AIR LIQUIDE

Air Liquide AGS GmbH

As Built Documentation

Chapter 2.1 Requirements specification

- Technical specification
  Equipment supply and installation contract for the turnkey supply of
  Air Separation Unit no. 9

EXHIBIT 1

TECHNICAL SPECIFICATION

EQUIPMENT SUPPLY AND INSTALLATION CONTRACT

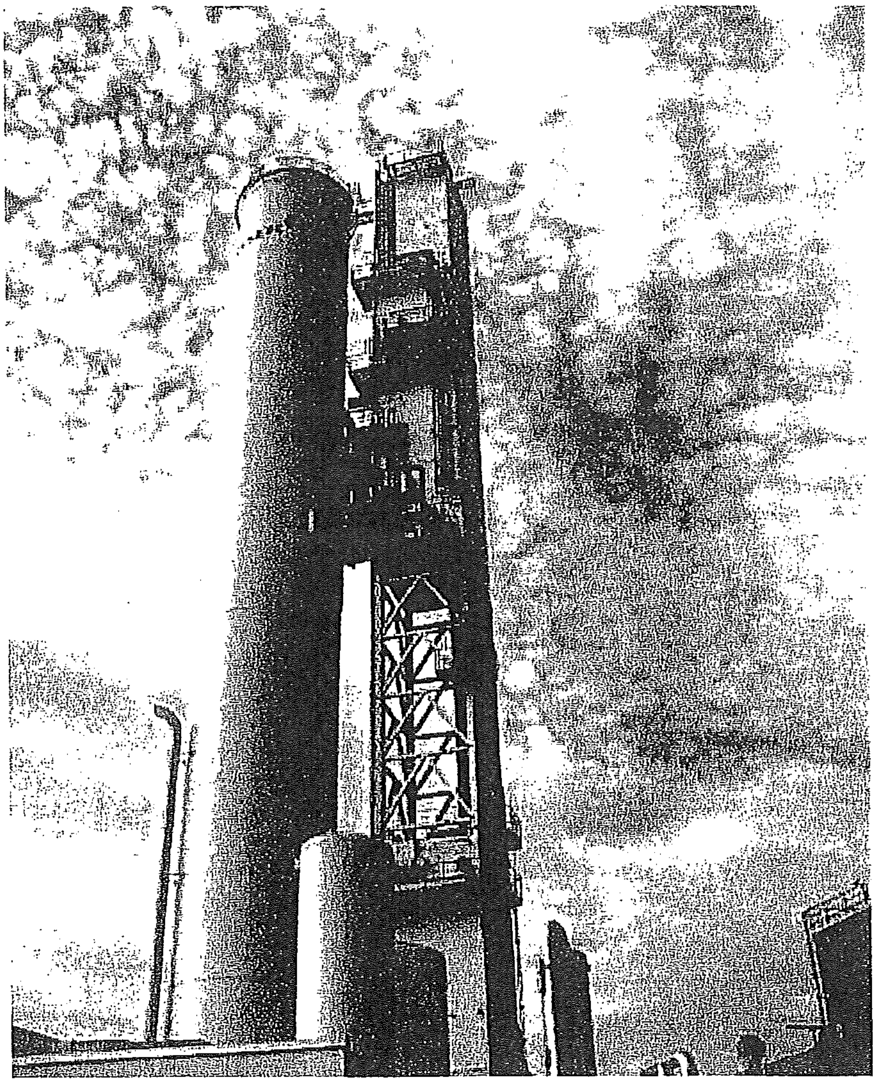
FOR THE TURNKEY SUPPLY OF

AIR SEPARATION UNIT NO. 9

(ATTACHED HERETO)

MESSER
AGS GmbH
Fö/Nip\ Rev. 5
April 07, 2004

AIR SEPARATION UNIT NO. 9
FOR U.S. STEEL KOSICE, S.R.O.



TECHNICAL SPECIFICATION

Specification No. 03 05 01 069

Revision:	**5**
Location:	**Košice, Slovak Republic**

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1.0 INTRODUCTION

U.S. STEEL KOSICE, s.r.o. plans to supply their future demands for Oxygen, Nitrogen and Argon with a new Air Separation Plant called ASU No. 9. That plant will replace the existing ASU 1 and ASU 4 and the Liquefier. The new plant will be integrated into the supply scheme of the existing plants ASU 7 and ASU 8 and into the present LOX / LIN Storage and Back-Up System.

To meet U.S. STEEL KOSICE's requirements MESSER AGS is sure to offer a reliable, cost efficient technical solution, based on the long term experience of one of the leading gas supply companies in planning, erecting and operating Air Separation Units all over the world.

The technical specification of MESSER AGS considers the design of a Liquid Gas Converter Cycle (LGCC) which offers a wide operating range for the oxygen supply between 11.000 Nm³/h and 25.000 Nm³/h with a nominal output of 20.000 Nm³/h (minimizing venting and vaporization).

Messer AGS will provide delivery, installation and start-up services of the ASU with an integrated liquefier, LGCC, LOX / LIN / LAR storage, back-up system for LOX, LIN and LAR and all auxiliary systems and optional spare parts, so that USSK will receive a fully operational facility.

2.0 PLANT TYPE AND GENERAL DESCRIPTION

Plant type: A 690 / L 110

The air separation plant has been designed for economical and reliable operation and for high availability.

The chosen plant size of an A 690 indicates that major parts like HP an LP column are identically to previously built plants. Thus Messer applies in their plants proven equipment.

The plant layout is based on the MESSER safety and reliability philosophy which has been applied for over 30 years in operating Oxygen plants for supply of numerous customers in the chemical industry and the steel industry mainly in Europe and in the United States.

In order to minimize personnel and operating cost, all equipment and process controls will be operated and monitored from a central control room. Only certain operations as machinery start-up, deriming, draining will be done locally.

The ASU will be designed according to the latest International rules and regulations. This refers not only to the design of equipment (e. g. machines, adsorbers, pipelines, workshop drawings, etc.), but also to the safety regulations which have to be applied in N_2- and O_2- plants.

The design, engineering, materials and workmanship for the plant are in accordance with the most advanced technical standards and construction practices which are suitable for the intended use. All plant process and auxiliary equipment will be supplied as specified in the scope of supply. The materials will be new and of the best quality and the most modern design available at the time of their purchase and manufacture.

Therefore trouble-free and safe operation of the ASU, little maintenance work and a long life of the equipment and material can be ensured.

2.1 LOX Pump Cycle with Integrated Liquefier

The air separation plant offered applies the cryogenic air separation process with an integrated liquefaction cycle and oxygen / nitrogen compression by internal liquid pumping. The high pressure product nitrogen will be as well compressed by liquid pumping whereas low pressure product nitrogen is supplied by external compression.

The LOX Pump Cycle offers a high degree of flexibility and it reduces the plant investment. As Messer provides all process pumps as two times 100% capacity a maximum availability is achieved. In respect of safety the internal compression is a more safe solution compared to the external compression by use of an oxygen compressor.

The scope of supply includes liquid storage and a backup system for oxygen, nitrogen and argon.

Following assumptions are made for the ASU design:

- Most efficient process cycles
- Integrated liquefaction cycle with air circulation
- Internal oxygen and high pressure nitrogen compression (liquid pumping)

- External low pressure nitrogen compression (2x50%)
- Argon purification by cryogenic rectification only (no catalytic reaction!)
- One-qualified man-per-shift plant supervision during normal operation of the ASU and storage / baxk-up system with the exception of truck loading and unloading operations.
- Applicable international and Slovakian rules and regulations, EIGA safety recommendations, and Messer design and safety standards (see listing in Section 5)

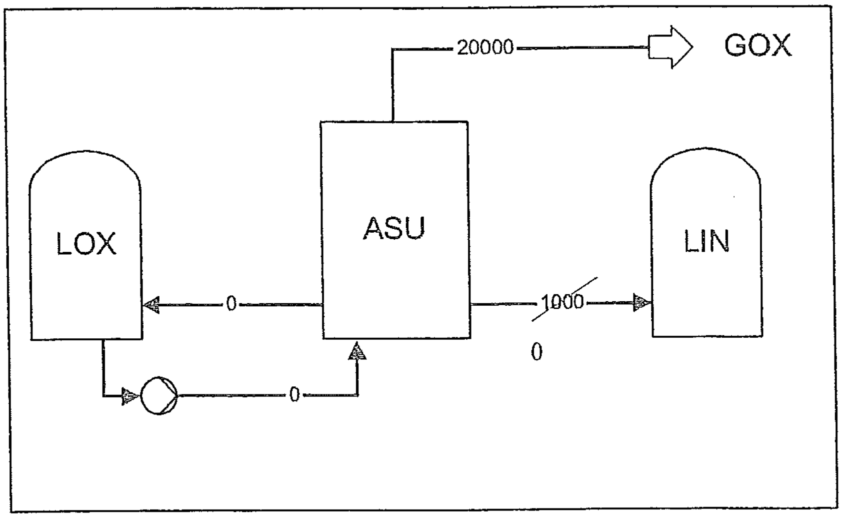
For more details please refer to the Process Flow Diagram, Attachment 2, drawing. no. 792.86029 and to the process description in Attachment 1.

2.2 Liquid Gas Converter Cycle (LGCC)

Due to the fluctuation of the oxygen demand at USSK, MESSER a Liquid Gas Converter Cycle process (LGCC). By that special feature the ASU is able to be operated in a range **between 11.000 Nm³/h and 25.000 Nm³/h of GOX production with a nominal output of 20.000 Nm³/h.**

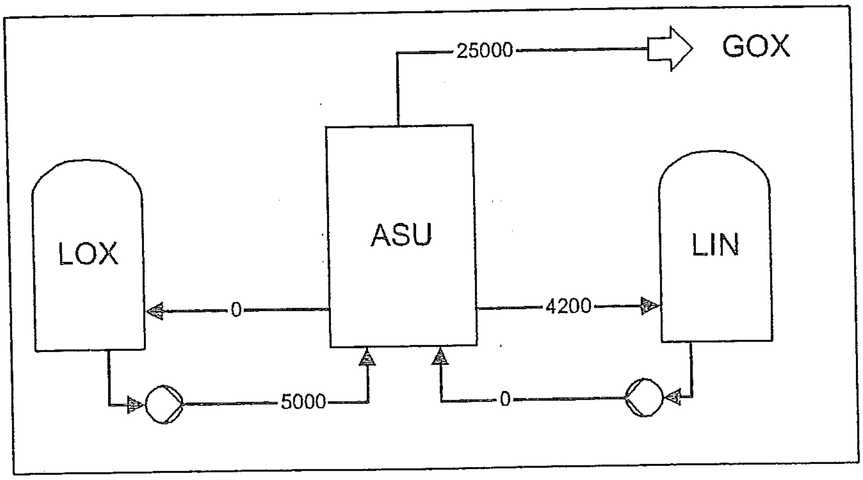
USSK will be able to follow their GOX-demands within a wide range **(between 45 % and 100 %)** without venting of gaseous oxygen or air during turndown and without evaporating of liquid oxygen in the Back-Up System during peak demand. In Addition to the existing gaseous buffer vessels at USSK, which cover short term flexibility, the LGCC Option ensures a wide operating range at high efficiency over an extended period. Considering that the existing plant No. 7 will be operated at fixed capacities the flexibility of the new ASU will become more important.

Below you can see in a schematic diagram the ASU production capacities at "Normal Operating Case" as specified. In the following graphics some product streams have been omitted for clarity (refer to Attachment 13 Table "Operating Modes of ASU 9" Mode B)



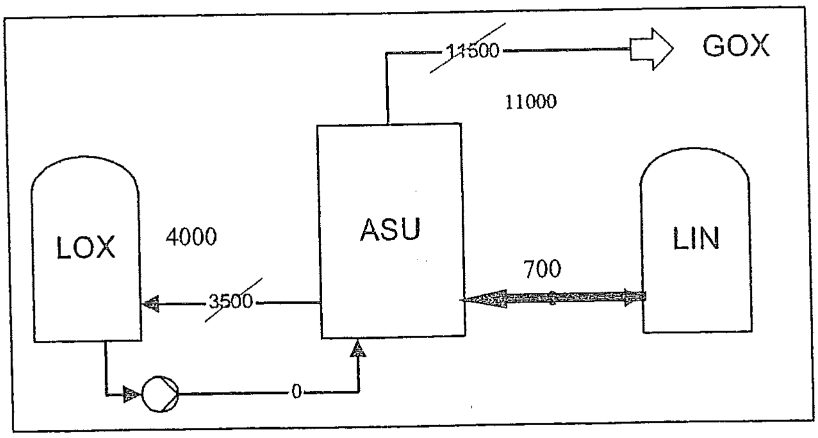
Graphic I: Normal Operation Case

Additionally USSK will have the option to cover a gaseous oxygen demand up to approximately 25,000 Nm³/h by injection of 5,000 Nm³/h liquid oxygen into the ASU process (refer to Attachment 13 Table "Operating Modes of ASU 9" Mode G). These product flows are shown in the diagram in the case "LGCC MAX GOX". By this mean it is assured, that the liquefaction energy will be recovered by an additional liquid nitrogen production (approx. 4,200 Nm³/h total).



Graphic II: Max. GOX Case

In the third case ("MIN GOX") (refer to Attachment 13 Table "Operating Modes of ASU 9" Mode E) the ASU is operating in the gaseous oxygen turn down (11.000 Nm³/h). Nevertheless the additional LOX taken from the storage tanks in the "MAX GOX Case" will be refilled in the "MIN GOX Case" with a total LOX capacity of approx. 4.000 Nm³/h.



Graphic III: Min. GOX Case

Due to the fluctuation of the oxygen demand the total storage capacities for LOX and LIN will effect the efficiency of the LGCC Process as it has to be kept in mind that in case of full storage tanks the LGCC Cycle can not be applied as economical as expected.

3.0 PLANT PERFORMANCE

3.1 Definitions

Flow rates are given in Nm^3/h, whereby Nm^3 is the dry gas volume at 0°C and 1013 mbar.
All specified pressures are given as gauge pressures, unless noted otherwise.

Flow rates, pressures and temperatures for liquid products are related to the coldbox outlet, if not stated otherwise. Tank and tank boil-off losses are not considered.

Flow rates, pressures and temperatures for gaseous products are related to the respective Tie-in Points (Section 8)

The production capacity and product specification data are based on design conditions as per section 4.

3.2 Product specification

As specified by USSK the following product purities details will be achieved:

Oxygen:	Purity:	≥ 99.5 mol % O2
	maximum nitrogen content:	< 1 vppm
	Note : The typical nitrogen in oxygen purity is less then 1 vppm !	
Nitrogen:	Purity:	≥ 99.999 mol % N2
	maximum oxygen content:	< 10 vppm
	Dew point:	- 68 °C or lower
Argon:	Purity:	≥ 99.999 mol % Ar
	maximum oxygen content:	< 2 vppm
	maximum nitrogen content:	< 5 vppm
	maximum CH4 content:	< 0.5 vppm
	maximum CO content:	< 1.0 vppm
	dew point:	- 68 °C or lower

3.2.1 Product Capacities at Guarantee Conditions

Ambient Temperature:	12 °C
Relative Humidity:	65 %
Cooling Water Temperature:	16 °C

Note: The performance data measured under the actual ambient conditions during performance test will be recalculated to the Performance data related to guarantee conditions mentioned above.

Product	Pressure	Flow (Normal Operation Case)	Flow (Max LOX Case)	Flow (Max LIN Case)	Flow (LGCC Case) Max GOX	Flow (LGCC Case) Min GOX
	bar (g)	Nm³/h	Nm³/h	Nm³/h	Nm³/h	Nm³/h
Gaseous Oxygen	27	20,000	17,000	20,000	25,000	11,000
Gaseous Nitrogen	20	3,500	3,500	3,500	3,500	3,500
Gaseous Nitrogen	6	29,500	29,500	29,500	29,500	29,500
Gaseous Argon	20	240	240	240	240	240
Liquid Oxygen		0	3,000	0	- 5,000	4,000
Liquid Nitrogen		0	0	3,000	4,200	-700
Liquid Argon		430	450	360	360	210

3.2.2 Product Capacities at Summer Conditions I

Ambient Temperature:	25 °C
Relative Humidity:	65 %
Cooling Water Temperature:	29 °C

Expected Values:

Product	Pressure	Flow (Normal Operation Case)	Flow (Max LOX Case)	Flow (Max LIN Case)	Flow (LGCC Case) Max GOX	Flow (LGCC Case) Min GOX
	bar (g)	Nm³/h	Nm³/h	Nm³/h	Nm³/h	Nm³/h
Gaseous Oxygen	27	20,000	17,000	20,000	25,000	11,000
Gaseous Nitrogen	20	3,500	3,500	3,500	3,500	3,500
Gaseous Nitrogen	6	29,500	29,500	29,500	29,500	29,500
Gaseous Argon	20	240	240	240	240	240

Liquid Oxygen		0	3,000	0	- 5,000	4,000
Liquid Nitrogen		0	0	3,000	4,200	-700
Liquid Argon		430	450	360	360	210

3.2.3 Product Capacities at Summer Conditions II

Ambient Temperature: 35 °C
Relative Humidity: 67 %
Cooling Water Temperature: 37 °C

Expected Values:

Product	Pressure	Flow (Normal Operation Case)	Flow (Max LOX Case)	Flow (Max LIN Case)	Flow (LGCC Case) Max GOX	Flow (LGCC Case) Min GOX
	bar (g)	Nm³/h	Nm³/h	Nm³/h	Nm³/h	Nm³/h
Gaseous Oxygen	27	20,000	17,000	19,500	24,500	11,000
Gaseous Nitrogen	20	3,500	3,500	3,400	3,400	3,500
Gaseous Nitrogen	6	29,500	29,500	28,500	28,500	29,500
Gaseous Argon	20	240	240	240	240	240
Liquid Oxygen		0	3,000	0	- 5,000	4,000
Liquid Nitrogen		0	0	2,900	4,100	-700
Liquid Argon		430	450	340	340	210

3.3 Plant operation

The plant is designed and optimized according to the required capacities in the Normal Operating Case. Due to the very high fluctuation of the oxygen demand in the steel mill the offered plant concepts includes additionally the possibility to increase the oxygen capacity up to 25,000 Nm³/h without the necessity of evaporating liquid oxygen in the back-up system. By this feature the power requirements during peak demand in the steel mill are significantly optimized. Furthermore the design enables to operate the ASU as well at low oxygen demand periods at a minimum capacity of 11,000 Nm³/h oxygen without venting of oxygen or air.

The on stream cycle of each air purifier adsorber is 5 to 6 hours.

Fast variations of the oxygen demand are assumed to be covered by the existing USSK buffer vessel system.

During flow change from 11,000 to 25,000 of 45 -60 minutes the product purities will not be affected.

After a Coldbox shutdown of up to eight hours a start-up time of about four hours is expected to reach oxygen and nitrogen purity. Argon purities will be achieved after additional 36 hours.

Deriming and cool down only (without major maintenance work) will take max. 2 days each! Drying-up time is dependent on the moisture contained in the system after completion of maintenance work.

Changing from normal to liquid production mode is done in a smooth and continuous manner without interruption of the gas supply. The load of the Booster Air Compressor BAC is increased by opening the inlet guide vanes. The additional air flow is directed towards the expanders by adjusting the inlet nozzles thereof. The liquids produced due to the higher cold production from the expanders can either be directed to the LIN or the LOX tank. The majority of the other parts of the plant are taken care of by the control system. Depending on the choice of product manual adjustments, e.g. air flow might be required.

The Back-Up System ensures highest product availability. The instantaneous supply for 6bar nitrogen will be ensured by the new high pressure LIN-tank. The 20 bar LIN pumps will have a cooldown time of 15 minutes maximum. The emergency vaporizer system in case of a lack of steam is ensured by a natural gas heater with a capacity of 16.000 NM³/h as specified.
After the liquid back up pump is cooled down and the water bath vaporizer is in operation the new LIN low pressure storage tank provides the Back-Up Supply.

The supply period for cooling down of the liquid oxygen back-up pump will be covered by the existing buffer system. Therefore the oxygen Back-Up System does not include a high pressure storage tank.
As MESSER AGS understands the availability of the Back-Up System as relevant, both back-up pumps (LOX and LIN pumps) are foreseen to be two times 100% pumps.

The maintenance schedule is mainly dependent on the deriming cycles of the ASU and statutory requirements. Based on IGC-document 65/99 a deriming cycle of 3 to 5 years is recommended for the type of ASU offered. All necessary maintenance work will be done during that turn down time of approx. 2 to 3 weeks. Pressure vessels safety valves, etc. may require additional inspection and/or certification as required by local regulations. The scope of work is based in the mean on preventive and condition based maintenance. Regular analysis of the plants condition such as

- Vibration analysis of major rotating equipment (compressors and turbines). Radial and vertical vibration sensors are installed on compressor and turbine wheel shafts with read-out on the PLC system.
- Thermo graphic checks of electrical equipment
- Analysis of the process data by trending will define the scope of maintenance work.

To ensure a highly qualified maintenance and operation team, the maintenance stuff shall attend already during the erection phase of the plant to get familiarized with the details of the plant. For the same reason the operational personal shall attend already the pre-commissioning phase. Afterwards the Operators are trained intensively during the commissioning phase of the ASU.

4.0 BASIC DESIGN DATA AND DESIGN CRITERIA

4.1 Ambient and site conditions

Ambient air temperature:	Maximum temperature:	35 °C
	Minimum temperature:	- 25 °C
	Yearly average temperature:	12 °C
Relative humidity:	yearly average humidity:	67 %
Altitude:		208 m above sea level
Water table:		approx: 3m below ground level
Seismic data:	Max. Macro Seismic intensity	7° MSK-64
	Min. Macro Seismic intensity	4.4° MSK-64
	According to seismo-tectonic maps !	
Barometric pressure:		990 mbara

Design basis for plant performance:

Ambient air temperature:	12 °C
Relative humidity:	65 %
Barometric pressure:	1013 mbara
Cooling water temperature:	16 °C
Cooling Water temperature increase max.:	10 K
Steam pressure:	10 bar (g)
Steam temperature:	280 °C

4.2 Ambient air quality

Normal industrial air, free of abnormal contents of chemical and physical impurities causing corrosion, damage to the molecular sieve unit or fouling in machinery and coolers has been assumed for the design of the plant.
The following air analysis has been used as a design basis:

Methane	CH_4	< 8 vppm
Ethane	C_2H_6	< 0.2 vppm
Ethylene	C_2H_4	< 0.2 vppm
Acetylene	C_2H_2	< 0.1 vppm
Propane	C_3H_8	< 0.2 vppm
Propylene	C_3H_6	< 0.2 vppm
Total hydrocarbons excl. methane	C_nH_m	< 0.5 vppm
Carbon dioxide	CO_2	< 400 vppm
Carbon monoxide	CO	< 0.8 vppm
Nitrous oxide	N_2O	< 0.5 vppm
Hydrogen chloride	HCl	< 1.0 vppm
Dust particles		< 0.5 mg/m³
Other impurities		nil

Messer has examined the local situation in Kosice. Messer will care about measures in case they are necessary. If needed, Messer will make air analysis to further check the air quality. Thus the required product specifications will be achieved. And safe operation of ASU can be guaranteed.

