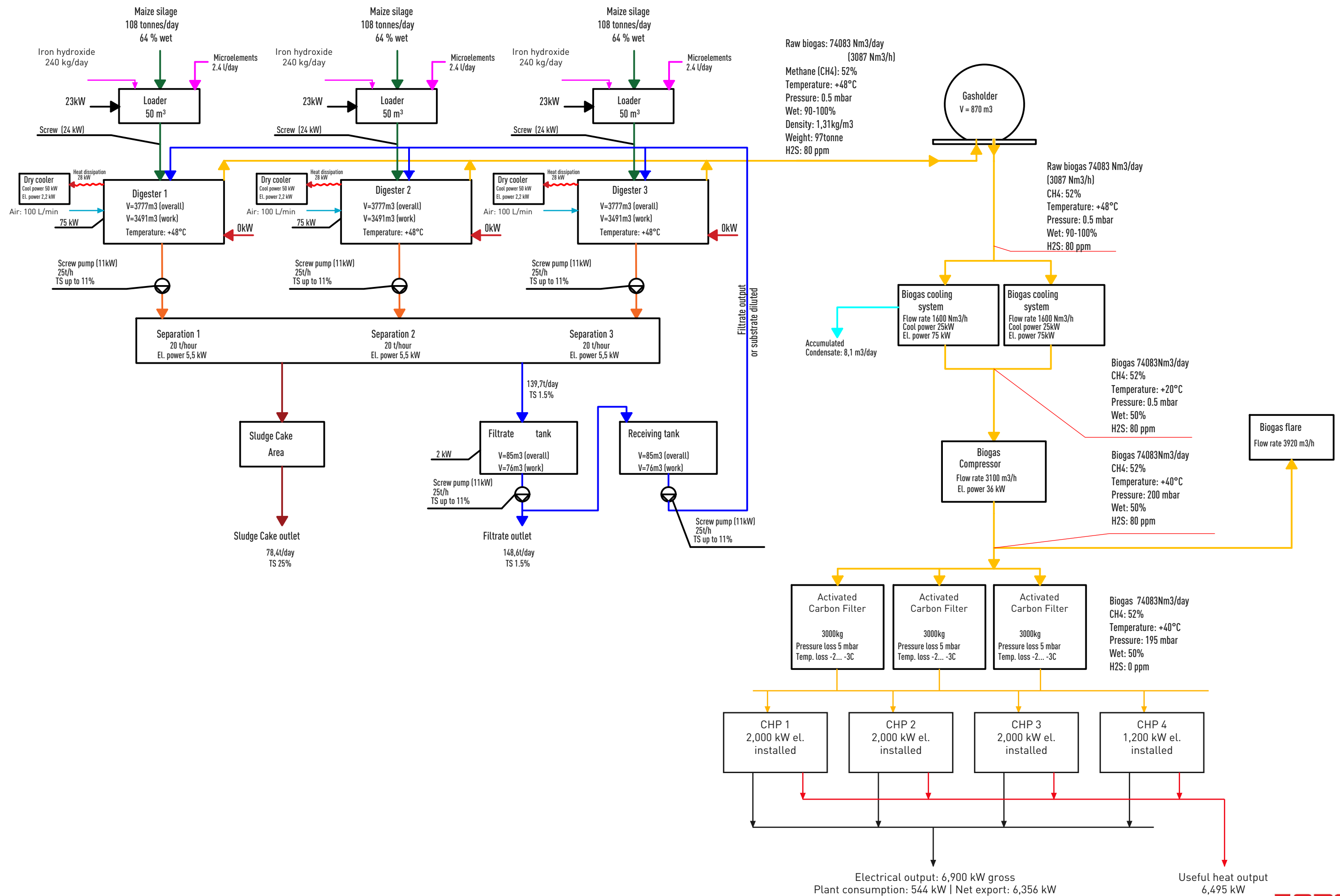
Nº	Equipment	Characteristic	Q-ty
8	Submersible mixer (Receiving tank)	N=3.0 kW	1
8.1	Airtight motor gearbox		1
8.2	Hydraulic screw (wear-resistant steel)		1
8.3	Mixer control mechanism (high-quality structural galvanized steel)		1
8.4	Electric motor mount (high-quality structural galvanized steel)		1
8.5	Set of fasteners (coating - hot dip galvanized)		1
9	Filtrate pump	30 m3/hour N=11 kW	1
10	PVC external gas holder, complete, disassembled	V=800m³	1
10.1	Weather protection film	Ø12,6m	1
10.2	Gasholder film PEELD methane permeation max.260 cm3/m2*d*1 bar, 650 N/5cm biogas resistant		1
10.3	Air blower	16A, 0,5kW	1
10.4	Excess and minimum pressure valve		1
10.5	Dome level sensor		1
10.6	Mounting system		1
10.7	Accessories		1
11	Biogas cooling system	1600 m3/hour N=75,0 kW	2
12	Biogas compressor	Q=3100 m³/h H=200 mbar N=36,0 kW	2
13	Activated Carbon Filter	3 000 kg	3
13.1	Numbers of charcoal columns		3
14	Electromagnetic flow meter		1
15	Gas analyzer		1