4.3 Utilities

4.3.1 Electrical power

Electrical power is available at the termination points TO1 and TO2.

Power is specified as below:

Nominal voltage:	110 kV, AC, 3 phases
Nominal frequency	50 Hz
Power quality according to:	EN 50160

Battery limits are as shown in Attachment A-4 (Single line diagram)
Grid Specification of 110 kV according to Attachment 10)
The HV compressor motors will be an asynchronous cage motor type. It is supposed that the main motors can be started directly (d.o.l.). For motor data please refer to the following schedule:

	MAC Motor	BAC Motor	GAN Motor
Power	8.0 MW	6.4 MW	2x 1.4 MW
Voltage	6 kV	6 kV	6 kV
Current	890 A	713 A	160 A
Power factor	0.94	0.94	0.94
Frequency	50 Hz	50 Hz	50 Hz
Start current	450%	450%	550%
Type of protection	IP 54	IP 54	IP 54
Type of construction	IM 1001 (B 3)	IM 1001 (B 3)	IM 1001 (B 3)
Type of cooling	IC 81 W	IC 81 W	IC 81 W
Thermal class	F	F	F
Thermal class used	B	B	B
Start method	D.O.L	D.O.L	D.O.L

4.3.2 Cooling water

Cooling water is available at the existing N2 Compressor building at a height of 8m. Return cooling water is fed back to the same location.
Water quality and condition as given below:

	Messers requirement	actual data by USSK
supply pressure at b.l.	2.8 bar g (constant)	ditto
supply temperature	20 °C (at design conditions)	ditto
allowable temperature rise	10 K	ditto
allowable pressure drop	2 bar	ditto
pH	7.5 – 8.5	8.0 – 8.6
conductivity	< 2,500 µS/cm	<1600 µS/cm
total hardness	< 40 ° dH *)	< 3.0 mmol/l
Calcium hardness (as CaCO3)	< 18 ° dH *)	< 80 mg/l (Ca^{2+})
Magnesium		< 80 mg/l (Mg^{2+})
m-value	< 6.4 mmol/l *)	1.0 – 3.0 mg/l ($KNK_{4.5}$)
Sulphates	< 500 mg/l	ditto
Chlorides	< 250 mg/l	ditto
Nitrates	< 100 mg/l	
Iron and Manganese	< 0.1-0.2 mg/l	< 2 mg/l (total Iron)
total suspended solids	< 0.3 mg/l	< 10 mg/l
Germs	< 10^5 germs/ml	
Oil		< 0.2 mg/l
Microbiologic Growth		<10^3 logCFU
Brass corrosion rate		0.005 mm/y
Carbon steel corrosion rate		< 0.05 mm/y
other impurities	nil	

*) suitable cooling water treatment, especially stabilization of hardness has been assumed. Cooling water quality has to be confirmed in advance by USSK.

Note: The actual water quality given by USSK deviates from our Cooling water specification given above. The actual cooling water is slightly corrosive. Therefore the water treatment has to take care, that the corrosion rates are kept steadily within ranges given above. In addition the water treatment has to assure, that no iron deposit will occur. Based on the water analysis given by USSK and provided that the water treatment will take care for slow corrosion speed and will prohibit deposits the actual water quality is acceptable for use in the ASU No 9.

4.3.3 Steam

Steam will be used for the back-up system and for the regeneration gas heater. As we could not identify the given location on the area plot plan we assumed that the termination point will be at the plant battery limit discharged into the plant sewer system.

Steam Conditions:

MP Steam max.:	20 barg	310 °C
MP Steam min.:	7 barg	240 °C

4.3.4 Natural gas

Natural gas is used for vaporizing of 16000 Nm³/h Liquid Nitrogen. It is assumed that the Natural gas is available at tie in point on the pipe rack (approx. 300m from plant battery limit) at 6 bar(g) with a caloric value of 34.3 MJ/Nm³ Natural gas pipe shall be installed on the existing pipe rack.

4.4 Soil conditions

Contract is based on soil conditions according to Attachment 11 (English language)

It is assumed that the site will be level and free from overhead and underground obstructions, such as foundations, drains (exept sewers), cables, pipelines, etc. and is free from contaminated soil.

4.5 Discharges

4.5.1 Waste water discharge

It is assumed that all condensate and water discharges will be connected to USSK sewage in front of ASU plant battery limit.

4.5.2 Waste gas discharge

In the design case the waste gas discharges are approximately:

Waste Nitrogen:	ca. 53,000 Nm³/h	1.4% Oxygen; 0.3% Argon	to atmosphere
Waste Argon gas:	ca. 2 Nm³/h	25% Nitrogen	to atmosphere

4.6 Traffic infrastructure

It is assumed that a connection from the ASU battery limit to the USSK road network will exist. It is taken for granted that the LP/HP column, machines and apparatus can be delivered as package units on site. Messer has examined the USSK road network and found it to be acceptable for such purpose.

4.7 Area classification

Non hazardous area, non explosive area

5.0 STANDARDS, CODES AND REGULATIONS

Plant design, manufacturing and inspection will be based on the following Standards and Regulations:

- DIN-Standards
- Pressure Equipment Directive (PED) AD-Codes 2000
- VDI/ VDE - Regulations
- UVV-Safety regulations
- ISO-/ ISA-Standards
- MESSER Standards
- Respective manufacturer's and sub supplier's own standards and practice
- Slovak Standards and Regulations

6.0 UTILITY AND ENERGY REQUIREMENTS

6.1 Power consumption*:

Average power consumption at:	-	Normal Operation Case	MAX LOX Case	Notes
12 °C (see 3.2.1)	kW	15,350	15,900	Guarantee Value
25 °C (see 3.2.2)	kW	15,850	16,410	Expected Value
35°C (see 3.2.3)	kW	16,290	16,860	Expected Value

* process related electrical consumers only.

6.2 Cooling water requirement:

total average at Design Case: 1,700 m^3/h

6.3 Steam requirement

Molecular sieve system

MP Steam at 280 °C and 10 barg:
Average: 700 kg/h
Peak Demand: 1,900 kg/h
- for 20,000 Nm^3/h; 6 bar(g) GAN-Backup 5.0 t/h
- for 24,000 Nm^3/h; 27 bar(g) GOX-Backup 6.0 t/h
- for drain vaporizer 4.0 t/h

6.4 Natural Gas requirement

For Back-up vaporizer (16,000 Nm^3/h nitrogen): Only during steam shortage!
- Natural Gas demand 400 Nm^3/h or 2800 kW

6.5 Potable water requirement

Max.: 1.5 – 2 m^3/day

6.6 Fire water requirement

Please refer to Attachment 13 as described in Section 16

7.0 TECHNICAL EQUIPMENT DESCRIPTION

General: Four printed copies of documentation and one copy on CD will be delivered. Drawings will be submitted to the customer as AutoCAD (.dwg) files as described in Article 4 and Article 12 of the Agreement.

The plant comprises mainly of the following units:

7.1 Mechanical Equipment

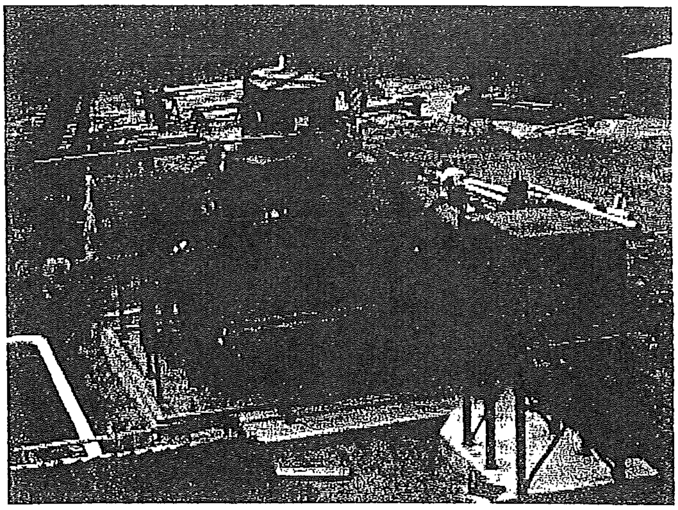
7.1.1 Air inlet filter system and suction silencer

The air inlet filter comprises two filter stages in series and acoustic elements downstream of the filter stages for installation in steel housing. The filters are break resistant pocket filters:
First filter stage: filter class: EU4
Second filter stage: filter class: EU6
The inlet filter is equipped with differential pressure measuring devices with alarm contact.
The filter elements installed in the filter-house are accessible and can easily be removed and replaced during normal ASU operation. The elements come in standardized sizes and are clamped in a framework.

7.1.2 Main air compressor

Three stage, gear type centrifugal compressor.

The compressor includes:
- compressor stages
- gear
- coupling between compressor and electric motor drive
- intercoolers
- lubrication system with main lube oil pump, oil tank, auxiliary oil pump, oil cooler, dual oil filter - oil filters can be changed during compressor operation (two filters installed in parallel); oil mist separator;
- interconnecting oil piping and gas piping
- cooling water system
- condensate traps
- blow-off-silencer
- check valve in discharge line
- local instrumentation
- shaft vibration monitoring for the pinion shaft
- shaft position monitoring for the bull gear shaft
- automatic anti-surge protection system

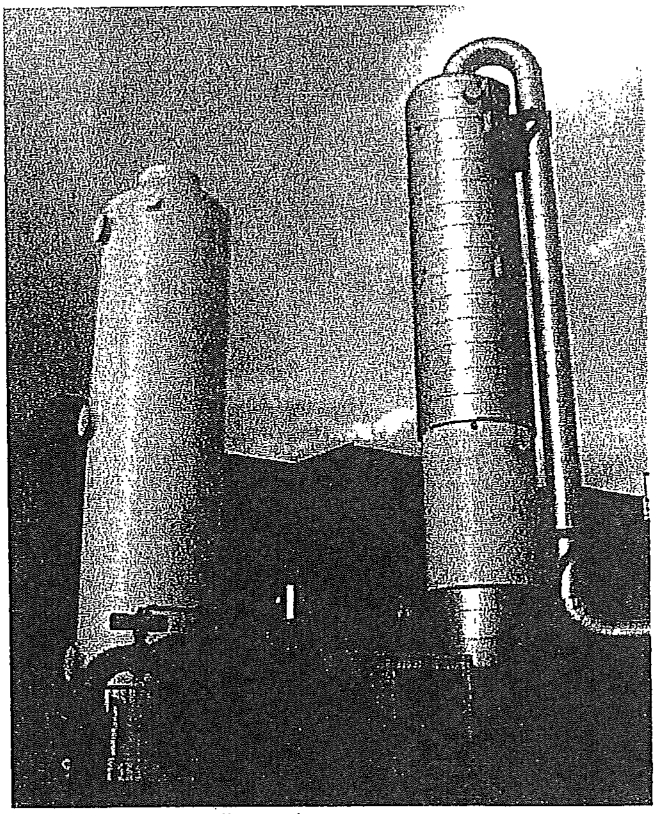


Typical Gear Type Turbo Compressor with air inlet filter system

Nominal Capacity of Main Air Compressor:
Flow: 100,000 Nm³/h
Pressure: 5 bar (g)
Power: 8 MW

7.1.3 Air precooling unit

Water cooled air precooling unit including:
- Direct contact aftercoolers (DCAC) with internals and packing
  for cooling of the feed air from main air compressor.
- DCAC with two stages
- Waste gas chill tower with internals and packing to chill fresh water
- mechanical water chilling unit delivered as packaged unit.
- DCAC cooling water pump (two 100% capacity pumps installed, one as stand-by) and
- Chilled water pump (two 100% capacity pumps installed, one as stand-by)
  for pumping the cooling and chilled water for use in the DCAC
- Interconnecting piping with valves
- Local panels
- Required insulation
- Instrument and controls

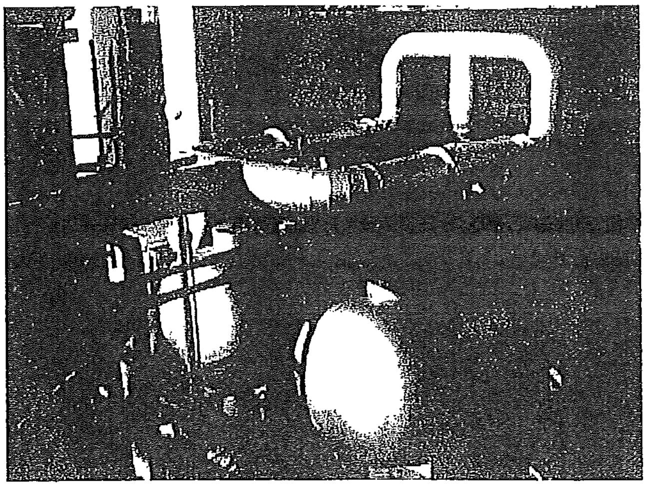


Typical air pre-cooling unit

7.1.4 Molesieve unit

The adsorbers are controlled and automatically switched by the computer control system. Logic and sequence functions are integrated in the DCS system. Vessels design for outdoor installation.

The mole sieve system mainly consists of:
- two automatically reversing adsorber vessels with required connections and equipment for filling
- steam heated regeneration gas heater with temperature control and shut-off
- after filter
- interconnecting piping, butterfly valves, valves, fittings
- initial activated alumina and molecular sieve filling
- required local instrumentation
- required heat insulation
- framework and fixings

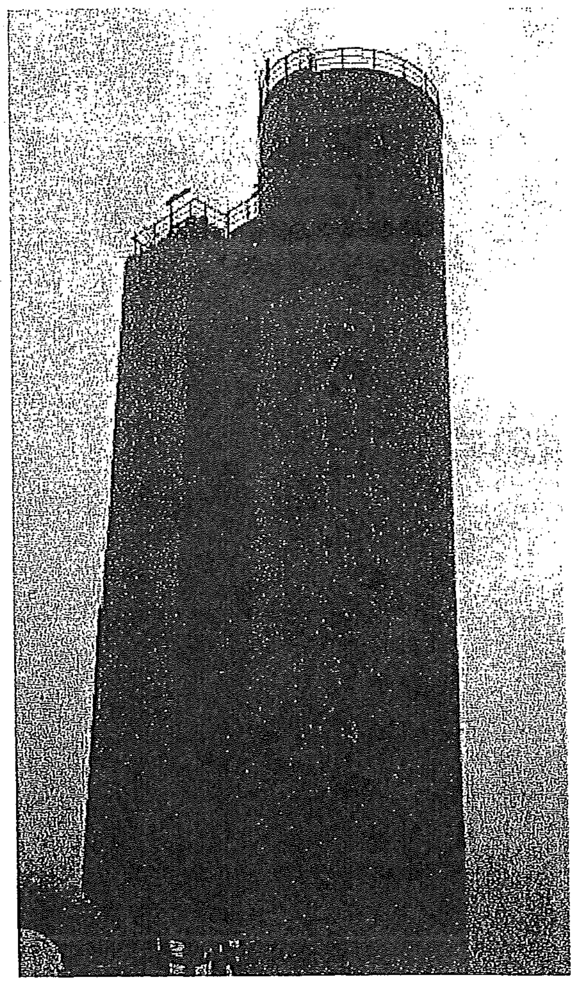


Typical molesieve unit

7.1.5 Air separation equipment

The Columns and vessels will be prefabricated and delivered separately. The structural steel Coldbox will be site erected and will be limited to max. 62 meters. The Air separation equipment mainly comprises:

- braised aluminum heat exchangers
- Medium pressure column (aluminum)
- Low pressure column (aluminum)
- Argon columns (aluminum)
- Piping, fittings and valves inside the coldbox (aluminum, stainless steel, bronze)
- Piping for liquid drains and cold box defrosting (stainless steel)
- Coldbox shell made of carbon steel for the above equipment
- Stairs, ladders and platforms as
- Insulation



Typical Air Separation unit

7.1.6 Drain vaporizer

- Steam blast type

7.1.7 Internal Compression Oxygen pumps

Two cryogenic Oxygen pumps (100% capacity each) will be installed in separate isolated boxes to pump the oxygen up to delivery pressure for HP GOX (27 bar(g)).

7.1.8 Internal Compression HP Nitrogen pumps

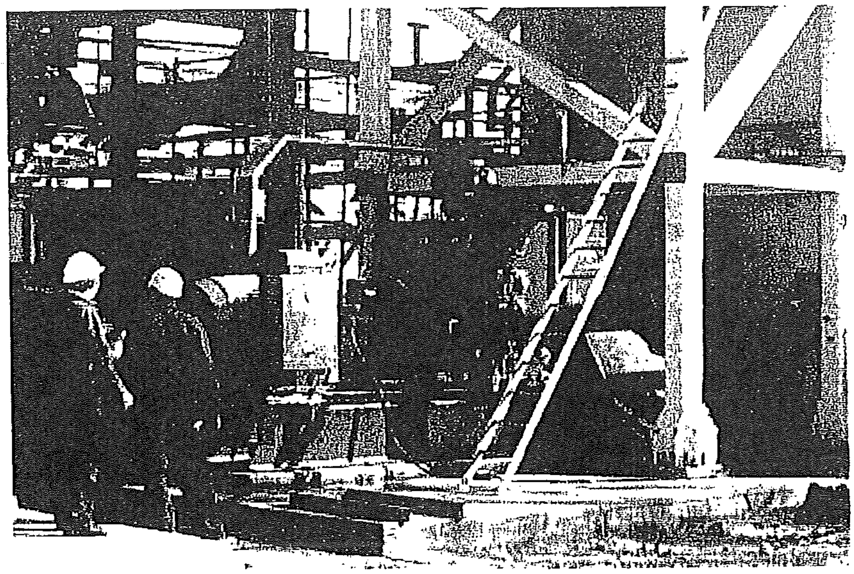
Two cryogenic Nitrogen pumps (100% capacity each) will be installed in separate isolated boxes for delivering High Pressure Nitrogen (20 bar(g)).

7.1.9 Argon process pump

The Argon process pump will be installed in separate isolated box for pumping Argon from the bottom of the Crude Argon Column to the LP Column.

7.1.10 Expansion turbine

Two generator brake expansion turbines skid mounted will be provided including all necessary auxiliary systems and controls including vibration monitors.



Typical generator braked expansion Turbine (single unit)

7.1.11 Booster air compressor

Five stage, gear type centrifugal compressor.

The compressor includes:
- compressor stages
- gear
- coupling between compressor and electric motor drive
- intercoolers and after cooler
- lubrication system with main lube oil pump, oil tank, auxiliary oil pump, oil cooler, dual oil filter oil mist separator
- interconnecting oil piping and gas piping
- cooling water system
- check valve in discharge line
- local instrumentation
- shaft vibration monitoring for the pinion shaft
- shaft position monitoring for the bull gear shaft
- automatic anti-surge protection system

Nominal Capacity of Booster Air Compressor:

Flow:	60,000 Nm^3/h
Pressure:	~ 60 bar(g)
Power:	6 MW

7.1.12 GAN Compressor (2x 50%)

Two times three stage, gear type centrifugal compressor.

The compressor includes:
- compressor stages
- gear
- coupling between compressor and electric motor drive
- intercoolers and after cooler
- lubrication system with main lube oil pump, oil tank, auxiliary oil pump, oil cooler, dual oil filter oil mist separator
- interconnecting oil piping and gas piping
- cooling water system
- blow-off-silencer
- check valve in discharge line
- local instrumentation
- shaft vibration monitoring for the pinion shaft
- shaft position monitoring for the bull gear shaft
- automatic anti-surge protection system

Flow:	2 x 15,000 Nm^3/h
Pressure:	6 bar(g)
Power:	2 x 1.4 MW

7.1.13 Low Pressure Liquid Oxygen storage tank

One flat bottomed cryogenic storage tank, perlite insulated for liquid oxygen, including pressure buildup system, safety devices for over- and under-pressure, interconnecting piping, control system, etc. Inner vessel is made of stainless steel, outer shell consists of carbon steel

net filling capacity:	1,800 ton
pressure:	max: 0.2 bar(g)
boil-off rate:	< 0.2 % per day

7.1.14 Low Pressure Liquid Nitrogen storage tank

One flat bottomed cryogenic storage tank, perlite insulated for liquid nitrogen, including pressure buildup system, safety devices for over- and under-pressure, interconnecting piping, control system, etc. Inner vessel is made of stainless steel, outer shell consists of carbon steel

net filling capacity	1,000 ton
pressure:	max: 0.2 bar(g)
boil-off rate:	< 0.2 % per day

To start the backup pumps automatically Messer recommends starting backup pumps with a Tank level of at least 20%. When backup pumps are in operation the tank can be emptied down to the minimum level. The minimum level of the tanks is approx. 300 mm for static reasons (otherwise the purge pressure of the outer tank may bend the bottom of the inner tank) and to avoid warming up of the inner tank.

7.1.15 Cryogenic Backup pumps

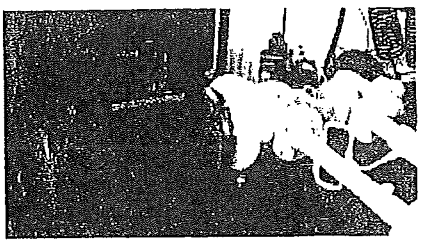
For each product (LOX and LIN) two gear type centrifugal backup pumps are installed to bring the liquid product to the required product pressure. In Backup case one pump is in operation and one pump is in stand by.

7.1.16 High Pressure LIN Backup Pump

For LIN two gear type centrifugal backup pumps are installed to bring the liquid product to the required product pressure (20 barg). In Backup case one pump is in operation and one pump is in stand by.

7.1.17 Truck filling pumps

For each product (LOX, LIN LAR) one truckfilling pump centrifugal type



Typical cryogenic truck filling pump

7.1.18 Vaporizer for Oxygen:

Steam heated vaporizer for gasifying 24,000 Nm^3/h oxygen for continuous operation.

7.1.19 Vaporizer for Nitrogen:

Steam heated water bath vaporizer for gasifying 20,000 Nm^3/h nitrogen for continuous operation.

Ambient air vaporizer for gasifying 3,500 Nm^3/h nitrogen (for continuous operation).

Natural gas fired water bath vaporizers for gasifying of 16,000 Nm^3/h only during steam outage

7.1.20 Low Pressure Liquid Argon storage tank

Two low pressure cryogenic storage tanks with a capacity of 62.5 m^3 each are provided for Argon storage.
boil-off rate: < 0.15 % per day

7.1.21 LAR Backup Pump

For LAR one gear type centrifugal backup pump is installed to bring the liquid product into the high pressure (~22 barg) LAR Tank.

7.1.22 High Pressure Liquid Argon storage tank

One high pressure cryogenic storage tanks with a capacity of 59 m^3 is provided for Argon supply.
boil-off rate: < 0.15 % per day

7.1.23 Vaporizer for Argon:

Two ambient air vaporizers are provided for gasifying of 400 Nm^3/h Argon (continuous operation)

7.1.24 MP Liquid Nitrogen storage tank

One medium pressure cryogenic storage tanks with a capacity of at least 10 m^3 is provided for Nitrogen supply during cool down of the backup pumps.

7.1.25 LGCC pressure build up equipment

LOX and LIN supply to the ASU Coldbox during LGCC operation will be provided either by additional cryogenic pumps or via connections downstream backup pumps (exact design is subject to detail engineering).

7.2 Main Electrical equipment

Please refer to attached Single Line Diagram. (Attachment 4)

7.2.1 Transformers

- **Two transformers 110kV / 6.3kV; 40MVA; ONAN/ONAF; Ynd; u_k 10.7% with protection relays**
- **Two zero transformers NT1, NT2 and 2 quenching chokes ZT1,ZT2 (400kVA) with ONAN cooling – external design**

7.2.2 High Voltage Switchgears

7.2.2.1 (110kV)

Two switchpanels with:
- 1pc. Circuit breaker 123 kV; 3150A; 40 kA
- 2pc. Disconnectors, 3-pol; 123kV; 2000A; 31.5kA
- 1pc. Cabel disconnector 3-pol; 123kV; 2000A; 31.5kA
- 2pc. Make proof earthing switch
- 3pc. Current transformer 123kV; 200/1/1/1 A
- 3pc surge arrester
- protection relays
- concrete cubicles

I recommend to change 7.2.2.1 and 7.2.2.2 according Att. 4-1 (31.7.03)

7.2.2.2 6kV indoor switchgear (T80)

50 kA maximum rated short time current
- rated voltage 7.2 kV, service Voltage 6.3 kV; 4000A; air insulated
- double busbar (back to back)
- metal enclosed; metal clad
- vacuum circuit breaker
- standard type – tested indoor switchgear acc. to IEC 60298
- Safety for operation and maintenance personnel
  - All switch operations behind closed doors
  - positive and robust mechanical interlocks
  - Arc fault tested metal enclosure
  - complete protection against contact (of persons)
  - maintenance free vacuum breaker

The remark is an internal recommendatio of USSK and not binding for Messer AG
17.04.04

including:
- 2pc. incoming feeders; 4,000A
- 2pc. Motor outgoing; 8MW and 6.4MW
- 2pc. Outgoing to T81; 2500A
- 1pc. Emergency incoming from T40; 2500A
- 2pc. Busbar measuring device
- 2 pc. Bus coupling; 4,000A
- 1pc. Bus sectionalizing point

7.2.2.3 6kV indoor switchgear (T81)

31.5 kA maximum rated short time current
- rated voltage 7.2 kV, service Voltage 6.3 kV; 2,500A; air insulated
- single busbar
- metal enclosed; metal clad
- vacuum circuit breaker
- standard type – tested indoor switchgear acc. to IEC 60298
- Safety for operation and maintenance personnel
  - All switch operations behind closed doors
  - positive and robust mechanical interlocks
  - Arc fault tested metal enclosure
  - complete protection against contact (of persons)
  - maintenance free vacuum breaker

including:
- 2pc. incoming feeder; 2,500A
- 2pc. Motor outgoing; 1.4MW and 1.4MW
- 1pc. Transformer outgoing
- 1pc. Emergency incoming from T46
- 1pc. Busbar measuring device
- 1pc. Bus sectionalizing point

7.2.3 Low voltage switchgear

7.2.4 Motors

- One high voltage motor for Main Air Compressor (P~8.0 MW, 6kV)
- One high voltage motor for Booster Air Compressor (P~6.4 MW, 6kV)
- Two high voltage motor for Nitrogen Compressor (P~2x 1.4 MW, 6kV)
  Type: cage induction, asynchronous motors, direct motor starting

- All necessary low voltage motors

7.2.5 UPS System

UPS System for the fail-safe supply of process control system and for emergency lighting (230V, AC)

7.2.6 Cabling

All necessary cabling for the scope of supply including but not limited to:
110 kV Cabling between T01 and T80 and between T02 and T80
6kV Cabling between T40 and T80; between T46 and T81 and between T80 and T81
6 kV and 400V Cabling beween T81 and all electrical consumers inside battery limits of ASU9

7.3 Main Instrumentation and control equipment

7.3.1 General

The air separation unit with their ancillary machines and accessories will be provided with all metering, instrumentation and control equipment required for trouble-free operation, so that the ASU as well as the LOX-LIN-LAR Storage/Backup systems with the exception of the truck loading and unloading operations can be continuously operated from a central control room.

Design, fabrication and installation will be in accordance with the latest revision of the following technical regulations:

VDE/ VDI-Regulations, DIN-Standards, VBG 4-Regulations and manufacturer's own practice
Units of measurements will be used in accordance with SI.
Symbols and identification on P & I diagrams will be in general in accordance with DIN 19227.
Slovak Standards and Regulations.

7.3.2 Process control system

For process visualization and control a compact computer control system will be provided, which offers high reliability and availability.
The plant will be controlled and monitored from a central control room. A distributed control system (DCS) will be used for this purpose. The DCS will handle all functions required to operate the plant from the control room. Safety relevant functions and interlocks are not implemented in the DCS system. They will be hardwired. Tank Farm and ASU are independently controlled (separate control units).
A temporary control system locally operated will be provided for operation of the Tank Farm and Backup System prior to commissioning of ASU no. 9.

Distributed control system (DCS)

Hardware concept

The DCS system for this plant consists of :

- 2 Operator interface stations (OIS)
  Each station consists of:
    PC with 19 " Monitor , Keyboard and Mouse
    Operating system Windows (Windows 2000)
- 1 Engineering station / Operator station
    PC with 19 " Monitor , Keyboard and Mouse
    Operating system Windows (Windows 2000)
- 1 Laser printer for reports , alarm events
- 2 Color Ink printer for copy's of graphic screens
- 3 controller
- I / O modules S800 connected to the controller via Profibus .

Software concept

The following software functions are used:

- Standard group displays
- Plant specific free graphic displays
- Trend displays
- Alarm reports
- Operating reports
- OPC server interface to enable data transfer to Oracle database system (customization of interface within the Oracle database to be performed by USSK)

Remote Access

For service, trouble shooting and assistance purpose from our offices in Germany (Krefeld) we will install a remote access to the DCS system. This will be done by a modem, installed at the Engineering station, or a router which connects to the TCP / IP Ethernet bus. Preferred phone line is ISDN.
The software used is PC Anywhere.

DCS Language

The used "system language" is English.
For the plant specific displays, alarm and operation reports and at least for each function, like PID
For controller, indicator, drive functions for motors and valves, the texts are in Slovak language.

Instrument rack room (IRR)

The DCS system will be placed in an instrument rack room, where the cabinets for the controllers and I/O cards are mounted. An air conditioning unit will be installed to keep a constant temperature.
This room will be placed near to the ASU column, molsieve, and machines.

Control Room

The control room provides enough space for operation of ASU no. 9 and no. 10.

7.3.3 Analysers

Automatic on-line analyzers will be installed as required.
Analyzed values will be hooked-up to the control system (DCS). The analyzer room shall be ventilated and air conditioned (refer to Attachment 13 Section E1).

7.3.4 Field instruments

Field instruments will be designed for the connection to the process control system. The signals will be collected at field mounted junction boxes and from their led to the process units of the control system.

Analogue signals from the field instruments will be 4 -20 mA DC or direct connected resistance thermo-detectors (PT 100).
Signal output to the field instruments will be 4 - 20 mA DC. These signals are converted to pneumatic signal via I/P positioner at the control valves.

7.4 Spare parts (optional, not included in Agreement Price, Article 5 of Agreement)

(Please refer to Spare part list Exhibit 2 of Agreement)

8.0 CIVILS AND INSTALLATION WORK

8.1 Civil Works

Messer assumes that the ASU construction site is leveled and free of any structures and/or installations above and below ground level. Within the designated boundaries of ASU no. 9, as indicated on drawing no. 792.85996 (Attachment 3) Messer shall perform all civil construction works needed to erect, to install and to operate ASU no. 9 turnkey. These works include the following main phases of construction:

- Preparation of additional soil analysis in areas required
- Structural calculations of all foundations, buildings and structures, etc.
- Excavation of foundations and grouting for machinery, buildings, structures, pipe racks, tanks, roadways, etc.
- Excavation of sewer system for storm and wastewater, underground piping, trenches, etc.
- Installation of all foundations for equipment, buildings, structures, etc.
- Installation of all foundations for new equipment in T01 andT02 if necessary
- Construction of buildings incl. finishing as required, shelters, etc. The control building (incl. control and analyzer rooms) and the electrical substation include ample space for future ASU no. 10
- Building T80 is foreseen to be a concrete skeleton construction with brick work between steel constructions. The building will have an underground cable channel with a head clearance of about 2500mm. The building will have two floors. The transformers are foreseen to be located outside the building under roof with fire protection walls on each side and a fenced access door on front side.
- Extension of cable channel coming from T01/T02 up to T80
- All Foundations and constructions to support the cables in case existing constructions cannot be used
- Installation of heating, ventilation and air conditioning (where required) systems, lighting, electrical systems and sanitary installations in the buildings
- Installation of roadways and gravelling within B.L ASU no. 9
- Installation of bumpers as required

8.2 Installation Work

Within battery limits as defined in Section 9 all equipment and facilities of ASU no. 9 shall be turnkey installed by Messer. The installation work comprises amongst others:

- Erection of all equipment
- Erection of all liquid storage tanks as specified
- Installation of all interconnecting piping and tubing including all valves, filters etc.
- Installation of all product supply piping to the designated Tie-in Points as described in Sect. 9
- Installation and hook-up of all MV and LV equipment
- Installation of all power cables
- Installation of lightning systems as required
- Installation of all control wiring and instrument air tubing, etc.
- Installation of all field control systems, including all instrumentations
- Installation of the PLC/DCS systems including analyzers
- Installation of plant lighting system
- Installation of required fire fighting system
- Installation of platforms and ladders (stairs are provided where daily inspections are required; otherwise ladders are foreseen

9.0 BATTERY LIMITS AND TIE-IN POINTS

General: It is in USSK responsibility that the tie ins can be performed according to Messer's project schedule. (e.g. depressurizing, draining, separating of pipes to be connected). Manual isolation valves for each Tie-In will be provided by Messer with the capability for a lockout tagout provision. Installation of the manual isolation valves may be provided by USSK if outages occurred prior to Messer's site mobilization.

Process Air:	inlet of air filter
HP Gaseous Oxygen:	Connection on pipe rack B-2 from pillar #15 to #16 approximately 8 m above ground connected to two pipes diameter 500mm and with automatic valves
MP Gaseous Nitrogen:	Connection to main Nitrogen header approx. 350 m from ASU boundary limit connected to one pipe and with automatic valve. Messer will provide the installation of DN 300 pipe from ASP No. 9 to MP GAN tie in point. Messer shall provide pipe and pipe supports assuming that existing pipe rack is capable of bearing loads and space. Messer shall also provide detailed evaluation of adequacy of existing pipe rack. Costs to improve existing pipe rack or provision of additional pipe supports, if needed, are excluded from the agreement price.
HP Gaseous Nitrogen:	Connection on pipe rack B-2 from pillar #15 to #16 approximately 8 m above ground connected to one pipe and with automatic valves
Gaseous Argon:	Connection on pipe rack B-2 from pillar #15 to #16 approximately 8 m above ground connected to one pipe and with automatic valve
Liquid oxygen	Connection at liquid tank and line to connect filling line of existing tank to filling line of new tank with all necessary valves to fill independently both storage vessels
Liquid nitrogen	Connection to existing fill line before new tank and connection to existing MP LIN tanks downstream of new LIN Back-Up pumps. The backup product lines for oxygen and nitrogen will be connected to the GOX and GAN product lines where it is necessary.
Power:	incoming 110kV line of terminals T01 and T02
Emergency Power:	if necessary: incoming feeder of 400V line at ASU area boundary
Cooling water:	near existing N2 compressor building approximately 8m above ground

Cooling water return:	near existing N2 compressor building approximately 8m above ground
Stand-by instrument air	Connection inside existing plant (100 m pipe)
Back-up nitrogen	Connection on pipe rack B-2 from pillar #15 to #16 approximately 8 m above ground connected to one pipe and with automatic valve (pipe size of existing steam lines DN 500).
Steam (inlet)	Connection on pipe rack B-2 from pillar #15 to #16 approximately 8 m above ground connected to pipe with manual valve (pipe size of existing steam line DN 500)
Potable water	Connection below pipe rack B-2 from pillar #15 to #16 approximately 2 m below ground connected to one pipe and with manual valve
Hot water (inlet/outlet)	Connection on pipe rack B-2 from pillar #15 to #16 approximately 8m above ground connected to pipe with manual valve
Sewer	Near B-2 utility line below ground surface, one common for sanitary, waste water, steam condensate, rain water
Steam Condensate:	to sewer
Natural gas:	Connection on pipe rack B-2 (max. 400m distance from Plant battery limit (Natural gas pipe shall be installed on Pipe rack B2.
Fire fighting water:	Connected to industrial water (refer to Attachment 13, item 16)
Waste nitrogen:	to atmosphere
Liquid drains:	outlet valves at disposal vaporizer
Deriming vents:	to atmosphere
Safety valve outlets:	to atmosphere
Condensate drain:	outlet flange to water separator

10. EXCLUSIONS

All equipment, materials and services not listed in this specification in section 7 and 8 are excluded from MESSER's scope of supply and shall be supplied by customer if required.

These exclusions are:

- Site preparation including clearance of the site from any above and below ground obstructions and surface leveling

- Domestic water and drainage system outside battery limits (except those mentioned in Section 9 "Battery Limits")

- Land/ property

- Provisions for hazardous zoning

- Utility supply systems (especially cooling water supply including cooling water treatment) and supply of utilities to the site during construction and commissioning and start up phase.

- Equipment and services outside B.L. (except those mentioned in Section "9. Battery Limits"))

- Deviations from Messer's design standards except where those conflict with Slovak laws and regulations.

- Consumables except first fillings

- Costs for lay-down area and for area for temporary site facilities

- Operators & maintenance personnel during commissioning and start-up of ASU no. 9
- Consequences due to site conditions that have changed subsequent to the Agreement and prior to the execution that directly affect said executions.

ATTACHMENT 1: PROCESS DESCRIPTION

Air Compression and Purification

Process Air is cleaned from dust and other particles in an air filter and then compressed to the required process pressure by a multi-stage centrifugal air compressor. The compressed air is cooled against cooling water and chilled water in a 2-stage direct contact cooler.

Then the air passes through a molecular sieve adsorber unit consisting of two cyclic operating adsorber vessels filled with different layers of molecular sieve material. Process air passes through one of the adsorbers where water, carbon dioxide and most of the hydrocarbons are removed from the air stream. Concurrently, the other adsorber is regenerated by dry waste nitrogen from the air separation unit. The regeneration gas is heated to improve and accelerate the desorption process. Before switching regenerated bed to adsorption it is cooled to operating temperature by waste nitrogen.

Part of the dry and CO_2-free air is withdrawn as instrument air downstream the adsorber.

Main Heat Exchanger

One portion of the dry air (hereafter called "main air") passes directly to the main heat exchanger where it is cooled close to saturation against out-coming product streams and fed into the high pressure (HP) column.

The remaining process air is further compressed in the booster air compressor (BAC), cooled to ambient in a shell-tube after cooler and thereafter cooled down in the main heat exchanger. A side-stream is withdrawn the mid-point of the heat exchanger expanded in two turbines operating in parallel. The expanded air is blended with main air from the cold-end outlet of the main heat exchanger. The remaining booster air is further cooled down and after the main heat exchanger reduced to HP column pressure. One part of this liquefied air is fed to the HP column; the other part is passed to the low pressure (LP) column via the subcooler.

Each turbine drives a generators producing 400 V, 50 Hz electrical power.

Air Separation

In the HP column, the air streams are separated in an oxygen-rich bottom liquid and a high purity nitrogen product at the top. The overhead vapor stream is condensed against boiling oxygen in the LP column sump. The condensed nitrogen serves as reflux for the HP and LP column, as nitrogen product after compression as liquid, and as refrigerant for the high purity argon condenser. The liquid nitrogen product and LP column reflux stream are subcooled in the subcooler. In a cryogenic liquid nitrogen pump condensed nitrogen is compressed to the required gaseous nitrogen pressure and thereafter vaporized in the main heat exchanger against inflowing air.

The bottom liquid of the HP column is subcooled, partially vaporized in the crude argon condenser and fed into the LP column. Some liquid bypasses the crude argon condenser and enters the LP column directly.

In the LP column the final air separation takes place. Nitrogen gas is withdrawn from the top of the low pressure column, passes the subcooler and is heated to near ambient temperature in the main heat exchanger. It is then compressed to the desired pressure and serves as low pressure product nitrogen

Also a waste gas stream is withdrawn from the LP column and heated to ambient in the subcooler and subsequently in the main heat exchanger. The waste nitrogen gas is then utilized to produce chilled water in the Evaporative Cooler and to regenerate the molecular sieve unit.

The liquid oxygen product is taken from the LP column sump, is pumped to the required pressure and vaporized in the main heat exchanger to provide GOX product. A part of the liquid oxygen is subcooled in the subcooler and fed to the LOX storage tank.

Argon recovery by rectification

A zone of argon enriched oxygen gas exists in the lower part of the LP column. This gas is used as a feed stream for the crude argon column. In this column, most of the oxygen of the argon enriched side-gas is removed by cryogenic rectification.

The feed enters the bottom of the column, is condensed against oxygen rich liquid from the HP column and the bottom liquid is returned to the LP column. Part of the top product is withdrawn from the crude argon column and is fed into the pure argon column.

In the pure argon column, remaining nitrogen is removed by cryogenic rectification. The gas leaving at the top of the column, containing mostly nitrogen, is vented to atmosphere; the pure liquid argon product from the sump is transferred to the liquid argon (LAR) storage tank (low pressure). The liquid argon is withdrawn from the low pressure storage tank, compressed by cryogenic pumps to the required product pressure and is evaporated in ambient air vaporizers. It is then passed as gaseous argon product to the customer.

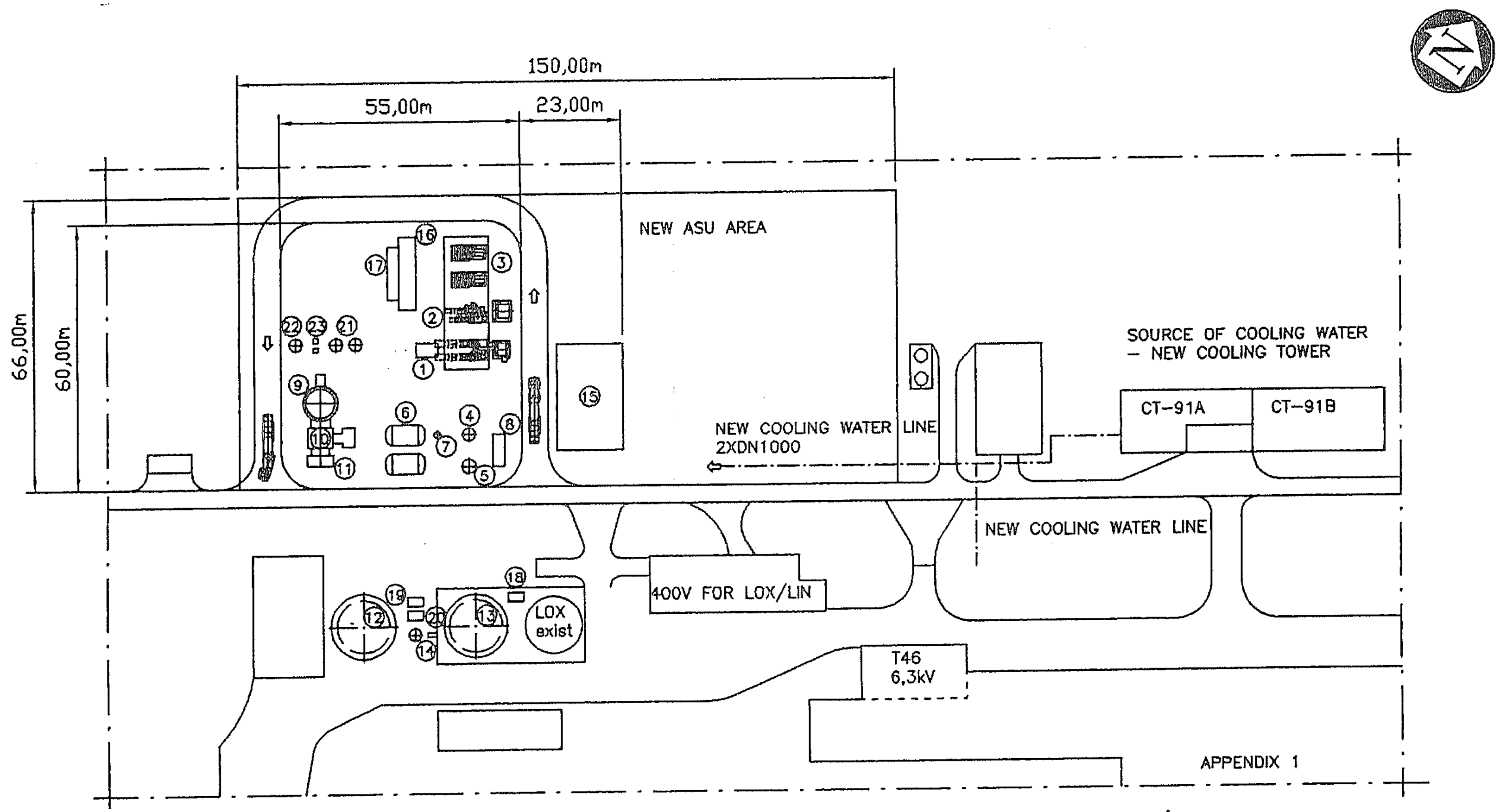
Back-up System

During shutdown or shortage of production of the air separation unit(s) the customer is provided with gaseous oxygen and gaseous nitrogen product from the back-up system.