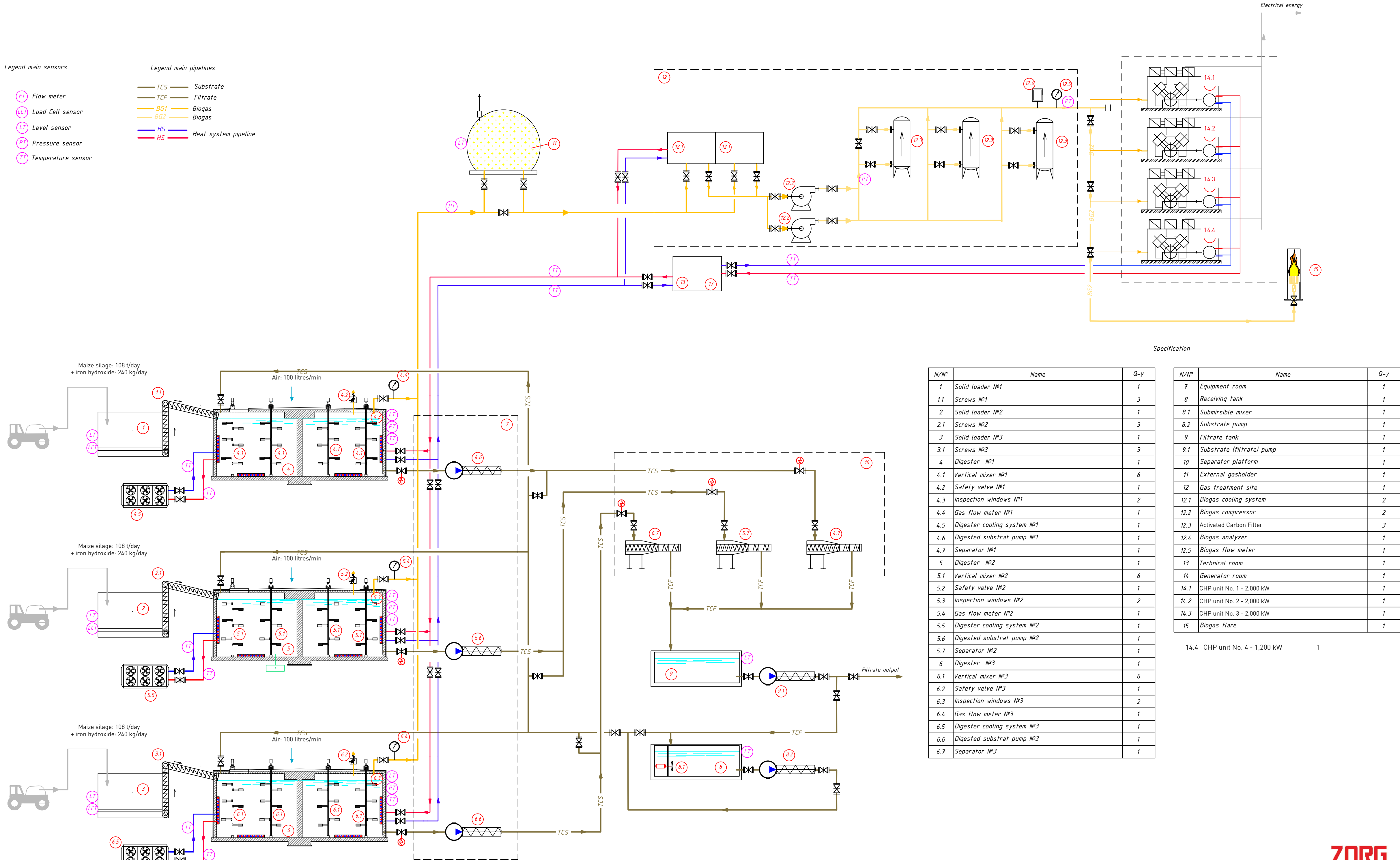
Nº	Equipment	Characteristic	Q-ty
16	Flare	3100 m3/h	1
16.1	Compressor		1
16.2	Manual locking element		1
16.3	Deflagration fuse		1
16.4	On-site control cabinet		1
16.5	Auto ignition system		1
16.6	Auto Main Gas Solenoid Valve		1
17	Containerised CHP units	3 x 2,000 kW 1 x 1,200 kW	4
18	The heat supply system	set	1
18.1	Circulation pump for supplying network water and electric boiler	G=7,8m³/h, H=6 m, Ne=0,37 kW, Dn40	1
18.2	Circulation pump of network supply water	G=0,74 m³/h, H=3m, Ne=0,04 kW, Dn15	1
18.3	Circulation pump for supplying network water to CHP	G=31 m³/h, H=8m, Ne=1,5 kW, Dn65	1
18.4	Propylene glycol feed pumping station for the heat supply system	G = 1.0 m³/h, H = 40 m, N = 0.775 kW,	1
18.5	Diaphragm expansion tank with volume V = 500L	P=10Bar, T=120°C, R1"	1
18.6	Propylene glycol storage tank with volume V = 300L with overflow line and float shut-off valve (kit)		1
18.7	Propylene glycol consumption meter for feeding the heat supply system of the biogas plant	DN15, G = 1.5 m³/h	1
18.8	Circulation pump for mains supply to the digester	G=11 m³/h, H=10m, Ne=0,75 kW, Dn50 ATEX EEx	1
20.9	Butterfly valve with el. drive	400V 3PH 50Hz	1
18.10	Three-way flanged control valve KVs6,3, Pn = 1.6MPa, DN20 with electric drive	U = 220V, N = 3.5 W, T = 150 s, 3-position	
18.11	Three-way flanged control valve KVs40, Pn = 1.6MPa, DN50 with electric drive	U = 220V, N = 3.5 W, T = 150 s, 3-position	
21	Automation with electrical equipment complete		1
21.1	Introductory switchgear VRU-1		1