Liquid oxygen is withdrawn from low pressure storage tanks, brought to the required pressures by cryogenic pumps, vaporized and heated to ambient temperature. The gas is fed into the product pipeline to the customer.

Liquid nitrogen is withdrawn from a low pressure storage tank, pumped to the required pressure and fed to a high pressure storage tank. Liquid from the high pressure storage tank is vaporized and heated to ambient temperature. The gas is fed to the product pipelines.

Liquid argon withdrawn from the low pressure storage tank is pumped to the required product pressure and fed to a high pressure tank. Liquid from the high pressure tank is vaporized and heated to ambient temperature. The gas is fed to the product pipeline.



Legend:

- ① – MAC Compressor with Inlet Filter
- ② – BAC Compressor
- ③ – GAN Compressors
- ④ – DCAC
- ⑤ – Chill Tower
- ⑥ – Molsieve
- ⑦ – Regeneration Gas Heater
- ⑧ – Chiller
- ⑨ – Cold–Box
- ⑩ – Main Heat Exhanger with LOX/LIN Process Pumps
- ⑪ – Expansion Turbine
- ⑫ – LP–LOX Storage Tank
- ⑬ – LP–LIN Storage Tank
- ⑭ – HP–LIN Storage Tank with Pump
- ⑮ – Electrical Room
- ⑯ – Instrument/Control Room
- ⑰ – Analytic
- ⑱ – LOX water bath vaporizer
- ⑲ – LIN water bath vaporizer (steam)
- ⑳ – LIN water bath vaporizer (nat. gas)
- ㉑ – LP–LAR Tanks
- ㉒ – HP–LAR Tank
- ㉓ – LAR ambient air vaporizer

PRELIMINARY

1 : 1000

0 10 50 100m

Rev.	Revisions	Date	Name	checked
B	d.Änd.	27.10.03	Dz/IES	Dr.Nipper
A	d.Änd.	25.07.03	Dz/IES	Dr.Nipper

MESSER Messer AGS GmbH

Date : 05.06.2003 | Name : Dziadek/IES | Checked: Grothues | History file: 792.85996.doc

Job code: K33686, ASU No.9 Kosice

Scale 1 : 1000 | Original format DIN A 3

Sheet: 001 | of 001 Sheets

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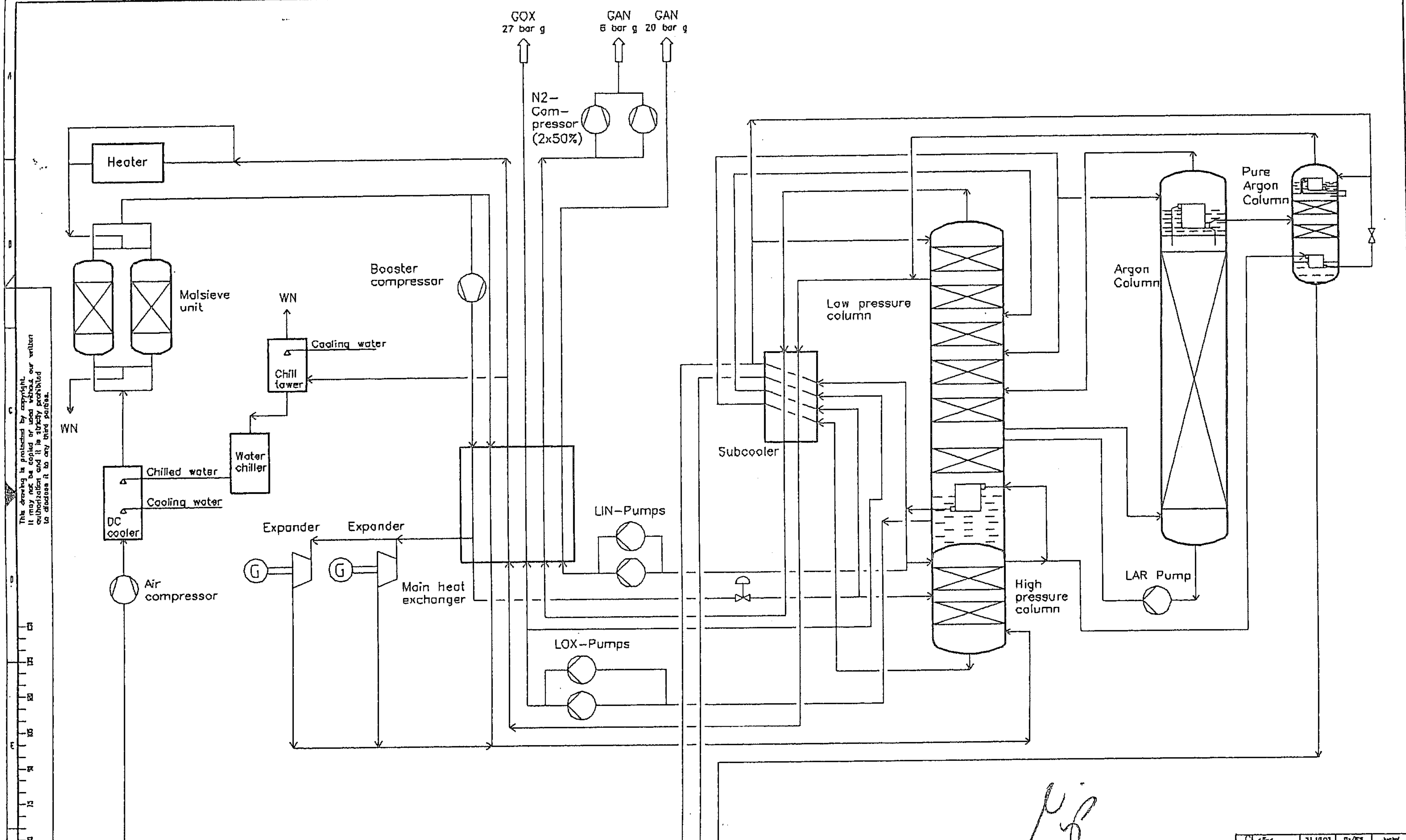
Replaced by: 79_.

Plot plan

Drawing Nr.: 792.85996 | Format D



GAN = Gaseous Nitrogen
GOX = Gaseous Oxygen
GAR = Gaseous Argon
LOX = Liquid Oxygen
LIN = Liquid Nitrogen
LAR = Liquid Argon
WN = Waste Nitrogen

Rev.	Revisions	Date	Name	checked
C	ändl.	31.10.03	Dz/IES	Jockel
B	ändl.	14.10.03	Rt/IES	Dr. Köpper

MESSER Messer MG GmbH

Date : 05.06.2003	Name : Dz/IES	Checked: Dr. Krey
Job code: K33686, ASU No.9 Kosice		History file: 792.86029001.doc
Scale —:—	Original format DIN A 2	Sheet 001 of 002 Sheets
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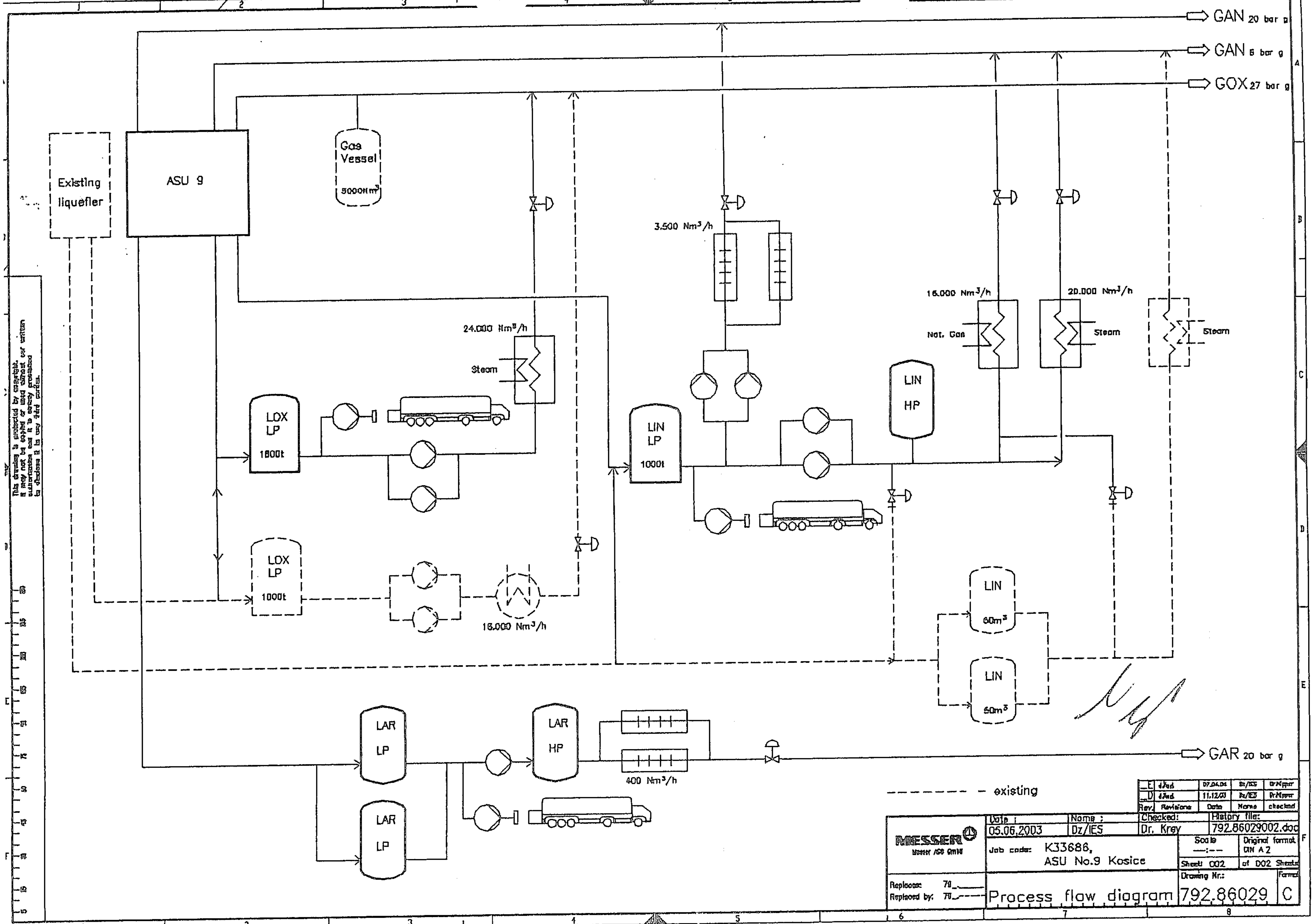
Process flow diagram — Drawing Nr.: 792.86029 — Format: C



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D	d.Ant	11.12.03	Dz/IES
Rev.	Revisions	Date	Name

Date: 05.06.2003 | Name: Dz/IES | Checked: Dr. Krey | History file: 792.86029002.doc

MESSER — Messer ... GmbH

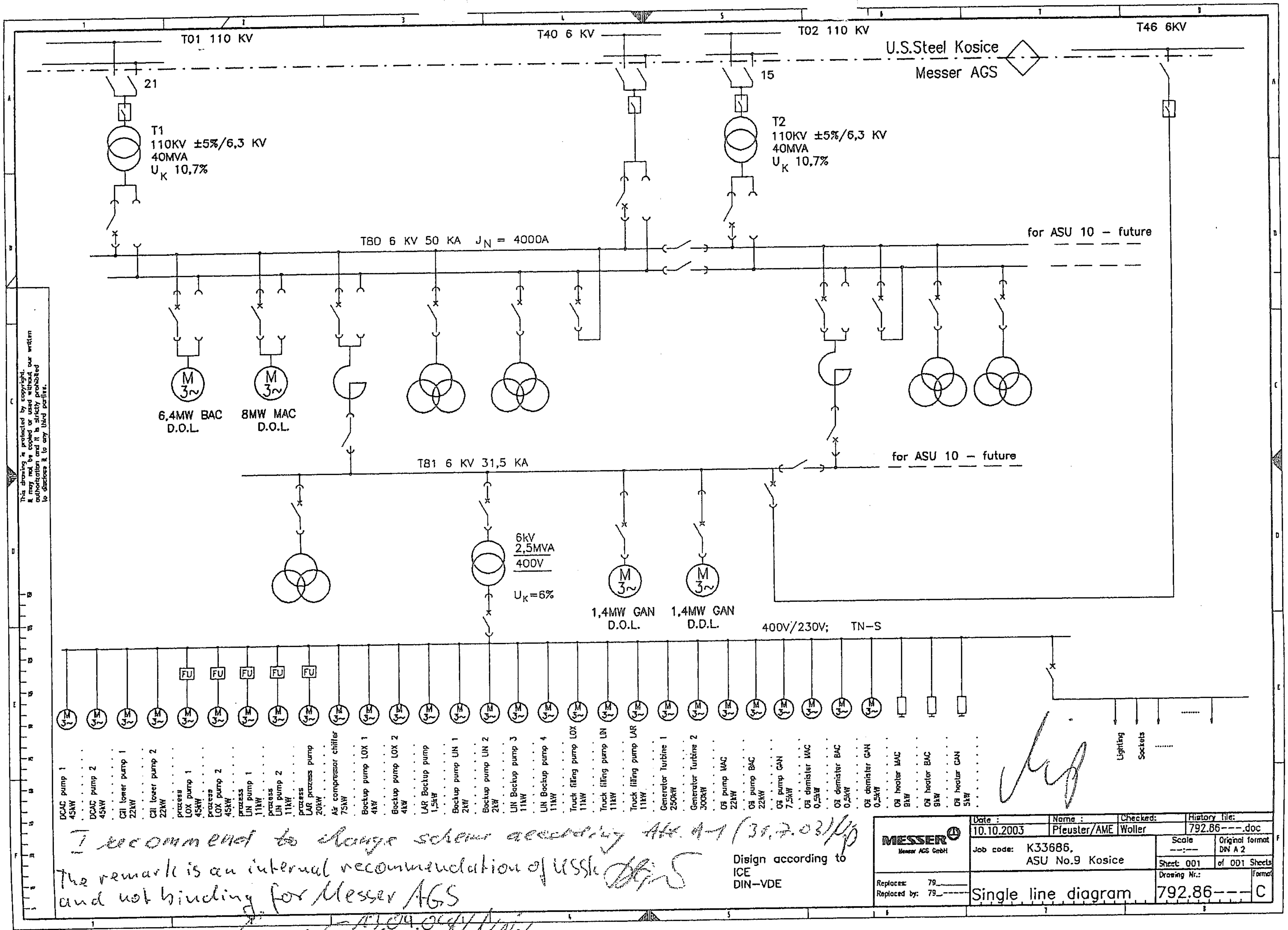
Job code: K33686, ASU No.9 Kosice

Scale: —:— | Original format: DIN A 2 | Sheet: 002 of 002 Sheets

Replaces: 79_____ Replaced by: 79_____

Process flow diagram

Drawing Nr.: 792.86029 | Format: C



I recommend to change schema according Att. 1-1 (31.7.03)

The remark is an internal recommendation of USSK and not binding for Messer AGS

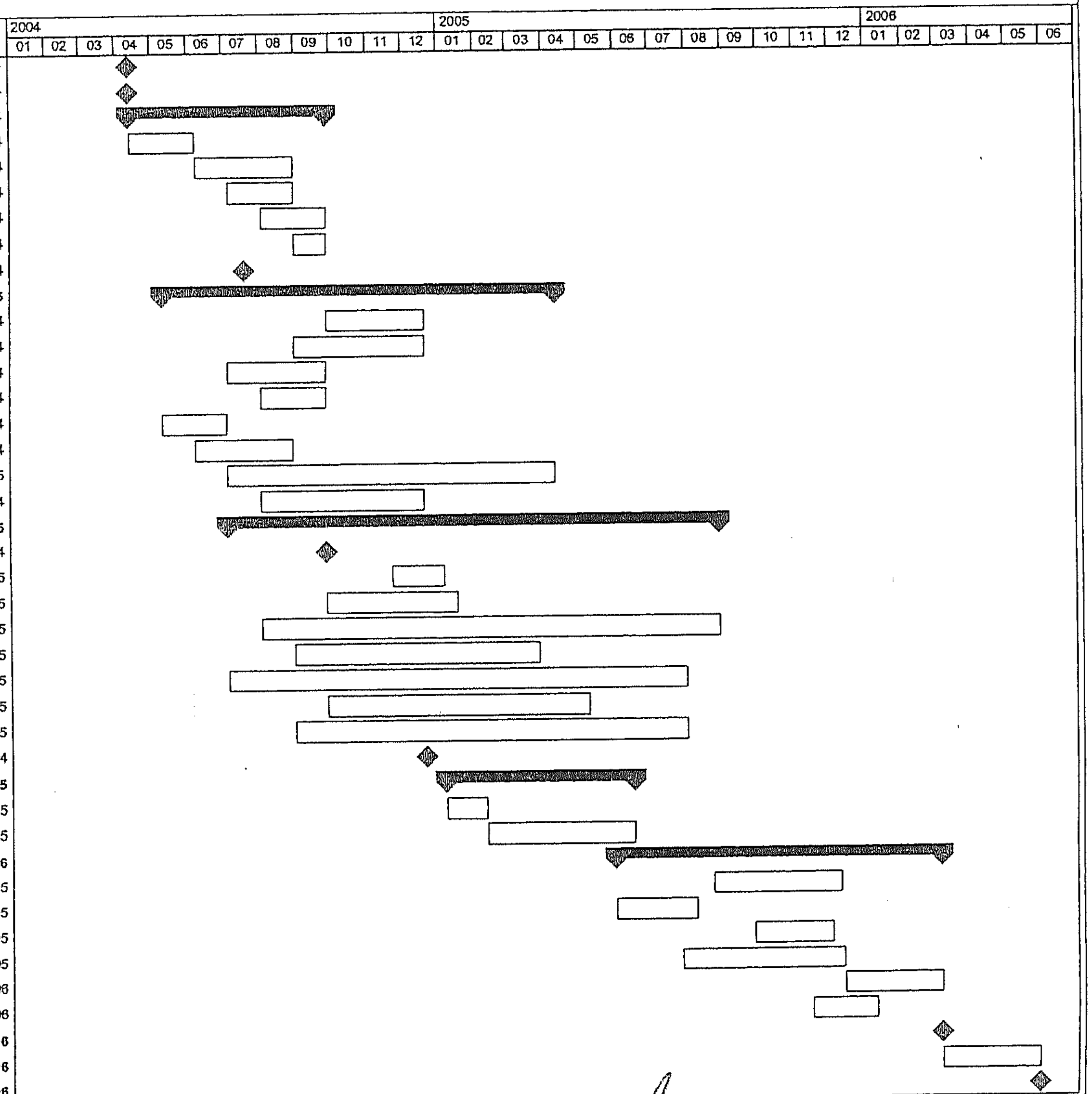
11.04.04

ASU No. 9 Kosice

MESSER

Project Master Schedule (Draft)
(Assumption: Start 13.04.2004)

Nr.		Action / Event	Duration	Start	End
1		**Effictiveness of the Contract**	0 t	Di 13.04.04	Di 13.04.04
2		**Full Project Clarification Including Authority Approvals**	0 W	Di 13.04.04	Di 13.04.04
3		**Basic Engineering**	**24 W**	**Di 13.04.04**	**Mo 27.09.04**
4		Process design	8 W	Di 13.04.04	Mo 07.06.04
5		Equipment Design	12 W	Di 08.06.04	Mo 30.08.04
6		Equipment Arrangement	8 W	Di 06.07.04	Mo 30.08.04
7		Arrangement within Buildings	8 W	Di 03.08.04	Mo 27.09.04
8		Foundation Drawings and Loads	4 W	Di 31.08.04	Mo 27.09.04
9		Documents for Building application	0 W	Mo 19.07.04	Mo 19.07.04
10		**Detail Engineering**	**48 W**	**Di 11.05.04**	**Mo 11.04.05**
11		Civils	12 W	Di 28.09.04	Mo 20.12.04
12		Piping	16 W	Di 31.08.04	Mo 20.12.04
13		Machinery	12 W	Di 06.07.04	Mo 27.09.04
14		Apparatus	8 W	Di 03.08.04	Mo 27.09.04
15		Cryotanks	8 W	Di 11.05.04	Mo 05.07.04
16		Coldboxes	12 W	Di 08.06.04	Mo 30.08.04
17		Measurement and Controls	40 W	Di 06.07.04	Mo 11.04.05
18		Electrics	20 W	Di 03.08.04	Mo 20.12.04
19		**Procurement / Delivery**	**60 W**	**Di 06.07.04**	**Mo 29.08.05**
20		General Contractor Award	0 W	Mo 27.09.04	Mo 27.09.04
21		Civils	6,6 W	Di 23.11.04	Do 06.01.05
22		Piping	16 W	Di 28.09.04	Mo 17.01.05
23		Machinery	56 W	Di 03.08.04	Mo 29.08.05
24		Apparatus	30 W	Di 31.08.04	Mo 28.03.05
25		Coldboxes	56 W	Di 06.07.04	Mo 01.08.05
26		Measurement and Controls	32 W	Di 28.09.04	Mo 09.05.05
27		Electrics	48 W	Di 31.08.04	Mo 01.08.05
28		Building permit available	0 W	Mo 20.12.04	Mo 20.12.04
29		**Civil Work**	**23 W**	**Fr 07.01.05**	**Do 16.06.05**
30		Site Clearance	5 W	Fr 07.01.05	Do 10.02.05
31		Civil Work	18 W	Fr 11.02.05	Do 16.06.05
32		**Field Construction**	**40 W**	**Di 31.05.05**	**Mo 06.03.06**
33		Coldbox	16 W	Di 23.08.05	Fr 09.12.05
34		Apparatus	10 W	Di 31.05.05	Di 09.08.05
35		Machinery	10 W	Di 27.09.05	Fr 02.12.05
36		Piping (above Ground)	20 W	Di 26.07.05	Mo 12.12.05
37		Instrumentation	12 W	Mo 12.12.05	Mo 06.03.06
38		Electrics	8 W	Mo 14.11.05	Mo 09.01.06
39		**Mechanical Completion**	**0 W**	**Mo 06.03.06**	**Mo 06.03.06**
40		**Commissioning / Start Up**	**12 W**	**Mo 06.03.06**	**Mo 29.05.06**
41		**Beginning of Commercial Operation**	**0 W**	**Mo 29.05.06**	**Mo 29.05.06**

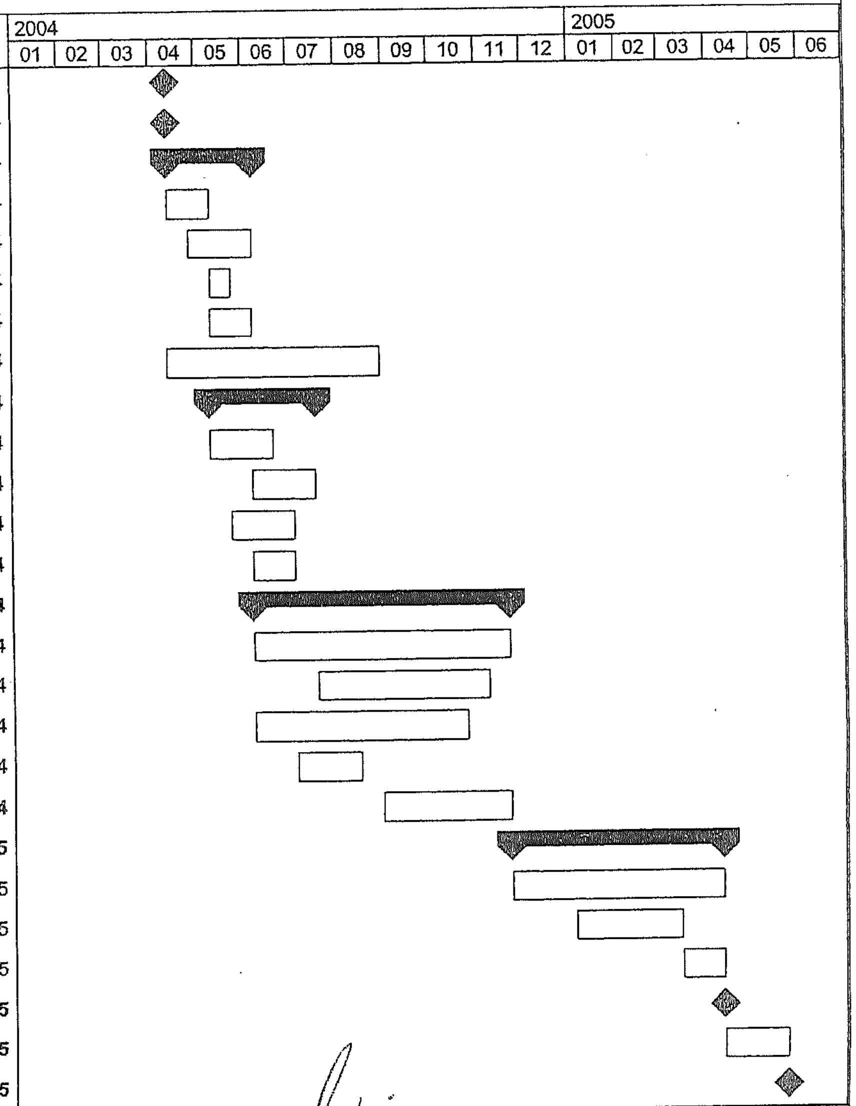


KF/NN 07.04.2004

ASU No. 9 Kosize

Tank Farm Time Schedule (Draft)
(Assumption: Start 13.04.2004)

Nr.		Action / Event	Duration	Start	End
1		**Effictiveness of the Contract**	0 t	Di 13.04.04	Di 13.04.04
2		**Full Project Clarification including Authority Approvals**	0 W	Di 13.04.04	Di 13.04.04
3		**Basic Engineering**	**8 W**	**Di 13.04.04**	**Mo 07.06.04**
4		Storage Tanks, Pumps, Vessels	4 W	Di 13.04.04	Mo 10.05.04
5		Piping	6 W	Di 27.04.04	Mo 07.06.04
6		Instrumentation	2 W	Di 11.05.04	Mo 24.05.04
7		Civils	4 W	Di 11.05.04	Mo 07.06.04
8		**Authority Approval Estimate**	20 W	Di 13.04.04	Mo 30.08.04
9		**Detail Engineering**	**10 W**	**Di 11.05.04**	**Mo 19.07.04**
10		Storage Tanks, Pumps, Vessels	6 W	Di 11.05.04	Mo 21.06.04
11		Piping	6 W	Di 08.06.04	Mo 19.07.04
12		Instrumentation	6 W	Di 25.05.04	Mo 05.07.04
13		Civils	4 W	Di 08.06.04	Mo 05.07.04
14		**Procurement**	**24 W**	**Di 08.06.04**	**Mo 22.11.04**
15		Storage Tanks, Pumps, Vessels	24 W	Di 08.06.04	Mo 22.11.04
16		Piping	16 W	Di 20.07.04	Mo 08.11.04
17		Instrumentation	20 W	Di 08.06.04	Mo 25.10.04
18		Civils	6 W	Di 06.07.04	Mo 16.08.04
19		**Civil Works**	**12 W**	**Di 31.08.04**	**Mo 22.11.04**
20		**Field Construction:**	**20 W**	**Di 23.11.04**	**Mo 11.04.05**
21		Storage Tanks, Pumps, Vessels	20 W	Di 23.11.04	Mo 11.04.05
22		Piping	10 W	Di 04.01.05	Mo 14.03.05
23		Instrumentation	4 W	Di 15.03.05	Mo 11.04.05
24		**Mechanical Completion**	**0 W**	**Mo 11.04.05**	**Mo 11.04.05**
25		**Commissioning, Start Up**	**6 W**	**Di 12.04.05**	**Mo 23.05.05**
26		**Conditional Acceptance**	**0 W**	**Mo 23.05.05**	**Mo 23.05.05**



PROJECT:

VENDORS LIST

The following list contains the preferred suppliers for Air Separation Plant Equipment as a result of MESSERS long term experience with self owned Air Separation Plants. These Suppliers are continuously monitored concerning cost, reliability and quality. MESSER reserves the right to add or remove suppliers from this list. The final selection of the suppliers for this project will be done according the project specific requirements. Customers' preferences can be taken into consideration before the contract is awarded.

A) **MECHANICAL**

Turbo Compressors

-Siemens PGI (former Mannesmann Demag DeLaval)
-MAN Turbomaschinen AG (former GHH MAN, GHH Borsig and Sulzer Turbo)
-Atlas Copco
-Cooper Joy
-Ingersoll Rand
-PGW

Piston Compressors

-Neumann&Esser
-Sulzer Burckhardt
-Köhler&Hörter
-SIAD

Screw Compressors

-Aerzener Maschinenfabrik
-Altas Copco
-Boge

Turbines

-Atlas Copco
-Cryostar
-ACD

Cryogenic Pumps

-Sefco
-Cryostar
-ACD Cryo
-Cryomec

Cooling water pumps	-KSB -Allweiler -Sulzer Pumps -Sterling SIHI
Gas coolers	-Oeltechnik -AEL -APL -Funke -Transitherm -GEA -Calorifer
Air inlet filters	-Freudenberg -Delba Camfill -R&M Gerber -AAF
Pressure Vessels	-Wolf -VAKO -Bertsch -Local turkish suppliers
Molsieve 13X / Alumina	-Uetikon -UOP -ALCOA
Internals Front-End-Vessels	
Water distributors & Demister	-Rauschert Verfahrenstechnik -2H-Kunststofftechnik
Packings / Filler material	-Rauschert Verfahrenstechnik -2H-Kunsstofftechnik
Regeneration Gas heaters	
Electrical heater	-Elmess -Schniewindt
Steam heater	-Calorifer -Oeltechnik
Natural Gas heater	-HTA Hochtemperaturtechnik

-Wessel
-K.E.U.

Cryogenic Storage Tanks
Flat bottom Tank
-BSL
-JPM
Cold Converters
-MESSER AGS
-Chart

Cryogenic vaporisers
Ambient air vaporisers
-MESSER AGS
-Cryoquip
-Krytem
Steam heated water bath vaporiser
-MESSER AGS
-Cryoquip
-Krytem

Cryogenic rectification columns and cryogenic vessels inside Coldbox
-MESSER AGS

Cryogenic Piping inside Coldbox

MESSER AGS

Cryogenic Column Internals

Trays
MESSER AGS

Packings
Sulzer Chemtech
Montz

Cryogenic heat exchangers
-Nordon
-Chart
-Linde
-Sumitomo

Warm Argon purification
-VOG
-Silica
-CDI
-PSB

Cooling water recooling system
Cooling water towers

-GEA
-Balke Dürr
-Hamon
-Axima (Sulzer)

Cooling water treatment
-Nalco
-BK Giulini
-Henkel

Side stream filters
-BWK
-Axima (Sulzer)
-Boll&Kirch
-FIOLA
-Didier Filtertechnik
-Huber

Dosing pumps
-Prominent
-Fildos
-Ondeo (Nalco)

Piping

Pipingmaterial CS
-Local turkish supplier
-Böhling
-Babcock
-Essener Hochdruck Rohrleitungsbau (EHR)

Pipingmaterial SS
-Local turkish supplier
-Böhling
-Babcock
-Essener Hochdruck Rohrleitungsbau (EHR)

Vacuumpipes
-DeMaCo.
-MESSER Cryotherm GmbH
-Schwanner GmbH

Valves
-Herose
-Samson
-Bestobell
-Krombach
-Phönix
-Schneider
-Stöhr
-Ritag
-Gestra
-Siekmann

Safety relieve valves
-Leser
-Bopp&Reuther
-Sempel
-MESSER Griesheim GmbH

Compensators
- -IWK
- -Hydra
- -Roth
- -Stenflex

Isolation: (therm. & noise)
- -Grünzweig und Hartmann (G + H)
- -Kaefer Isoliertechnik
- -IFU

special pipe supports
- -Bernecker
- -LISEGA
- -Stauff

B) ELECTRICAL

Cable
- -ABB
- -Pirelli
- -Nexans

Luminaire
- -Siemens
- -Philips
- -Schuch

Switchgears
- -Siemens
- -ABB
- -AEG
- -Alstom

MCC
- -Siemens
- -ABB
- -AEG
- -Moeller

Power Transformers
- -Siemens
- -ABB
- -AEG
- -Alstom
- -SGB

MV Motors
- -Siemens

-ABB
-AEG
-Elin
-Schorch

LV Motors

-Siemens
-ABB
-Loher
-Schorch

UPS

-Remivak
-AEG
-Alstom
-Liebert

C) INSTRUMENTS & CONTROL

Process Control System

-ABB
-Siemens
-Yokogawa
-Rosemount

Printer

-Hewlett Packard

Analyser

-Siemens
-ABB
-Servomex
-Rosemount
-Control Analytic

Orifice plate cold box

-Himpe
-ABB

orifice plate warm

-Himpe
-ABB

Floating cone flowmeter

-Krohne
-Fisher & Porter

Mass flowmeter	-Rosemount -Endress& Hauser -ABB
Pressure transmitter	-Siemens -ABB -Rosemount -Endress & Hauser
Differential pressure transmitter	-Siemens -ABB -Rosemount -Endress & Hauser
Level Transmitter	-Endress & Hauser -Saab
Pressure switch	-Honeywell Fema -Pinter
Manometer (with signal contact)	-Wika Armaturenbau -VDO
Local thermometer	-Rüeger -Wika
Temperature elements Pt100	-Steffen Meßtechnik -ABB Sensycon -Rosemount -Wika
Temperature elements Cold box	-ABB Sensycon
Temperature transmitter Exi	-ABB Sensycon -Rosemount -Wika

Temperature transmitter	-ABB Senscyon -Rosemount -Wika
Control valves	-Arca -Samson -Kämmer
Butterly valves	-Samson -Linde Mapag -Xomox -Kühme
Solenoid valves	-Herion -Samson -Seitz
Limit value monitor	-ABB -Siemens
Isolating amplifier	-ABB -Knick -Pepperl & Fuchs -Phönix
Switch amplifier unit	-ABB -Pepperl&Fuchs
Electrical indicator	-ABB -Knick -Pepperl&Fuchs
Electrical controller	-ABB -Siemens
3-way valve block	

	-Schneider
Double gate valve	-Schneider
Instrument air terminal	-PSG
Filter pressure controller	-Fairchild / Binder Engineering -MESSER -SMC
Pressure reducer	-MESSER

MESSER

Advanced Gas Systems GmbH

Referencelist

Air Separation Plants, designed and operated by Messer
Start-up 1994 -

On Stream		Plant Type		Capacity Oxygen t/d	Nitrogen t/d	Argon t/d	Liquid t/d
1994	USA	ASU	A88	80			180
	USA	ASU	A88	80			
	USA	ASU	A88	80			
1995	USA	ASU	A750	680	1580	30	
	USA	ASU	A165	150	400	7	
	Germany	N_2-Generator	N18		15		
	USA	ASU,Liquifier	A750/L200	680	1580	30	270
	USA	N_2-Generator	N40		40		
	USA	N_2-Generator	N60		60		
	Germany	N_2-Generator	N30		30		
1996	USA	ASU,Liquifier	A750/L300	680	1580	30	360
	USA	ASU	A350	320	790	15	
	UK	N_2-Generator	N18		18		
	RSA	ASU,Liquefier	A50/L60	50	70	3	60
	USA	N_2-Generator	N80		80		
	Germany	N_2-Generator	N18		18		
	Germany	N_2-Generator	N18		15		
	Finland	ASU,Liquifier	A70/L70	70	120	3	70
	Germany	N_2-Generator	N50		45		
	Germany	ASU	A270	270			

Nip

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Air Separation Plants, designed and operated by Messer
Start-up 1994 -

On Stream		Plant Type		Capacity Oxygen t/d	Capacity Nitrogen t/d	Capacity Argon t/d	Liquid t/d
1996	USA	N_2-Generator	N40		40		
	USA	N_2-Generator	N80		80		
	UK	N_2-Generator	N18		18		
1997	USA	ASU	A750	680	1580	30	
	Germany	N_2-Generator	N18		18		
	China	ASU	A70	70			
	USA	N_2-Generator	N40		40		
	USA	N_2-Generator	N80		80		
	USA	ASU	A350	320	790	15	
1998	Malaysia	ASU,Liquefier	A900/L200	800	2000	35	200
	Hungary	N_2-Generator	N100		105		
	USA	ASU,Liquefier	A165/L250	150	400	7	200
	USA	N_2-Generator	N80		80		
	France	N_2-Generator	N18		12		
	China	ASU	A165/L23	150	400	7	20
	China	ASU,Liquefier	A50/L60	50	70	3	60
	Switzerland	N_2-Generator	N18 UHP		18		
	USA	ASU	A185	165	400	7	
	Germany	ASU	A1700	1700	2000	75	
	Germany	N_2-Generator	N100		80		
	USA	N_2-Generator	N500		470		

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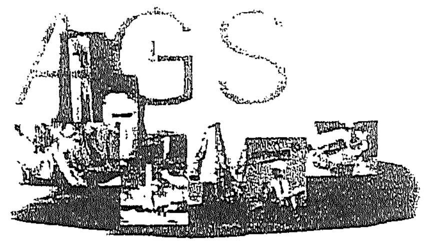
Air Separation Plants, designed and operated by Messer
Start-up 1994 -

On Stream		Plant Type		Capacity Oxygen t/d	Nitrogen t/d	Argon t/d	Liquid t/d
1998	USA	N_2-Generator	N80		80		
	Norway	ASU,Liquefier	A70/L70	70	7	3	70
	USA	N_2-Generator	N200		200		
	Germany	ASU	A190	190			
	Germany	N_2-Generator	N18		15		
	Germany	N_2-Generator	N50		45		
	Greece	N_2-Generator	N18		15		
1999	USA	ASU,Liquefier	A165/L200	150	400	7	200
	Mexico	ASU,Liquefier	A375/L250	340	790	15	250
	USA	ASU,Liquefier	A800/L200	720	1580	30	200
	India	ASU,Liquefier	A130/L100	130	60	5	100
	Taiwan	ASU,Liquefier	A240/L100	240	500	11	100
	Germany	N_2-Generator	N35		36		
	Sweden	ASU,Liquefier	A70/L140	70	66	3	140
	Germany	N_2-Generator	N35		36		
	USA	ASU	A350	340	790	15	
	Trinidad	ASU,Liquefier	A1450/L60	1400	1800		60
	Brazil	ASU,Liquefier	A165/L250	150	400	7	100
	Algeria	N_2-Generator	2 x N100		200		
	Hungary	N_2-Generator	3 x N100		300		
	Croatia	ASU,Liquefier	A140/L230	140	85	5	230

Air Separation Plants, designed and operated by Messer
Start-up 1994 -



On Stream		Plant Type		Capacity Oxygen t/d	Nitrogen t/d	Argon t/d	Liquid t/d
1999	Austria	N_2-Generator	N18		15		
	USA	N_2-Generator	N18		15		
2000	USA	N_2-Generator	N40		40		
	Austria	N_2-Generator	N18		15		
	Singapore	ASU,Liquefier	A1000/ L200	1000	2300	45	200
	USA	ASU,Liquefier	A165/ L200	150	400	7	200
	Germany	Kr/Xe concentr.					
	Germany	N_2-Generator	N9		8		
	Germany	N_2-Generator	N9		8		
	Germany	N_2-Generator	N18		15		
	Germany	N_2-Generator	N35		30		
	Germany	N_2-Generator	N18		15		
	Germany	ASU	A 1700	1700	2000	75	
2001	Germany	ASU	A 1700	1700	2000	75	
	Egypt	ASU	A300/ L60	300	75	12	60
	Austria	N_2-Generator	N 35		35		
	Germany	N_2-Generator	N 18		15		
2003	USA	ASU	A720	720	600	34	
	Germany	N_2-Generator	N18		18		

MESSER

MESSER
AGS GmbH

Fö \ Krefeld, June 5th. 2003

ATTACHMENT 9: MESSER SAFETY INFORMATION

Number of lost workday cases:	1999:	1
	2000:	2
	2001:	2
Total hours worked:	1999:	452761
	2000:	424880
	2001:	433859
OSHA Incident Rates for lost workday cases:	1999:	0,44
	2000:	0,94
	2001:	0,93

Attachment 10

U.S. Steel Košice s.r.o.
Vstupný areál U.S.Steel
044 54 Košice
Slovenská republika

Odpoveď na otázky [illegible] zo dňa 20.8.2003

Súčasťou dodávky elektročasti ASU9 má byť:

- vyzbrojenie 110 kV polí na T01a na T02
- 110 kV káble T01÷T1/T80 a T02÷T2/T80
- 2 transformátory T1 a T2 s prevodom 110±5% /6.3kV (prepínanie odbočiek bez záťaže), Ynd1, Sn=40 MVA, u_k=10,7%
- 6 kV kobková rozvodňa T80 In=4000 A, 50/125 kA
- vyzbrojenie kobky č.12 na rozvodni T40 na In=4000 A
- kábel T40÷T80, In=4000 A
- 6 kV skriňová rozvodňa T81 In=2500 A (3150 A)* , 31.5/80 kA
- 2 kábely T80÷T81, In=2500 A (3150 A)*
- vyzbrojenie skrine č. 44 na rozvodni T45 na In=2500 A (3150 A)*
- kábel T45÷T81, In=2500 A (3150 A)*
- všetky káble potrebné pre napájanie motorov a transformátorov 6/0,4 kV z rozvodne T80 ako aj z T81

* - podľa potreby dodávateľa

Všetky 6 kV motory s výkonom nad 5 MVA musia byť napájané z T80. Rozbeh 6 kV a 400 V motorov musí byť riešené tak, aby napätie prípojniciach rozvodní neklesio pod min. hodnoty (uvedené nižšie) počas celej doby rozbehu.

Tolerancie napätí na prípojniciach:

Un	min	max
110 kV	-5%	+10%
6 kV	-5% a)	+10%
400/230 V	-5% b)	+10%

a) pri rozbehu najväčšieho motora napätie na prípojniciach nesmie klesnúť pod 85% Un — Motor standing
b) pri rozbehu najväčšieho motora napätie na prípojniciach nesmie klesnúť pod 90% Un

Tolerancia frekvencie: 50±0,2 Hz

Skratové parametre rozvodu USSK

S_{kz}		min	max
	T01, T02 (110 kV)	8,45 kA / 1529 MVA	16,28 kA / 3411 MVA
	T80 (6 kV)	29,44 kA / 290 MVA	32,73 kA / 374 MVA

Úroveň vyšších harmonických 110 kV siete

v	U[V]	U[%] v1	v	U[V]	U[%] v1	v	U[V]	U[%] v1	v	U[V]	U[%] v1
1	6324	100,00	11	123.6	1.95	21	1,8	0.03	31	1,8	0,03
2	0,6	0,01	12	8,4	0,13	22	7,8	0,12	32	1,2	0,02
3	6,6	0,10	13	79,8	1,26	23	93	1,47	33	3	0,05
4	1,8	0.03	14	4,8	0,08	24	12	0,19	34	1,2	0,02
5	15,6	0,25	15	4,8	0,08	25	30	0,47	35	9	0,14
6	1.2	0,02	16	2,4	0.04	26	4,8	0,08	36	1,8	0,03
7	21	0,33	17	10.8	0,17	27	1,2	0,02	37	7,8	0,12
8	0,6	0,01	18	1,2	0,02	28	0,6	0,01	38	0,6	0,01
9	7,8	0,12	19	20,4	0,32	29	2,4	0,04	39	3	0,05
10	3,6	0,06	20	7,8	0,12	30	0,006	0.00	40	0,6	0,01

Celková harmonické skreslenie (THD): 2,112

Poklesy napätí – spracované na základe údajov z rokov 2000÷2003:

U1 (kV)	U2 (kV)	T (ms)
67,85	20,6	90
68,86	18,87	200
67,59	9,5	100
69,1	7,7	320
67	52,76	220
68,24	43	640
67,21	22,57	200
67,43	36,3	200
68,4	21,2	90
68,43	20,76	380
68	10	300
68	32	200

Požadovaný účinník celkového odberu ASU 9: cosφ= 0,94

Vypracoval: Ing. Pataki

V Košiciach 28. 8. 2003

English Attachment M

GEOKONZULT, a.s., KOŠICE

ENGINEERING GEOLOGY, HYDROGEOLOGY, ECOLOGY, SPECIAL BUILDING WORKS

miesto:
- tabuľky v origináli text
- mapy situácie
- grafy
- prílohy - tabuľky laboratórne

v texte je to označené ako „chart"

FINAL REPORT

ANGLICKÝ PREKLAD ČASTI SPRÁVY

Title of the task	: Košice – USS – oxygen apparatus no. 9
Number	: 2001-317
Procurement	: US STEEL s.r.o. Košice
Task solved by	: Mgr. J. Ondrejka – engineering geology : Ing. A. Höger – geotechnics : Ing. V. Pramuk – chemistry of the soil types : Ing. A. Szabová – chemistry of water
Date	: December, 2001

Ing. Vadimír Fabian

Business – geology deputy director

Ing. Ján Koščo

Director of the Corporation

CONTENT:

1.0 INTRODUCTION

In accordance with order No. AG21Z210259 of 27 November, 2001 the company U.S. Steel, s.r.o., Košice ordered engineering-geological and hydro-geological research for "US Steel, s.r.o., Košice objects – oxygen apparatus No. 9".