Nº	Introductory switchgear VRU-2		1
21.2	Introductory switchgear VRU-3		1
21.3	Ventilation board for generator room SHVG-1		1
21.4	Ventilation board for generator room SHVG-2		1
21.5	Ventilation board for generator room SHVG-3		1
21.6	Ventilation board for generator room SHVG-3	SPA-380-08 (0-6m)	5
22	Sensors set		1
22.1	Pressure sensor (gas pressure)	0,025 bar	3
22.2	Pressure sensor (gas pressure)	0,4 bar	3
22.3	Pressure sensor (substrate level)	1 bar	3
22.4	Pressure sensor (substrate pressure)	2,5 bar	5
22.5	Pressure sensor (coolant pressure)	6 bar	12
22.6	Thermoconverter (gas)	Pt100	3
22.7	Thermoconverter (substrate in fermenters)	Pt100	6
22.8	Thermoconverter (heat carrier)	Pt100	12
22.9	Conductometric sensor		6
22.10	Conductometric sensor		1
22.11	Radar level sensor		2
22.12	Gas level sensor (gas holder)		1

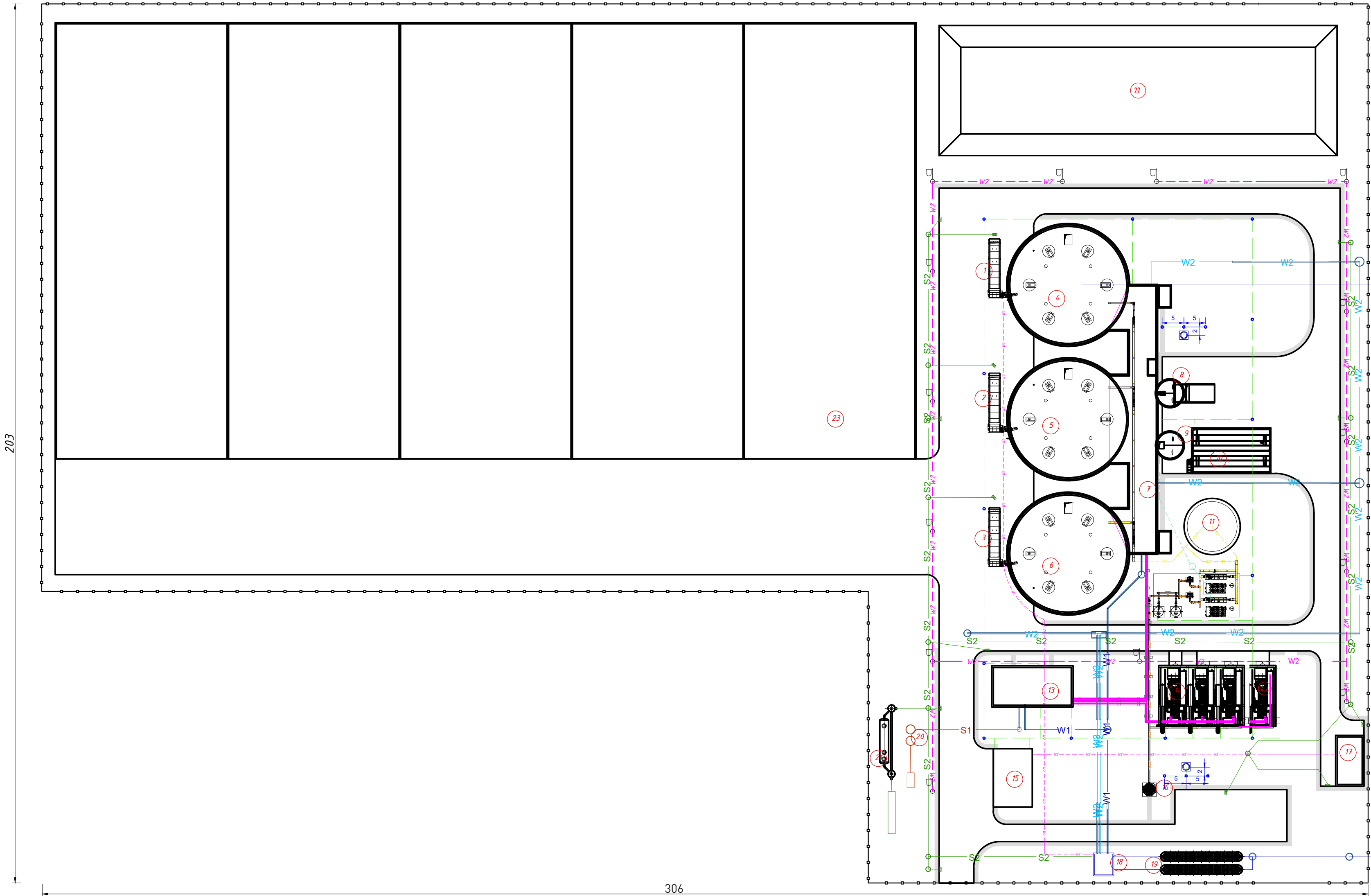
APPENDICES







Plan



Legend of buildings and structures

N/Nº	Name	Note
1	Solid loader Nº1	
2	Solid loader Nº2	
3	Solid loader Nº3	
4	Digester Nº1	
5	Digester Nº2	
6	Digester Nº3	
7	Equipment room	
8	Receiving tank	
9	Filtrate tank	
10	Separator platform	
11	External gasholder	
12	Gas treatment site	
13	Technical room	
14	CHP area: 3 x 2 MW + 1 x 1.2 MW	
15	Spare parts warehouse	
16	Biogas flare	
17	Electric control room (external design)	
18	Water supply pump station	
19	Water storage tanks	
20	Waste water treatment	
21	Rainwater treatment facilities	
22	Lagoon	
23	Silo	