Scope and specification of the geological-survey works have been worked out in project of geological-research works, that US Steel, s.r.o., Košice has accepted in full amount. Economical relations have been concluded by signing the contract on the work No. 2001-317.

2.0 PURPOSE OF THE GEOLOGICAL WORKS

The purpose of the geological-research works rested in:

- finding out geological relations of the concerned territory
- finding out physical and descriptive characteristic of the soil
- finding out the ground water level
- assessment of the ground water from the aspect of its aggressiveness on concrete and iron
- assessment of the foundation conditions
- definition of the classes of workability
- finding out the current state of the pollution of the mineral environment of the aeration zone and ground water in the concerned area

3.0 USED DOCUMENTS

- Elaborated price offer of 13 November, 2001
- Situation on the territory in ratio M 1:1000 and 1: 3000
- Kaličiak Michal et al. (1996): Regional Geology Maps of Slovakia, ratio M= 1:50 000; Geologická mapa Slanských vrchov a Košickej kotliny (Geology Map of Slanec Hills and Košice-basin) – the southern part with appropriate commentaries : GÚDŠ Bratislava – Land survey Institute.

4.0 NATURAL CONDITIONS OF THE LARGER SURROUNDING AREA

4.1 Geo-morphological relations

According to the geographic relief of Slovakia (Mazúr, Lukniš) the concerned territory belongs to the Lučenec-Košice lowland region and to the complex of the Košice-basin, division of Medzev hills.

The surface of the territory is plain with relatively small height differences. It is significantly marked by building and industrial activities – adaptation of the terrain near premises and building up a scrap yard.

4.2 Geological relations

The concerned territory consists of Neogene and Quarter sediments.

Neogene - made up of clay and silts with components of gravel sand of so called Sečov strata. From place to place there are components of tuffs and tuffits.

Quarter – is represented by sediments of fluvial cone created by stream Ida. Quarter sediments are represented by fine-grained soil, 1-2 m thick on the surface (or anthropogenic sediments - made up grounds). Under sluiced soils there are gravel components from fluvial cone. The thickness of the proluvial sediments in the concerned territory exceeds 9 m.

4.3. Hydro-geological relations

Hydro-geological relations of the territory are conditioned by the geological structure, the flow of ground waters is affected by building up VSŽ – steel works. The ground waters are supported by infiltration of atmospheric water or by transfers from higher situated locations. The water collector represents a complex of fluvial and proluvial gravel sand with variable content of fine-grained fraction. The ground water level is mildly under pressure in the concerned area.

5.0 METHODOLOGY AND SCOPE OF RESEARCH WORKS

For achievement of the target of the geological works the following activities have been carried out:

- Boreholes – 5 boring, three of them have been supplied as surveying probes with filtration part, made from PVC.
- Sample-collecting works – taking samples from soil and ground water
- Dynamic penetration probes
- Laboratory works – physical-descriptive characteristics of the soil, physical-chemical characteristics of the ground water, analysis of the extractions of soil samples
- Measuring works

While stating the places of carrying out the surveying probes, we took into consideration the planned location of the buildings and the preconditions of the most vulnerable locations from the aspect of the possible pollution. The scope of the sample taking and laboratory works has been defined regarding the information on quantitative and qualitative parameters of the potential contaminants in mineral environment of the aeration zone and in ground water.

Geological works have been carried out by company Geokonzult, a.s. Košice, by its own employees, measuring works and hydro-chemical analyses of water and soil extractions have been ensured through sub-contracting.

Research works – bore holes and penetration probes have been carried out at presence of Ing. Vertala. The situation of researched objects is included in Annex No. 2.

5.1 Boring and sample collecting works

In order to find out the geological and hydro-geological conditions of the territory, 5 core samples: V-1 – V-5 have been made. All of them have been bored in depth up to 10 m. The whole amount made 50 bm. The bore works have been carried out by the staff of drilling foreman, Mr. Andrejčák by machine drilling rig UGB-50M in November, 2001. During the boring documentation, samples of soil had been taken which were discarded after geological documentation. The written documentation on boring works is included in Annex No. 3.

From the boreholes soil samples have been taken that have been processed in laboratory on mechanics of soil. All together 12 disturbed samples of gravel and 4 disturbed samples of fine-grained soil with saved humidity have been taken into paper bags. The data on depth under surface, the samples have been taken from, and their numbers are put down in engineering-geological sections – Annex 6/1-6/2.

From boreholes V-1, V-2, V-4 and V-5 samples have been taken in order to define the content of potential contaminants, found in the mineral environment of the aeration zone as a result of the anthropogenic activity. Following from lithological attributes of the minerals, their relatively unfavorable structure from the aspect of transfer and migration of the pollution from the concerned surface, we have taken samples especially from the levels, situated immediately under surface (from relatively pervious sub-surface zone sediments, resulted by human activities). – 0,5 m u.t. (= under terrain) and 1,0 m u.t.; subsequently samples have been taken from 1,5 m u.t., 2,0 m u.t. 2,5 m u.t. and 3,0 m u.t. Because of presence of organic smell in bore hole V-1, we removed soil sample from stratum 3,5 m u.t. The different depths and numbers of samples are depicted in engineering–geologic profiles in Annex 6/1 and 6/2.

Soil samples, designated for definition of the content of the possible contaminating materials, had been put to paper bags, which were immediately after delivered to the chemical laboratory in labeled and imperviously closed packages.

On the basis of the works, directed to taking samples and the subsequent laboratory–tests, while respecting the available date on the location, we orientated our activities mainly to find out information on the most supposed present contaminant i.e. hydrocarbons. Besides this, considering the type of activities in the concerned location (scrap yard) and the previously known results, we have taken samples of soils for stating the trace-metal level in the terrain – TOX, BTX, PAU, PCB.

Altogether 20 samples have been taken from the boreholes, i.e. 5 samples from each of them.

Ground water samples for assessment have been taken directly to sample containers. We have taken samples of water from bore holes V-3 and V-5 for basic physical-chemical analysis and for stating the presence of NEL, PAU, phenols, cyanides, tenzides and certain trace metals; from bore holes V-1 and V-3 we have taken samples of water in order to assess the ground waters from aspect of their aggressiveness on concrete and iron.

The results of the laboratory analyses of the samples of ground water and soil are shown in Annex No. 7.

5.2 Penetration tests

In order to find out the geo-technical characteristics of the Quarter soil in-situ, on the concerned territory we performed 5 dynamic penetration probes, marked DP-1 – DP-5. The depth of the dynamic penetration probes was between 3,20 – 5,80 m, their whole volume was 19,80 bm.

The penetration probes serve to find out some characteristics in-situ. The test is founded on the ability of the soils to resist to tip of the instrument (by driving in piles of 50 kg, falling from height 50 cm).

Dynamic penetration probes have been carried out by heavy dynamic penetration test device, made by firm BORROS. By dynamic penetration probe the number of strikes, needed to drive the pile-tip into standard depth 20cm (value N_{20}), is recorded. This value is corrected by friction of the earth with the testing rods. The corrected value N_{20} is re-calculated under empirical formulae to measured dynamic resistance q_{dyn} (MPa). The values of measured dynamic resistance q_{dyn} are initial date for stating some attributes according to verified correlation.

Dynamic penetration probes have been carried out by the group, specialized for terrain tests from Geokonzult a.s. Košice in November 2001. The results of these dynamic penetration probes are shown in Annex No. 4.

5.3. Laboratory works

Taken samples of soil have been processed in laboratory of mechanics of soils within Geokonzult a.s., Košice. From the total number of 16 samples after macroscopic assessment all 16 have been designed for laboratory evaluation. The selected samples have been tested in regard of their grain structure, plasticity and humidity.

The results of laboratory tests of the soil, the number of different tests and their brief methodology is shown in Annex 5.

The water samples and extractions of the soil have been analysed in hydro-chemical laboratory EKOLAB, s.r.o., Košice, the results of the hydro-chemical analyses with evaluation are included into Annex 7. The analytical works have been performed in accordance with the valid standards and methodology.

5.4. Measurements

After finishing surveys in terrain (boring holes, penetration probes) the borcholes were surveyed from the aspect of planimetry and altitude by surveyor group from US STEEL, s.r.o. Košice, division - Implementation of projects Košice, lead by Ing. Bartka.

Planimetric co-ordinates are shown in local co-ordinate system - U.S. STEEL Košice, altitude co-ordinates are shown in system Jadran. The location of the boreholes is descripted in Annex No. 2.

In the following chart it is shown the list of the co-ordinates and heights of surveying probes:

(chart)

6.0 RESULTS OF THE RESEARCH WORKS

6.1 Engineering-geological relations

The surveyed territory's surface is plain. In the past the surface was affected from building works.

Engineering geological-relations of the territory were observed by boreholes V-1 – V-5 and penetration probes DP-1 – DP-5. On the base of these probes were later constructed the engineering-geological sections I-I in M=1:500/100 and II – II′ in M= 1:200/100 (Annex 6/1 – 6/2) On the basis of these sections have been assigned the following characteristic strata in the surveyed territory:

1. **Made up Ground**

The most upper situated position on the surveyed territory consists of made up ground with cross cut and backward fillings near the foundation of objects and along the underground mains installation. The made up ground consists of mainly form fine-grained soil of rich grained structure and plasticity with variable content of rough fraction – gravel boulders and fragments of building work waste with switches into gravel soils. The average size of the made up ground is between 1,00-2,00 m, in some places they are absent. We studied the maximal size of the made up ground in the place of dynamic penetration probe DP-3, the verified size of the made up ground is 3,6 m. It has been a backward filling, made by building the sewerage system.

In accordance with STN 73 1001 (standard system) it is a special soil – tipped earth material, marked by symbol GCY, CGY, SPY and GPY. Taking into consideration the little depth of the made up ground we are not going to analyse it in details.

To give complex information we are giving the limit values of the geo-technical attributes of the made up grounds with fine-grained soil and gravel, studied by penetration tests:

(chart)

2 Fine grained fluvial sediments

It is a discontinuous stratum with limited territorial extent. In the most of the territory they are absent, have been found within bore holes V-1 and V-3 in depth 1,30-1,80 and 0,30 – 1,00 m u.t.

From macroscopic aspect the fluvial sediments have been evaluated as clays of different plasticity and variably grainy structure. They are of grey and brown colour having stiff, stiff-solid and solid consistency. On the basis of the laboratory test results and analyses we can characterize them with the following values of humidity, plasticity and consistency: W_n=22,0%, W_L = 38,5% W_P = 19,2%, I_C= 38,5%.

In accordance with STN 73 1001 we can classify these soils into group F – fine–grained soil types, class F6 – clay with medium and low plasticity. Regarding their limited impact in depth and the area, we are not going to discuss them in details.

3 Gravels from the fluvial cone

They have been found under fluvial sediments and under the made up ground in depth under 1,0 – 2,0 m u.t. We did not check the whole size of the gravels with borings into 10,00 m depth. The amount of the gravel we have checked has been stated between 8,0-9,6 m. We suppose that their thickness is more than 10-12 m.

From macroscopic aspect they have been evaluated as grey and brownish grey gravels, containing fine-rained soil. The size of the boulders makes 5-7 cm, some of them have 10-15 cm. The boulders are medium shaped. The lower part of the gravels under 5,50 –7,00 m u.t. we evaluated as gravelly clays.

According to the results of the granularity analysis the gravel stratum consists of gravels with fine grained soil as additional agents – symbol G-F, class G3, lower strata gravelly clays – symbol GC, class G5.

From place to place in the gravel we have found strata of fine-grained soils of variable granularity and plasticity (Boring V-2 3,00 – 3,20 m u.t.; V-3 7,50-7,80 m u.t.; V-5 5,30-5,60 m u.t.). On the basis of the laboratory examinations and analyses we characterise them with the following limit values of humidity and plasticity and consistency: Wn=12,0-22,2%, W_L = 25,5 -33,0% W_P = 16,3 – 21,3%, I_C = 0,90 – 1,49%. The thickness of the fine-grained soil strata is between 0,20 – 0,30 m. According to the results of the granularity analysis there are sand-clays and gravelly clays.

On the basis of laboratory test results and analyses wc can classify fine–grained soil strata in gravel in accordance with STN 73 1001 into group F – fine grained soils class F4 and F2 – (sand clays and gravel clay).

In accordance with STN 73 1001 – soils representing proluvial gravel belong to group G3 – (gravel with fine-grained soil as additional agents-GC) and class G5 (clayey gravel – G-F).

We did not check the entire thickness of the gravels with penetration probes taking into consideration their settlement and capacity of the penetration device. **Their most upper situated loamy and medium compact position** we checked with the following probes in the shown depth: probe DP – 1 in 0,80-2,2 m u.t. deep; probe DP – 4 in 2,20-3,0 m u.t. deep and probe DP – 5 in 0,60-2,0 m u.t.

On the basis of the penetration probe results we can characterise this position of gravel through the following limit values derived from geo-technical characteristics:

(chart)

The position of compact gravels we investigated in depth 0,80-2,20 m u.t., within probe DP-3 under made up ground under 3,6 m u.t. – we checked them only up to 1,2-2,4 m under the surface. On the basis of the penetration test results we can characterise the compact gravel positions as following:

(chart)

For the purpose of geo-technical calculations in case of **compact gravel of class G3 and G5** we recommend to consider under STN 73 1001 (Foundation ground under surface foundations) the following attributes

(chart)

The positions of fine-grained soil we can characterise through the following standard values under STN 73 1001.

(chart)

6.2. Hydro-geological relations

In the time of carrying out the survey (November 2001) the ground water level was struck by all borings in depth 6,0 – 6,7 m u.t., after the strikes the water level raised by 0,60 – 0,70 m up to level 5,20 – 6,00 m u.t.

The ground water is bound to positions of gravel and its level varies depending on atmospheric precipitation. We consider the ground water level average. At the time of higher precipitation it is necessary to take into account the raise of ground water level by another 1,5 – 2 m.

On the basis of the hydro-chemical analyses the water is about medium mineralised. Under S. Gazda´s classification the ground water, coming from bore hole V-3 belongs to basic type Ca-So_4 and water from bore hole V-5 disposes with mixed chemism with prevailing S2(SO_4) component.

Through surface foundation laying the foundation structures would not contact the ground water level. Through deep foundation, built on piles, it is necessary to calculate with the raised aggressiveness in relation to iron materials, however the ground water is not aggressive to concrete materials. The detailed description of chemism with the analysis lists is included into Annex 7.

6.3 Relations of the foundation

According to the engineering-geological survey we can state that the geological structure of the observed territory is relatively simple. On the surface there is a layer of made up ground and cross cut, reaching to depth 1,00-2,00 m u.t., in some places up to 3,80 m u.t. Under the made up ground on some places there is a layer of fluvial fine grained sediments of size 0,50 – 0,70 m.

In the subsoil of the made up ground and the fine-grained fluvial sediments there is a layer of proluvial gravel – gravel with additional fine grained soil and clayey gravel with positions of clay up to 0,10 – 0,20 m. We checked the gravel component as deep as 10,00 m u.t.

Ground water has been found in all bore holes in depth 6,0-6,7 m u.t. After striking, its level has raised by amount of 0,60-0,70 m as high as 5,20-6,00 m u.t. Ground water is bound to positions of gravel and its level depends on the precipitation.

Under standard STN 73 1215 "Classification of aggressive environment" – we can evaluate the water as non-aggressive on concrete materials. Under standard STN 03 8375 "Protection of metal pipes, put down to ground or water" the water can be evaluated as having raised aggressiveness in relation to iron materials.

Carrying capacity

By surface foundation laying we recommend to avoid foundation, made on non-homogeneous made up ground and we would prefer **settled gravel – soil of class G3,** with depth of laying down D=1,0 m u.t.. for different foundation width we can take into consideration the following values of carrying capacity:

(chart)

By different depth it is necessary to adapt the shown data in accordance with the influence of the used depth of foundation under 1st comment of Annex 6 – standard STN 73 1001.

Settlement

From the aspect of compressibility the gravel soils represent a very little compressible foundation ground. The settlement process will be weak and most of it will take place during the building works and its unsteadiness would not exceed the permitted values.

The foundation pit/ditch

By machine excavation of the ditch, its last layer over the level of foundation of size 20-30 cm, we recommend to excavate manually in order not to disturb the natural settlement of the soil.

Temporary gradient of slope of the ditch in the made up ground and fine-grained soil up to 2 m u.t. can be chosen in ratio 1:1. In the case of gravel with additional fine grained soil in gradient 1:1,25.

6.4 Classes of the workability of the minerals

Under standard STN 73 3050 the minerals, that will be affected by earth works we classify to following classes of workability:

- made up ground, fluvial fine-grained minerals 3rd- 4th class
- gravels with additional fine grained minerals, settled 3rd- 4th class
- clayey gravels 3rd- 4th class

The classes of workability have to be precised according to the circumstances during the earth works.

6.5. Evaluation of the laboratory-works results - ground water and minerals

6.5.1. Evaluation of the chemical structure of the ground water from boreholes V-1, V-2 and V-4

Water, originating from bore hole V-1 is neutral (pH=7,06), quite mineralised with mineralisation 0,83 $g.l^{-1}$.

The entire mineralisation is resulted especially by ions SO_4^{2-} and HCO_3^-, before Cl^- and NO_3^-, from cations there are Ca^{2+} and Na^+ that define the chemical type of the water. According to Gazda´s classification the water shows mixed type with prevailing component S_2 (SO_4), it is mildly under-saturated with low content of aggressive CO_2.

Water, originating from bore hole V-2 is slightly alcalic (pH=7,3), quite mineralised with mineralisation 0,52 $g.l^{-1}$. The entire mineralisation is made especially from ions SO_4^{2-} and HCO_3^-, from cations there are Ca^{2+}, Na and Mg^{2+}. According to Gazda´s classification the water shows mixed type with prevailing component $S_2(SO_4)$, it is mildly under saturated with content of aggressive CO_2.

In the water we found increased content of organic materials, defined as chemical consumption of O_2 by manganese and NEL.

Water originating from bore hole V-4 is alcalic (pH=11,27), quite mineralised with mineralisation 0,82 $g.l^{-1}$. The water mineralisation is made especially from ions SO_4^{2-} and Cl^-.

High pH of the water causes the presence of CO_3^{-2} and OH^- ions. According to Gazda´s classification the water shows mixed type with prevailing component $S_2(SO_4)$. The chemical structure of the water is significantly affected secondarily. Besides the increased concentration of organic materials (SO_4^{2-}, Cl^-, Cr, CN^-, NH_4^+, NO_2^-, Mn) there are increased organic materials stated as chemical consumption of O_2 by manganese, but in the form of non-polar extractable materials (NEL).

Basic chemical parameters of the water, originating from boreholes V-1, V-2 and V-4, and their comparison respecting the criteria, laid down in the

Directive of the Ministry of the Administration and Privatization of the National Property of the Slovak Republic and the Ministry of the Environmental Affairs of the Slovak Republic of 15 December, 1997 No. 1617/97 min (Further: Directive) and respecting the standard STN 75 7111 "Drinking Water" - is included in Chart No. 1.

6.5.2. Evaluation of the quality of the ground water in relation to the Directive of MAP SR and MEA SR) of 15 December, 1997, No. 1617/97 min

The ground water, originating from borehole V-4 contains increased amount of NEL, phenols and Pb. The concentration of NEL (1,07 mg $.l^{-1}$) exceeds by 0,07 mg $.l^{-1}$ the limit value of C category and that indicates strong influence of polluting oil carbohydrates on the ground water.

Content of Pb (0,094 mg $.l^{-1}$) is within category B that shows the influence on hydro-sphere, caused by this contaminating stuff. The phenol content of V-4 sample in the ground water (3,9 mg$.l^{-1}$) oversteps category C too. Probably, the increased content of phenols is related directly to increased content of carbo-hydrates as products of their degradation. The water contains increased amount of NH_4^+, CN^-, and Cd which overstep the limit values of B category of the Directive, Cu and Cr exceed the C category values, stated in the Directive.

In other boreholes and analysed samples (V-1, V-2) the presence of increased amount of crude oil carbohydrates has been shown too, however, their extent is much less.

Water from boring V-1 showed increased content of NEL in extent of B category (0,23 mg $.l^{-1}$), in water from V-2 it was within A category (0,13 mg $.l^{-1}$).

Water from V-2 has increased concentration of NEL NH_4^+, CN^-, exceeding limit values of B category of the cited Directive.

6.5.3. Evaluation of the quality of the ground water in relation to STN 75 7111 (Slovak Standard System) „Drinking water"

Water from bore hole V-1 has increased content of Mn, Al, Fe, Hg, NO_2^-, SO_4^{2-}, NEL and CHSK-Mn which overstep the limit values of the set standard for drinking water.

Ground water from V-4 is intensively polluted from the aspect of the cited standard. Elements, exceeding limit values of the standard are: NEL, Pb, Cd, Fe, Mn, NH_4^+, Cl^-, CN^-, NO_2^- SO_4^{2-}, CHSK-Mn and Cr. The found concentration of the last element is very high in this water (152,86 mg $.l^{-1}$ Cr). There has been increased the pH value and conductivity of this water too.

Water from V-2 has a high amount of organic materials, defined as chemical consumption of O_2 by manganese and NEL.

Mn, Fe, NH_4^+, CN- and NO_2^- have exceeded the limit values, defined for drinking water from inorganic components.

6.5.4. Evaluation of the quality of the mineral environment in relation to requests of the Directive of MAP SR and MEA SR No. 1617/97 min

Within the present task we have taken samples from the soil, originating from V-1, V-2, V-4 and V-5. The samples have been removed from depth 0,5, 1,0, 1,5, 2,0, 2,5, 3,0 and 3,5 m u.t.

The implemented chemical analyses were directed on defining the inorganic and organic components, recommended by Directive of MAP SR and MEA SR of 15 December, 1997, No. 1617/97 min. The survey aimed to study those elements that were supposed to occur there, regarding the type of antrophogene activities in the concerned territory.

From tabular evaluation of the observed results (Chart 2) and their comparison with the criteria of categories B and C of the Directive, it follows that the soil samples from boreholes contain increased concentration of polluting organic materials, namely non-polar extractable elements (NEL) and benzene in different levels of the boring V-1, V-2 and V-4. NEL is increased especially in V-1 where in depth up to 2,5 m u.t. they exceed limit values of B category. Samples taken 1,0 m u.t. overstep even limits of C category NEL, defined in UV-spectrum (1265 mg .kg $^{-1}$ solids).

In deep level of aeration zone 3,5 m u.t. in V-1 the NEL content values are again deeply under B category in both parts of the spectrum (86 mg .kg $^{-1}$ solids in IR, 268 mg .kg $^{-1}$ solids in UV spectrum). Respecting the found lithological characteristics we can state increased NEL content in soil as a result of penetration and cumulation of the pollution in relatively permeable environment of anthropogene made up grounds.

Similar situation appeared in borehole V-2 where NEL polluted is just the sub-surface stratum in zone 0-0,5 m u.t. (571 mg .kg $^{-1}$ solids in IR and 3614 mg .kg $^{-1}$ solids), while higher amounts, defined in UV part of the spectrum indicate relatively new pollution.

From the defined inorganic materials concentration of Ba has been increased in V-1 and V-2 which exceeded the limit value of B category of the Directive. The increased content was a result of anthropogene made up grounds again.

The other organic and inorganic elements values did not exceed the limit values of A category. The laboratory works results, aimed at defining the content of polluting materials in the soils is shown in Chart No 2.

Chart 2.

7 CONCLUSIONS

On thc basis o the performed engineering- geological survey we can observe the following:

The foundation conditions at the building site are simple, consistent with Article 20 of standard STN 73 1001

the surface level of the territory 1,0-2,4 m thick, in some places up to 3,6 m consists of discontinuous stratum of made up grounds and cross cut and in some places fine-grained soil, coming from fluvial cone.

deeper there is a stratum of medium settled and settled gravel; we checked it up to 10 m u.t.

the ground water level is between 6,0-6,70 m u.t., it is mildly under pressure, stable in depth 5,20-6,00 m u.t.

Under standard STN 73 1215 "Classification of aggressive environment" – the water is non-aggressive on concrete materials. Under standard STN 03 8375 "Protection of metal pipes, put down to ground or water" the water disposes with raised aggressiveness in relation to iron materials.

we recommend to make foundation of objects in the level of bearing gravels. Objects, founded this way, will be settling down minimally.

pollution of the mineral environment: in the observed samples during the boring works we have found in part of the samples increased concentration of organic polluting materials, namely they were non-polar extractable materials (NEL) and benzene.

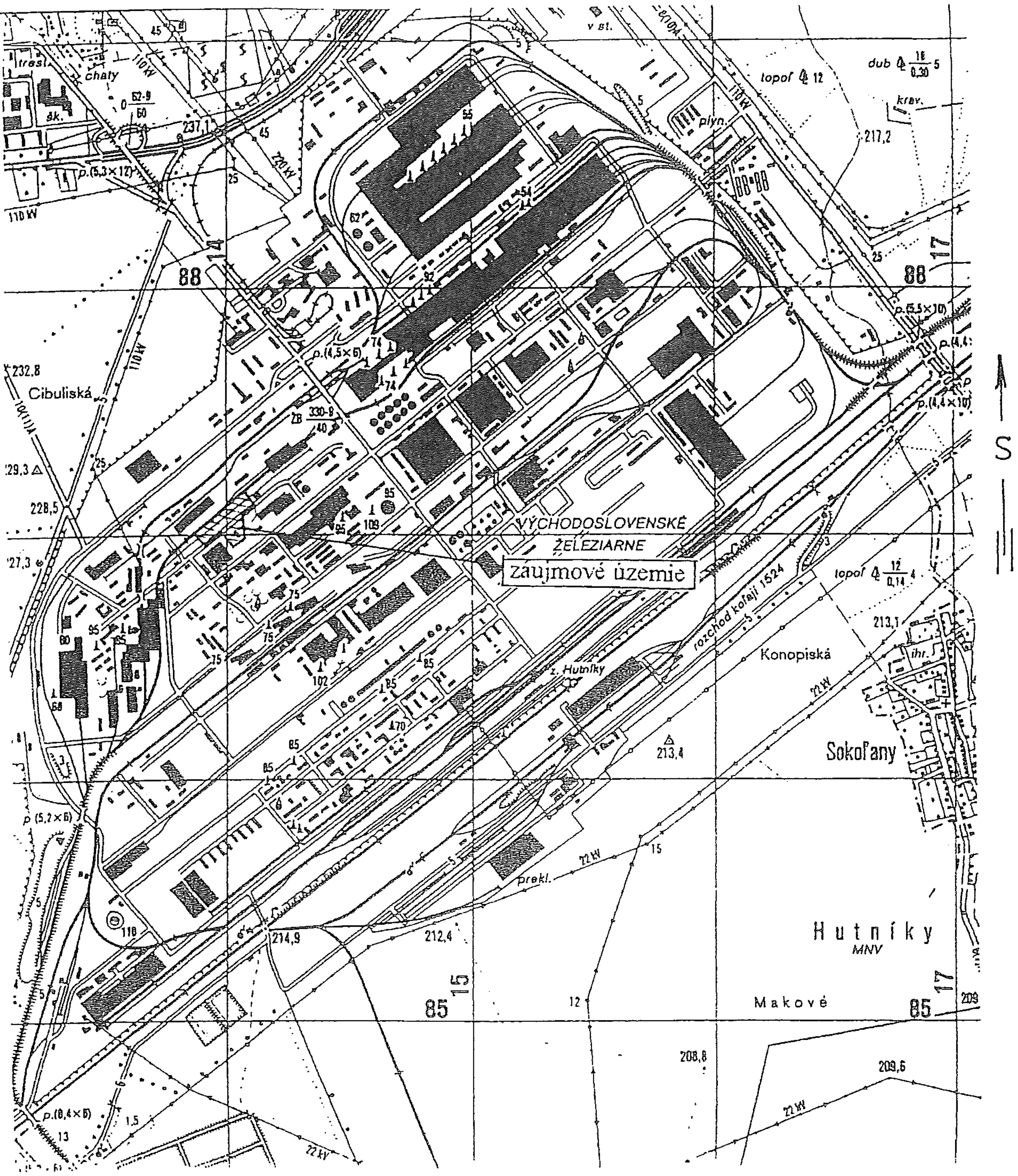
Following the defined lithological characteristic we can state increased NEL content in the soil as a result of penetration and cumulation of the pollution in relatively permeable environment of anthropogene made up grounds.

The other values of organic and inorganic materials in the soil did not exceed the A-category limit values.

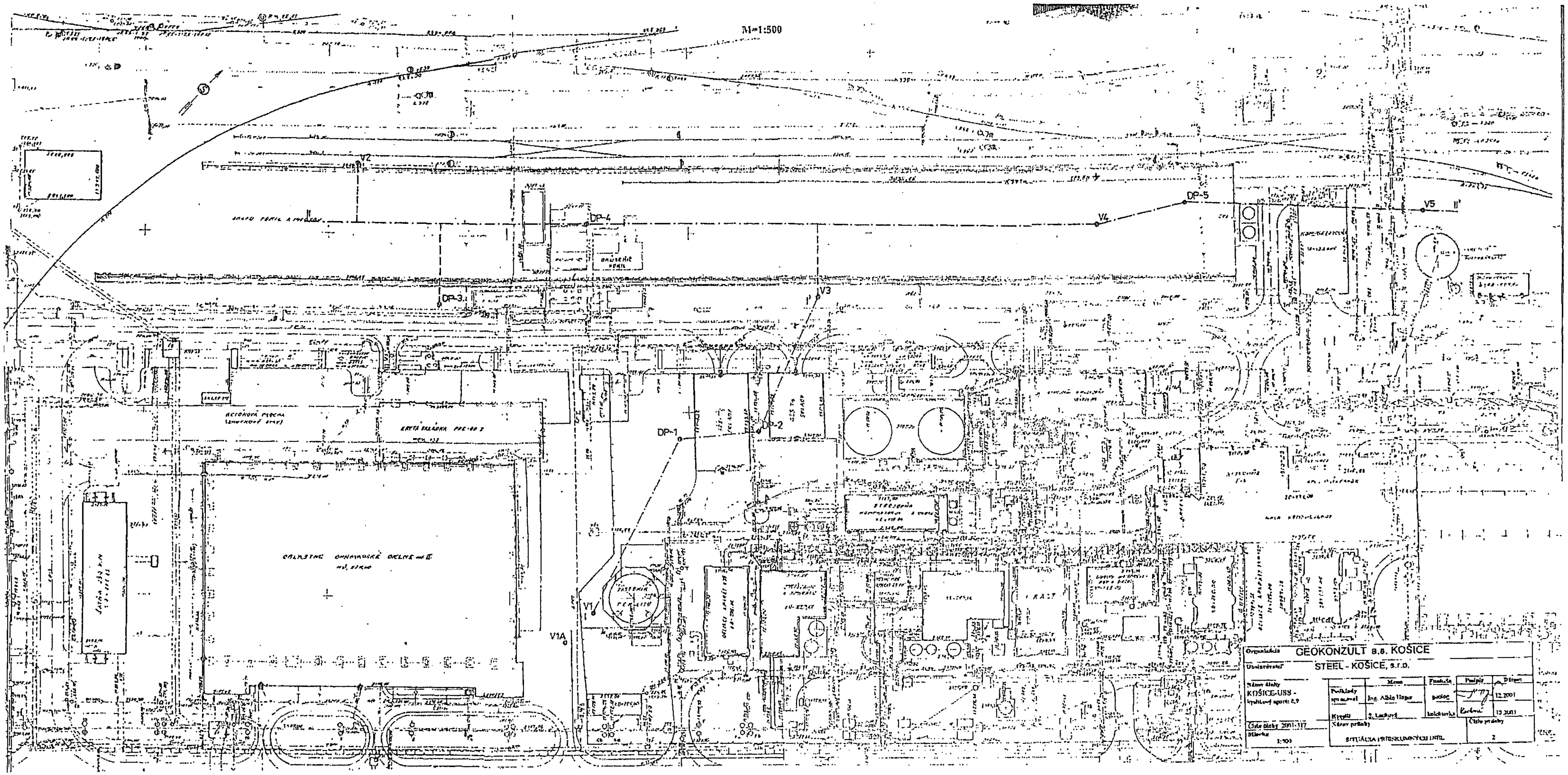
pollution of the ground water: in the ground water there are increased contents of NEL. Content of NEL falls to B category (in bore hole V-4 they exceed C category), it indicates the influence of these contaminants on the underground hydrosphere. Besides this in the ground water there is an increased amount of : CN^- , NH_4^+, Cd , Cu, Hg that exceed the limit values of B category; Cr oversteps category C.

These inorganic contaminants in the mineral environment of the aeration zone are not found in amounts, exceeding the limits values. We can exclude secondary pollution of the ground water by infiltration of harmful materials from the settled sediments by influence of vertical migration. It is more likely to expect the effect of water, originating from the surrounding area.

Annex 1 of Attachment 11



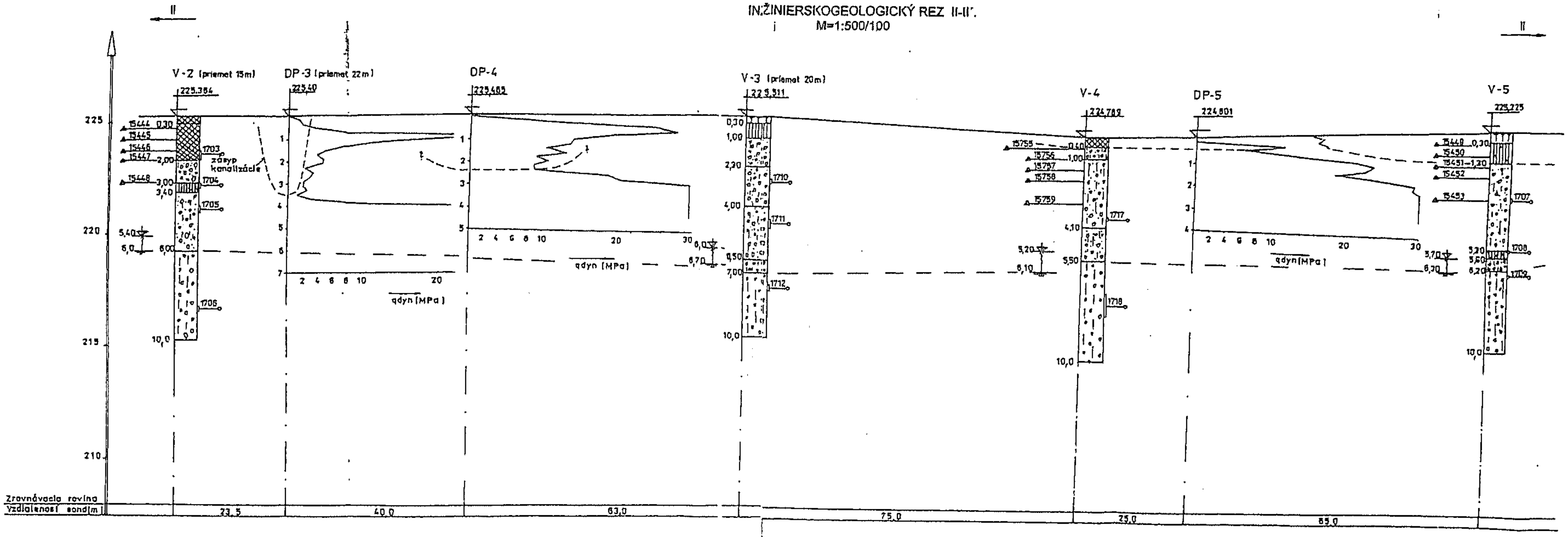
Organizácia	GEOKONZULT a.s. KOŠICE				
Objednávateľ	STEEL - KOŠICE, s.r.o.				
Názov úlohy		**Meno**	**Funkcia**	**Podpis**	**Dátum**
KOŠICE - USS - kyslíkový aparát č. 9	**Podklady spracoval**	Ing. HÖGER	geológ	[signature]	11.2001
	Kreslil	Farkašová	kreslička	Farkašová	11. 2001
Číslo úlohy 2 001 - 317	**Názov prílohy**			**Číslo prílohy**	
Mierka 1 : 25 000	SITUÁCIA ZÁUJMOVÉHO ÚZEMIA			1	
Počet A$_4$ – 1 = 0,062 m^2					



M=1:500
DP-1
DP-2
DP-3
DP-4
DP-5
V1
V1A
V2
V3
V4
V5
GEOKONZULT a.s. KOŠICE
STEEL - KOŠICE, s.r.o.
KOŠICE-USS -
Ing. Albín Hegar
geológ
12.2001
Číslo úlohy 2001-117
1:500
2

INŽINIERSKOGEOLOGICKÝ REZ II-II´.

M=1:500/100



Názov úlohy:	Košice - U.S.S. - kyslíkový aparát č.9	
Číslo úlohy: 2001 - 317	Kontroloval:	Číslo prílohy: 40

Attachment 12:

Training Program

The objective of this training program is to familiarize USSK's operating and maintenance personnel with the functions, operation and servicing of the ASP process, systems, equipment and controls. The training courses shall be given by qualified technical people in class-room, at operating Messer plants, during ASU #9 installation -, checkout- and startup phase.

Training will be held verbally in English. The training documentation will be issued in Slovak and English.

A training schedule will be provided by Messer.

1. Training of Operating and Maintenance Personnel

Objective: To familiarize plant personnel with ASP functioning and operation.

Topics:

- Product and system safety
- Air separation process
- Storage and backup systems
- HV and LV Power supply system
- DCS-system
- Rotating equipment
- Product quality

One (1) week class-room training in Kosice.

2. DCS-Maintenance

Objective: Maintenance, adjusting set point, reprogramming cetain systems, etc.

One week class-room training at contractors office.

3. Training for Supervisors and Managers

Training will be performed at a reference air separation plant in Germany. The training will include class-room hands-on training.

4. Training during Installation, Commissioning and Start-Up

Maintenance and operation personal will be educated on the job during final stage of erection, check out, commissioning and start-up of the ASP to become familiar with the facility.

MESSER
AGS GmbH
IA.Z / Fö\ 01.11.2003

Attachment 13

USSK ASP Technical Proposal Review Questionnaire
August 11, 2003 (revised November 1, 2003)

Messer Group

1. Attachment A-1 of this document contains a verbal description of the power supply scheme acceptable to USSK, Attachment A-2 contains a plot plan of the same arrangement, please review and confirm that this is the approach contained in the offering.

MESSER: Yes __X__ No _____

2. Please complete the table contained in Attachment B for the operating conditions described.

MESSER: see Attachment B1

3. Please confirm whether the proposed facility is capable of producing liquid oxygen and liquid nitrogen at the same time.

MESSER: Yes __X__ No _____

4. Please confirm that the height of the tallest component in the proposed facility is less than 60 meters above ground level.

Yes _____ No __X___

MESSER: < 62 m (from top of foundation)
(according to Email dated 18th August from Mr. Gutshall acceptable)

5. Please provide boil-off rate for the liquid oxygen, liquid nitrogen bulk storage tanks proposed.

MESSER: LOX - ___< 0.2___ % / day LIN - __< 0.2____ % / day

6. USSK has reviewed the air contaminant table provided in the latest submittal; however we are unable to confirm attainment of the parameters specified. What are the consequences of exceeding any one of these parameters? Are they consistent with the air quality for an installation in a steel making facility? (Provide description on a separate sheet.)

MESSER: see Attachment B2 and Messer's Technical Specification Rev. 3

7. Please confirm that offer contains provisions for Bidder making the appropriate physical connections to each of USSKs utility lines (USSK will make arrangements for outages for such connection) and installing the appropriate isolation block valve(s) immediately adjacent to such connection.

MESSER: Yes __X__ No _____

8. Please confirm that Bidder has provided for the design and installation of cabling, piping, supports, etc. necessary for the connection to USSK utilities from the takeover points described in Attachment C to the Bidders equipment within the battery limits.

MESSER: Yes __X__ No _____

9. Please confirm that Bidder has provided for the connection to USSK utilities, as is where is, for the purposes of construction power, telephone, water or other utilities. Costs for the consumption of these utility services shall be provided free of charge to Bidder by USSK.

MESSER: Yes __X__ No _____

10. Please confirm that Bidder is providing all necessary construction support offices, tool trailers, rest room facilities, etc. during installation and commissioning of the facility. USSK has no facilities with 2 kilometers of the project site suitable for such purposes.

MESSER: Yes __X__ No _____

11. Please confirm that Bidder has reviewed the geotechnical report information provided by USSK in Attachment F and has provided for sufficient foundation design for actual site conditions.

MESSER: Refer to Messer Technical Specification Rev. 3 !

12. USSK has reviewed the proposed site layout and found that it does not adequately address the future potential installation of ASU 10. USSK feels it would be beneficial to locate the control, electrical and common rooms and any other potentially shared facilities at the center of the site such that the rooms can be shared by both facilities in the future. Please confirm that this approach will be incorporated into offer.

MESSER: Yes __X__ No _____

13. Please confirm that along with the location change for the control, electrical and common rooms that Bidder has provided additional building space (not including any equipment, electrical or control panels or other apparatuses) necessary for the future ASU 10.

MESSER: Yes __X__ No _____

14. USSK has reviewed the proposed schematics provided for product gas storage and vaporization and feels that it does not adequately address utilization of existing equipment. Please review the schematics contained in Attachments D-1 & D-2 and provide confirmation that offer satisfies the functional requirements contained therein.

MESSER: Yes __X__ No _____

15. Please confirm that Bidder has provided for the truck loading and unloading of product at the facility (oxygen, nitrogen and argon).

MESSER: Yes __X__ No _____

16. Please confirm that offer provides obtaining fire water from either the drinking water system (0.8 to 1.5 bar – DN 100) or the industrial water system (1 bar - DN 250) and is providing all necessary booster pumping and piping to protect the facility in the event of a fire in accordance with Factory Mutual (FM) guidelines.

MESSER: Yes __X__ No _____
Note: For booster pumps an emergency power supply is necessary (provided by USSK)

17. Please provide the recommended level of manning for the facility.

MESSER:
Normal operation __10_ people Normal maintenance __5__ people

Major outage _____ people (depends on duration and kind of outage)

18. Please provide the offered method of Argon purification.

MESSER: cryogenic rectification

19. Please provide the turndown rate and its maximum rate of change while maintaining purity requirements.

MESSER: Turndown ___44_ % (=11000 Nm³/h /25000 Nm³/h)
Maximum rate of change ___1-2 % / min

20. Please confirm that Bidder has reviewed the existing foundation for the new bulk liquid nitrogen tank and either has determined that it is adequate or has contained in its offer the necessary costs to repair or replace and make it adequate for use.

MESSER: Yes __X__ No _____

MESSER: The Foundation will be used. Nevertheless a repair of the foundation will be required.

21. Please confirm that Bidders offer shall be incompliance with all Slovak regulations.

MESSER: Yes __X__ No _____

22. Please confirm that Bidder has made provisions for the effort necessary to obtain and pay for all required permits (construction, building, work, entry, exit, etc.), visas and approvals for the design, fabrication, construction and installation of the proposed facility. USSK will make every effort to assist in this effort however; Bidder shall be primarily responsible for application processing, engineering/design effort, fees, etc. All costs shall be included in the commercial offer.

MESSER: Yes ____ No __X___

Please refer to Agreement.

23. Please confirm that Bidder has made provisions to arrange, obtain and pay for all import fees, taxes and duties (custom or otherwise) in connection with the execution of this project. All costs shall be included in the commercial proposal.

MESSER: Yes __X__ No _____

Refer to Agreement !

24. Please confirm that Bidder has provided for an expedited schedule for the design fabrication and installation of the new bulk liquid product tanks and vaporization equipment and has made provisions of the control and operation of these vessels from the time of their commissioning until the ASU 9 is operational.