Appendix 4

Biogas plant

Equipment	Unit power, kW	Quantity	Installed, kW	Hours/day	kWh/day
Solid feeders, 50 m ³	23	3	69.00	7	483.00
Screw conveyors	24	3	72.00	7	504.00
Digester vertical agitators	15	18	270.00	18	4860.00
Submersible agitator - receiving tank	2	1	2.00	12	24.00
Biogas cooling system	75	2	150.00	24	3600.00
Biogas compressor	36	1	36.00	24	864.00
Separators	7.5	3	22.50	9	202.50
Substrate feed pump	11	1	11.00	3	33.00
Substrate pumps to separators	11	3	33.00	9	297.00
Filtrate pump	11	1	11.00	3	33.00
CHP self-consumption	21	4	84.00	24	2016.00
Air compressor - gasholder lock	1.5	1	1.50	1	1.50
Air blower - double membrane	1	1	1.00	24	24.00
Digester cooling system	4	3	12.00	As required	
Circulation pumps - digester heating	0.75	3	2.25	24	54.00
Circulation pump - digester cooling	2	1	2.00	24	48.00
Circulation pump - technical building	0.37	1	0.37	As required	
Propylene glycol pump station	0.8	1	0.80	0.5	0.40
Drinking-water pump station	0.75	1	0.75	3	2.25
Drainage pump	0.37	1	0.37	0.5	0.18
Site lighting	1	1	1.00	8	8.00
Inspection-window spotlights	0.1	1	0.10	0.5	0.05
Switchboard lighting	0.1	1	0.10	0.5	0.05
Total installed power, kW					782.74
Total consumed electrical energy, kWh/day					13,055
Average consumed power, kW					544

Prices for a 6,9 MW biogas plant using maize silage or straw pellets

Pos	Name	Number of units	Unit price, EUR	Price sub-total, EUR	
1	Project documentation	1	77.400	77.400	
2	Supervision	1	40.000	40.000	
3	Startup and training	1	40.000	40.000	
4	Living and travel expenses	1	45.000	45.000	
5	Delivery of the equipment (container)	18	8.000	144.000	
6	Laboratory	1	19.600	19.600	
7	Solid feeder (dosing buffer machine)	3	101.500	304.500	
8	Screw conveyor	3	107.800	323.400	
9	Digester vertical agitator	15	38.400	576.000	
10	Frame for Digester vertical agitator pos 3	15	4.200	63.000	
11	Substrate pump	3	20.300	60.900	
12	Digested substrate pump	1	20.300	20.300	
13	Filtrate supply pump	1	20.300	20.300	
14	Substrate separation unit	3	33.600	100.800	
15	Submersible agitator for receiving tank	1	9.100	9.100	
16	Submersible agitator for filtrate tank	1	9.100	9.100	
17	Over- and under pressure safeguard	3	3.100	9.300	
18	Sight glasses/viewing windows with projector	3	5.400	16.200	
19	Water supply and canalization system	1	31.500	31.500	
20	Heat supply station	1	28.000	28.000	
21	Dry-cooler cooling system for reactors	3	18.200	54.600	
22	Automation and electric cabinet	1	360.000	360.000	
23	Motorized valves (set)	9	5.600	50.400	
24	Sensors (set)	5	25.000	125.000	
25	Gasholder	1	47.500	47.500	
26	Biogas chiller (Biogas cooling system)	2	87.500	175.000	
27	Biogas blower	2	38.500	77.000	
28	Desulphurization column with active coal	2	31.500	63.000	
29	Biogas flare	1	124.600	124.600	
30	Gas analyzer	1	18.900	18.900	
31	Gas conditioning unit	1	37.100	37.100	
31	Cogeneration power plant 1,2 MW	1	498.000	498.000	
32	Cogeneration power plant 2 MW	3	650.000	1.950.000	
33	Construction	1	2.400.000	2.400.000	Client
34	Filtrate Storage	1	80.000	80.000	Client
35	Silo 120 000 m3	1	1.000.000	1.000.000	Client
ZORG, EUR				5.519.500	
by Client, EUR				3.480.000,00	
ZORG+Client, EUR				8.999.500,00	

Implementation terms and payment

Months	1	2	3	4	5	6	7	8	9	10	10	11	12
Project documentation	50%		50%										
Approvals and permits													
Equipment				30%		25%	25%	20%					
Delivery						25%	25%	25%	25%				
Construction													
Supervision				50%			50%						
Biogas plant start-up											50%	50%	

Contracts

Project implementation is executed simultaneously under several contracts

- Engineering contract
- Equipment supply contract
- Supervision contract
- Start-up and training contract



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