MESSER: Yes __X__ No _____

25. Please confirm that all Operation and Maintenance manuals, drawings (as-built), and other support information necessary for the efficient operation and maintenance of the facility are provided in the Slovak language.

MESSER: All essential documents for plant operation and all safety documents will be provided in Slovak language.

26. Please confirm that offer includes all necessary operator and maintenance personnel training to allow the safe, efficient operation and maintenance of the facility. Bidder is to assume that operation personnel have a general understanding of the operation of an air separation plant and that the maintenance personnel have a working knowledge of general maintenance functions. Training shall provide for the specialized knowledge required for the specific equipment and control system(s) provided with offer.

MESSER: Yes __X__ No _____

27. Please confirm that Bidder has provided product analyzers including, but not limited to the ones listed in Attachment E.

MESSER: Yes __X__ No _____

28. Please list additional monitoring analyzers anticipated beyond those contained in Attachment E.

MESSER: Please refer to Attachment E1

29. Please confirm that all rotating equipment will be provided with industry standard vibration monitoring in all appropriate axis, analysis and electronic data recording equipment with appropriate operator alarm features.

MESSER: Messer confirms, that all centrifugal compressors will be provided with vibration monitoring. All pumps vital for the operation of the plant are provided 2 x 100%. Because of the redundancy the pumps are not provided with vibration monitoring.

30. Please confirm that offer provides for the electronic recording of all operational monitoring points at the facility and that certain key functions can be electronically sent to USSK supervisory system interface for management monitoring.

MESSER: Yes __X__ No _____

31. USSK has reviewed the proposed nitrogen compression scheme and feels it is not adequate to meet the operational variability with a single 100% nitrogen compressor. Please confirm that the offer will provide for two (2) – 50% nitrogen compressors.

MESSER: Yes __X__ No _____

32. USSK has reviewed the proposed liquid nitrogen pumping scheme and feels that due to high maintenance requirements that the high pressure pump needs and installed 100% spare. Please confirm that the offer will include two (2) – 100% high pressure nitrogen pumps.

MESSER: Yes __X__ No _____

33. Please describe the operation and function of the expansion turbines during normal operation and when liquid product is not being produced and any operational redundancy that is provided for the turbines. (Provide on a separate sheet)

MESSER: see Attachement B3

34. Please provide a description of how the existing liquid argon tanks and vaporizers are to be incorporated into the overall operation of the facility. (Provide on a separate sheet)

MESSER: Due to the high operating pressure of the existing LAR storage tanks and due to the method used for pressure build up of the existing tanks, the existing equipment has not been incorporated into the offered LAR backup System.

35. Please confirm that in the event of facility malfunction that the ASP will automatically shutdown in a safe manner (valves failing open or closed, etc.)

MESSER: Yes __X__ No _____

36. Please describe the proposed provisions for performing maintenance on the major equipment (i.e. main air compressor, booster compressors, etc.). Please describe all lifting devices (cranes, hoists and monorails) provided for in the offer as well as any specialized tools necessary for a safe and efficient repair. (Provide on a separate sheet)

MESSER: Free access provided for all equipment, so maintenance and repair on all parts of the plant can be done easily. In addition special tools for repair of machines will be provided within the spare parts.

37. Please provide the anticipated quantity of cryogenic liquid required to be provided by USSK for storage tank commissioning.

MESSER: LOX - ~ 50,000 Nm^3 LIN - ~55,000 Nm^3 for purching and cool down
Additional LOX Tank filling for commissioning of LOX pumps
(approx 10% of max Tank level)
Additional LIN Tank filling for commissioning of LIN pumps
(approx 10% of max Tank level)

LAR – 40,000 Nm^3 (in total)

38. Please confirm that offer includes provisions the supply of all the recommended spare equipment, parts and tools for the first two years of operation.

MESSER: Yes __X__ No _____

It is offered as a separate option price.

Company Name:	Messer AGS GmbH	
Signature:	____________	____________
Printed Name:	Klaus Förster	Dr. Norbert Nipper
Date:	01.November 2003	

Attachement A-1

U.S. Steel Košice s.r.o.
Vstupný areál U.S.Steel
044 54 Košice
Slovenská republika

Requirements of U. S. Steel Košice s.r.o. for connection of ASU 9 to USSK electric lines

Initial data:

- Consumption of 15 to 20 MVA in case of steady operation of ASU 9
- Need to take into consideration the increased power demand during the start-up of big electric motors
- Power supply at MV and LV levels
- ASU 9 consumers will be installed near the existing Oxygen Plant
- Concept of ASU 9 connection must be designed taking into consideration the future construction of ASU 10

Existing situation:

The only tie-in point in the area of the Oxygen Plant is the T40/70 substation. Installed 40 MVA transformers 110/6 kV - T1 in T40 and T1 in T70 - are used at 60% of their capacity, and so it is not possible to use them for feeding the ASU9. T2 transformer in T40 is a back-up for transformers in T40/70 and T10/20, and so it cannot be taken into consideration as the main source for ASU 9.

Required solution:

a) A new 6kV substation – T80 will be built for feeding the ASU 9.
b) T80 will be fed by two new 40 MVA transformers - T1 and T2.
c) T1 transformer will be fed from the 110 kV T01substation, T2 transformer will be fed from the 110 kV T02 substation.
d) Connection between T80 and T40 substations will be established as the emergency feeding of T80.
e) Big electric compressors of ASU 9 will be fed directly from the T80 substation.

There are two alternatives for feeding the minor drives (up to 5 MVA) and 6/0,4 kV transformers:

f1) they will be fed directly from the T80 substation
f2) they will be fed from a new T81 metal clad substation

The following is required for realization of the above stated:

1. T80 – double busbar substation (with cubicles) with longitudinal division of busbars with the following parameters:
   - nominal voltage: 6000 V network operation with insulated neutral (earthed through zero transformer and choke coil) with compensation of earth currents
   - bus-bars nominal current: 4000 A
   - short circuit current I_{ks}/I_{km}: 50/125 kA
   - number of cubicles: min. 11 (depending on which of the above listed alternatives is selected – see item 11.)
   - design: internal
   - electric equipment drives: electric
   - breakers: VD4 vacuum

   T80 three floor substation will be built next to the existing T40/70 substation. Building layout:
   - basement - cable space that will be connected to the existing cable channel
   - ground floor - reactors, outlet disconnectors and cable terminals, DC batteries, rectifiers, LV switchgears
   - 1st floor – busbars, busbar disconnectors, circuit breakers and instrument transformers
2. Two transformers T1 and T2 with the following parameters:
   - rated output: 40 MVA
   - voltage transfer: 110±5% / 6,3 kV (tap change without load)
   - connection: Ynd1
   - voltage - short: 10,7 %
   - design: external
   - cooling: ONAN/ONAF

Attachement A-1

3. Two zero transformers NT1 and NT 2 and two 400 kVA quenching chokes ZT1 and ZT2 with ONAN cooling – external design.

4. The 110kV T01 substation will be equipped complete with reserve field No.21; the following components will be installed: 3 busbar disconnectors (2000 A, 31,5/80 kA), circuit breaker (type 3AQ1, 3150 A, 40/100 kA), instrument transformers (type IMBD 200/1/1/1A), outlet disconnector (1250 A, 31,5/80 kA) with earth knives, and surge arresters. Switchgear will be electrically driven. The field will be equipped with protection relays (7SD502 a 7SJ511), electro-meters, transducers, I/O control unit, and will be connected to the existing control system - SINAUT LSA 678.

5. 110 kV cable will be laid between field No. 21 T01 and transformer T1 in T80. Approximately 2400m of cable will be laid on cable racks in the existing cable channel. Cables that will be used: the SILEC single-core cable with aluminum core, 240mm^2 with polyethylene insulation.

6. The 110 kV T02 substation will be equipped complete with reserve field No. 15; the following components will be installed: 2 busbar connectors (2000 A, 31,5/80 kA), circuit breaker (type 3AQ1, 3150 A, 40/100 kA), instrument transformers (type IMBD 200/1/1/1 A), outlet disconnector (1250 A, 31,5/80 kA) with earth knives. Switchgear will be electrically driven. The field will be equipped with protection relays (7SD502 a 7SJ511), electro-meters, transducers, and will be connected to the existing control system.

7. 110kV cable will be laid between field No.15 T01 and transformer T2 in T80. Approximately 650m of cable will be laid on cable racks in the existing cable channel. Cables that will be used: the SILEC single-core cable with aluminum core, 240mm^2 with polyethylene insulation.

8. Reserve cubicle No. 12 in the 6 kV substation T40 will be equipped with the following: 2 bus-bar disconnectors (4000 A, 50/125 kA), breaker (type VD4, 4000 A, 50/125 kA), instrumental transformers (4000/5/5 A), outlet disconnector (4000 A, 50/125 kA) with earth knives. All switchgear will be electrically driven. The field will be equipped with protection (7SD600 a REF545), electro-meters, transducers, and will be connected to the existing control system.

9. 6 kV cable will be laid between cubicle No. 12 T40 and related cubicle in T80 substation. Number of cables will be determined by transmission capacity 4000 A. Approximately 100m of cable will be laid on cable racks in the cable channel. Cables that will be used: 6-AXEKCY single-core with aluminum core 500mm^2.

10. Big motors (electric compressors) with output of more than 5 MVA will be fed from T80. Start-up of these motors must be designed in the way that the 110kV voltage in T01 and T02 substations does not drop under 95% Un during the whole start-up.

11. Feeding of smaller drives (up to 5 MVA) and transformers 6/0,4 kV can be realized in two ways:
    11.A Feeding of drives and transformers from the new T81 metal clad substation, built next to ASU 9. T81 will be fed by two feeders T80. T81 parameters:
    - Nominal voltage: 6000 V
    - Bus-bar nominal current: 2500 A
    - Short-circuit current I_{ks}/I_{km}: 31,5/80 kA
    - Number of cubicles: 16
    - Number of bus-bars: 1 (with longitudinal division)
    - design: internal
    - electric equipment drives: electric
    - breakers: vacuum VD4

    A new cable will be installed running from the reserve cubicle in the existing T46 substation for the purpose of emergency feeding of T81. Number of cables will be determined by transmission capacity 2500 A. Cables that will be used: 6-AXEKCY cables, installed on steel structure. Cable route length: approximately 100 m. Reserve cubicle in T46 substation will be equipped with a circuit breaker (type VD4, 250 A, 31,5/80 kA), instrument transformers (2500/5/5 A), protection relays, electro-meters and control system.

    11.B Smaller drives (up to 5 MVA) and transformers 6/0,4 kV can be fed directly from the T80 substation

12. There are two alternatives for installation of cables between T80 and ASU 9 (T81):
    12.A to build a new cable channel from T80 to Š2 shaft; cables from this shaft to the ASU9 (T81) would run on a new steel structure
    12.B install new steel structure for the entire route T40÷ASU 9 (T81)

Attachement A-1

13. It is necessary to free one rack in the cable channel running from T40 to the D1 shaft for the 110 kV cable T02 – T80. Therefore one line T40 – T46 will be transferred to a new route – specified in item 12. It is a relocation of 6 cables 6-AYKCY 3x240mm^2.

14. Further requirements regarding the electric system of ASU 9:
    - Min. power factor - total off take of ASU 9 cos f = 0,94
    - Voltage fluctuation in USSK low voltage lines caused by ASU9 operation must be limited to the allowable ±10% Un
    - Meet the EMC criteria regarding the affect of ASU9 equipment on USSK electric lines
    - The equipment must be safe and reliable

Prepared by: Ing. Pataki, Planning and Development Engineering | Kosice, 31. 7. 2003

Operating modes of ASU9 - please fill in the parametres in this chart (for better understanding of bidder's proposal)

OUTPUT MEDIA OF ASU 9 Nm^3/hour		A min. production Only in gas form	B nominal production Only in gas form	C max. production Only in gas form	D production Only in gas form	E min. production gas + liquid form	F nominal production gas + liquid form	G max. production gas + liquid form	H production gas + liquid form
GOX HP - 27 bar	bar	27	27			27	27	27	27
	Nm^3/hour	15000	20.000			11000	20000	25000	17000
	Purity % of O_2	> 99,5	> 99,5			> 99,5	> 99,5	> 99,5	> 99,5
	Contens ppm N_2 in GOX	< 1	< 1			< 1	< 1	< 1	< 1
GAN MP 6 bar	bar	6	6			6	6	6	6
	Nm^3/hour	29500	29500			29500	29500	29500	29500
	Contens ppm O_2	< 10	< 10			< 10	< 10	< 10	< 10
GAN HP 20 bar	bar	20	20			20	20	20	20
	Nm^3/hour	3500	3500			3500	3500	3500	3500
	Contens ppm O_2	< 10	< 10			< 10	< 10	< 10	< 10
LAR(in GAR form)	Nm^3/hour	210	430			210	360	360	450
	Contens ppm O_2	< 2	< 2			< 2	< 2	< 2	< 2
	Contens ppm N_2	< 5	< 5			< 5	< 5	< 5	< 5
	Contens ppm CO	< 1	< 1			< 1	< 1	< 1	< 1
	Contens ppm H_2								
	Contens ppm CH_4	< 0,5	< 0,5			< 0,5	< 0,5	< 0,5	< 0,5
GAR 20 bar	Nm^3/hour	240	240			240	240	240	240
	bar	20	20			20	20	20	20
	Contens ppm O_2	< 2	< 2			< 2	< 2	< 2	< 2
	Contens ppm N_2	< 5	< 5			< 5	< 5	< 5	< 5
	Contens ppm CO	< 1	< 1			< 1	< 1	< 1	< 1
	Contens ppm H_2								
	Contens ppm CH_4	< 0,5	< 0,5			< 0,5	< 0,5	< 0,5	< 0,5
LOX (in GOX form)	bar								
	Nm^3/hour	0	0			4000	0	-5000	3000
	Purity % of O_2	> 99,5	> 99,5			> 99,5	> 99,5	> 99,5	> 99,5
	Contens ppm N_2 in LOX	< 1	< 1			< 1	< 1	< 1	< 1
LIN (in GAN form)	bar								
	Nm^3/hour	0	0			-700	3000	4200	0
	Contens ppm O_2	< 10	< 10			< 10	< 10	< 10	< 10
Possibility of simultaneous LOX and LIN production	Y / N If Y - What is the ratio or range of LOX &LIN production?								0-3000 LOX 3000 - 0 LIN
Total electricity consumption in condition No 1	kWh	14520	15850			14430	17030	16530	16410
Total electricity consumption in condition No 2	kWh	14000	15350			13920	16500	16020	15900
Steam	kg/hour	700	700			700	700	700	700
	MJ/hour								
Cooling water	m^3/hour	1700	1700			1700	1700	1700	1700
	bar								
Make-up water	m^3/hour	45	45			45	45	45	45
	bar								
Potable water	m^3/hour	1-2	1-2			1-2	1-2	1-2	1-2
	bar								

NOTES!

Condition No 1		
	ambient temperature	25 °C
	humidity	65%
	ambient pressure	101 325 Pa
	cooling water temperature	29 °C

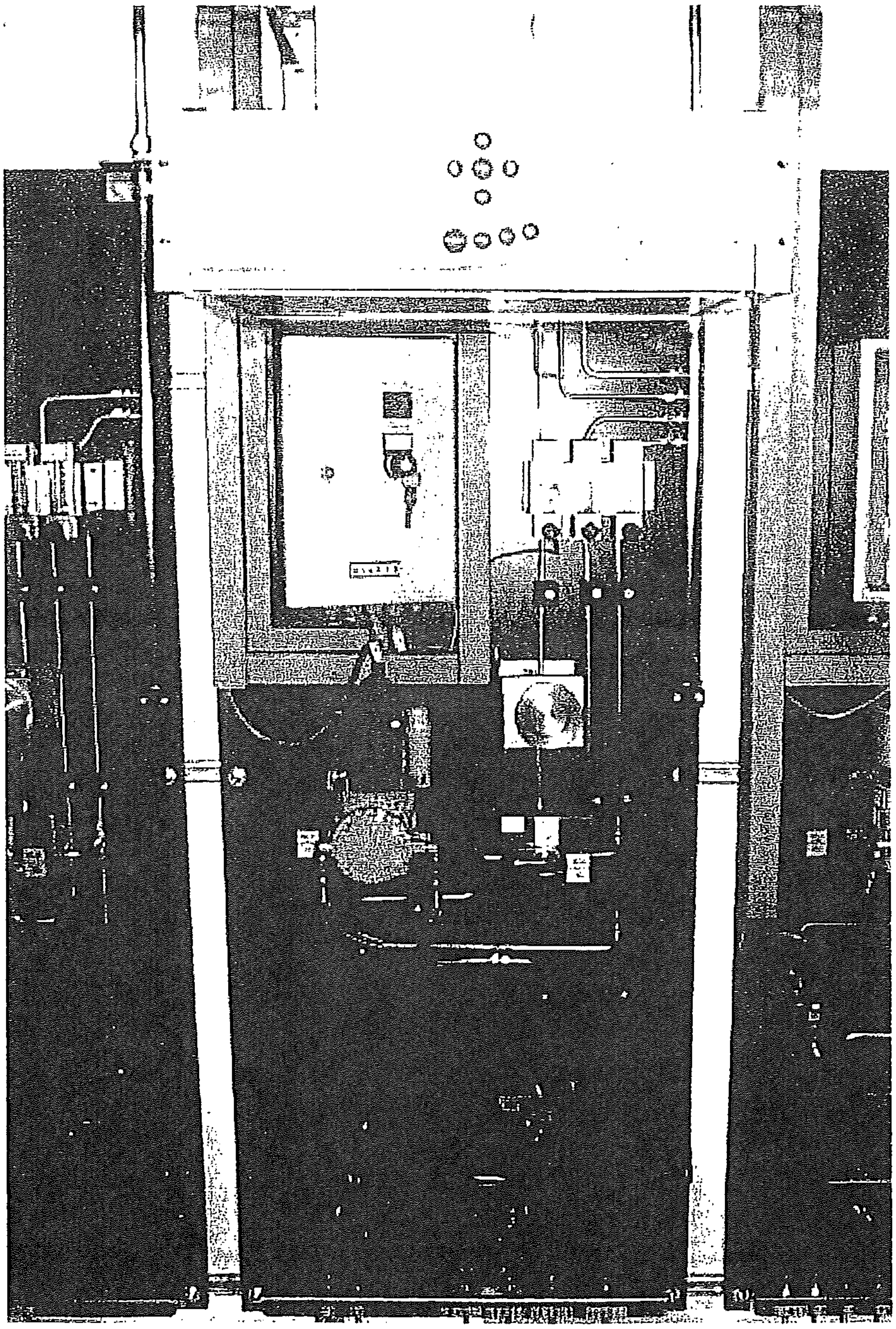
Condition No 2		
	ambient temperature	12 °C
	humidity	65%
	ambient pressure	101 325 Pa
	cooling water temperature	16 °C

Prepared by :
J. Soška
31[th] of July 2003

MESSER
AGS GmbH
Nip\ Attachment_E1_zu Rev5.doc
Krefeld, April 07,. 2004

Attachment E1: **Analyser**

General
Equipment mounted on racks in an air conditioned analyser room.
For example see picture:



The most important advantage of this kind of equipment mounting is the ease of maintenance. Each screw connection and each piece of equipment can be changed or observed very easily.

List of analysers (please refer to analysis point scheme):

Q 1	**PPM CO2 in air behind Molsieve** Device: Servomex Xentra 4100 C	Range 1: Range 2:	0 - 5 ppm CO2 0 - 50 ppm CO2
Q 2	**% O2 in waste Nitrogen** Device: Servomex Xentra 4100 C	Range 1:. Range 2:	0 - 5 % O2 0 - 30 % O2
Q 3	**%O2 in HP Column** Device: Servomex Xentra 4100 C	Range 1: Range 2:	0 - 5 % O2 0 - 30 % O2
Q 4	**ppm O2 in GAN 20barg Product** Device: Servomex Xentra 4100 C	Range 1: Range 2:	0 - 2 ppm O2 0 - 10 ppm O2
Q 5	**% O2 sidearmgas to crude Ar column** Device: Servomex Xentra 4100 C	Range 1: Range 2:	80 - 100 % O2 50 - 100 % O2
Q 6	**ppm O2 at top of crude Ar column** Device: Servomex Xentra 4100 C	Range 1: Range 2:	0 - 2 ppm O2 0 - 10 ppm O2
Q 7	**ppm O2 in LIN Product** Device: Servomex Xentra 4100 C	Range 1: Range 2:	0 - 2 ppm O2 0 - 10 ppm O2
Q 8	**% O2 in GOX Product** Device: Servomex Xentra 4100 C	Range 1: Range 2:	99 - 100 % O2 80 - 100 % O2
Q 9	**ppm O2 in GAN 6barg Product** Device: Servomex Xentra 4100 C	Range 1: Range 2:	0 - 2 ppm O2 0 - 10 ppm O2
Q 10	**% O2 in LOX Product** Device: Servomex Xentra 4100 C	Range 1: Range 2:	99 - 100 % O2 80 - 100 % O2
Q 11	**ppm O2 in LAR Product** Device: Servomex Xentra 4100 C	Range 1: Range 2:	0 - 2 ppm O2 0 - 10 ppm O2

Q 12	**not used**		
Q13	**Sum CnHm in LOX Product** Device: Servomex 4100 C with catalyticoven	Range 1: Range 2:	0 - 100 ppm CnHm 0 - 1000 ppm CnHm
Q 14	**ppm H2O behind Reg. Gas Heater** Device: Panametrics oder Equivalent	Range 1: Range 2.	0 - 10 ppm H2O 0 - 1000 ppm H2O
Q15	**ppm N2 in GOX Product** Device: Control Analytik K3000	Range 1: Range 2:	0 - 100 ppm N2 0 - 1000 ppm N2
Q16	**GC for LAR Product** Device: Siemens Maxum II	Range 1: Range 2: Range 3: Range 4: Range 5:	ppm CnHm ppm CO ppm CO2 ppm N2 ppm H2
Q 17	**ppm O2 in LIN to pipe net** Device: Servomex Xentra 4100 C	Range 1: Range 2:	0 - 2 ppm O2 0 - 10 ppm O2
Q 18	**% O2 in LOX to pipe net** Device: Servomex Xentra 4100 C	Range 1: Range 2:	99 - 100 % O2 80 - 100 % O2
Q 19	**ppm H2O portable analyzer** Device: Panametrics oder Equivalent	Range 1: Range 2:	0 - 10 ppm H2O 0 - 1000 ppm H2O