

Stupeň / Level  
Projekt pre realizáciu stavby  
Construction Design

Dátum / Date  
Jún/June /2005

Kód / Code

2. Technická správa PO (anglicky)  
Technical report of fire protection (english)

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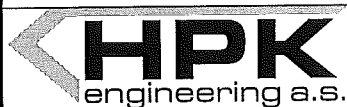
Projekt pre realizáciu stavby spracovaný pod z. č. 3821.2.Pos  
Detailed project prepare under No. 3821.2.Pos  
Zohľadnené pripomienky Ferrohasu zo dňa 7. 12. 2005  
Ferrohas comments is incorporated from day 7. 12. 2005

AIR LIQUIDE<sup>TM</sup>

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2	23.3.2006	Ing. Plavecki	<i>[Signature]</i>	Ing. Kobylánová	<i>[Signature]</i>	Ing. Pavličko		
1	15.12.2005	Ing. Plavecki		Ing. Kobylánová		Ing. Pavličko		
0	28.06.2005	Ing. Plavecki		Ing. Kobylánová		Ing. Pavličko		
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Názov zákazky / Job :

KYSLÍKOVÝ APARÁT č. 9  
ASU No. 9 KOŠICE



Němcovej 30  
042 18 KOŠICE, SLOVAKIA

Objekt / Unit :  
Prev. celok / Unit :  
Prev. súbor / Unit :

Profesia / Profession :  
Prev. jednotka / P. Unit:

POŽIARNA OCHRANA  
FIRE PROTECTION

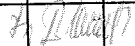

A

STAVBA / JOB : KYSLÍKOVÝ APARÁT č. 9 ASU No. 9 KOŠICE

OBJEKT / UNIT :

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**REVÍZIA DOKUMENTÁCIE**  
**REVISION OF DOCUMENT**

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2	23.3.2006	Ing. Plavecki		Ing. Kobyřanová		Ing. Pavličko		
1	15.12.2005	Ing. Plavecki		Ing. Kobyřanová		Ing. Pavličko		
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OBJEKT / UNIT:

**Technical Report – Fire Protection****a/ General Data**

The comments of Ferrohas from 7.12.2005, point "a" are incorporated in solution of Fire protection. Point "b" doesn't concern of our building solution.

Fire protection, as suggested here, follows from the model presented for building permit, when globally, the whole site was assessed. The repeated assessment of the following premises as parts of implementation project brought about some layout modifications within the premises and changes in some construction elements (fencing). Subject to fire protection in this stage are the following items:

SO 001 – Low-temperature block  
SO 003 – Air preparation  
SO 012 – Pipe bridges  
SO 017 – Roads and reinforced areas

SO 002 – Compressor station  
SO 006 – Foundation for liquid Ar tank  
SO 014 – Distribution of cooling water

The other items are engineering networks (SO 015, 016, 026), which need not be reviewed in terms of fire protection. The other premises and items fall under the responsibility of other designing company and their fire protection will be specified by this company.  
See the building part for data on design and layout. See site layout for the layout of premises.

**b/ Fire Protection Design**

SO 001 and 002 are new premises designed with fire-proof structure systems. The carrying vertical (columns) structure is made of steel. As peripheral jacketing, reinforced panel prefabricates are fixed to the columns. The roof on the lower part of SO 001 is made of prefabricated reinforced panels. The roof of the higher part is made of monolithic concrete in lost boxing made of ribbed sheets. Roofing of SO 002 is made of ribbed sheets with thermal insulation.

SO 001 houses the production equipment (expansion turbines) for compression and subsequent liquefaction of air. Air is compressed into the tank placed above the ground on concrete foundation built on open area within SO 003.

SO 002 houses compressors for the production of compressed air.

SO 003 forms an open equipment in accordance with Article 1, par. 1g of Decree 94/2004. It is an overground tank for liquefied air with a pump system and heat exchanger. Fire raising and propagation probability index and spacing distance:

$$P1 = 0.15 \times 1 = 0.15$$

The item is without fire risk, spacing distance is zero.

SO 006 – is an open equipment in accordance with Article 1, par. 1g of Decree 94/2004. It is a system of overground Ar tanks with pumps and evaporator. Fire raising and propagation probability index and spacing distance:

$$P1 = 0.15 \times 1 = 0.15$$

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The item is without fire risk, spacing distance is zero.

Both Argon and air are non-reactive, non-inflammable gasses.

SO 012 – is a utility bridge to house cable and pipings as specified in Article 1, par. 94/2004. No fire dangerous area is specified for this utility piping bridge according to Article 2.6.4c Slovak Technical Standard 92 0201-4, because the carrying and limiting structures are D1 type. The pipes carry compressed air, oxygen, nitrogen, argon, steam and cableways. These gases are noninflammable.

SO 014 – underground cooling water distribution system – overground engineering networks – no fire risk.

SO 017 – complements communications to new premises and allows fire equipment to get to all premises.

SO 001 and 002 are single-roof, statically independent premises, and in accordance with Tab. 1 item 11 of Slovak Standard 92 0201-2 fire resistance is not specified for their building structures.

People may escape from SO 001 to the surrounding open area through one unprotected escape route. Table 3, item 2 of Slovak Standard 92 0201-3 allows one non-protected escape route. SO 002 has more non-protected escape routes for people and their length meet limit values. See assessment.

Distances from items 001 and 002 are zero.

The required amount of fire water needed for fire fighting is 9,9 l/s. Fire water is supplied with external pipings DN 100 and 200 with underground hydrants due to lack of space. For local fire fighting, hoses may be used too. Underground hydrant must be labelled by table according annex No. 2 of Governmental decree No. 699/2004 Coll. Table is located on fixed vertical shank of height 1,8 m or it is located on civil construction in height 1,8 m in distance 6 m from underground hydrant.

Internal hydrants are not required.

### c/ Other technical requirements of Fire Protection

Decree 94/2004, Article 83, part 1a, does not specify any entrance platform.

Article 84, part 1 does not specify internal intervention roads. External intervention road must be available for SO 002 and it is made of external ladder on the front face. Decree 94/2004 does not specify Electric Fire Alarm system (EFA) for the assessed items. In spite of this, however, EFA will be installed in SO 002. EFA exchange must be placed in a continuously manned room. The presence of equipment is used to assess coefficient  $cv_1$  for enlargement of permitted area of fire cell. Need for Electrical fire signaling system resulting from Air Liquid standards, Europe Union standards and from requirements of firm U. S. Steel. Fire fighting is made by the internal fire brigade unit of U. S. STEEL KE s. r. o. Cables of EFA must be made of ZO, PH (ZO – fire resistant, PH – functional within a specified time while on fire).

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OBJEKT / UNIT:

## d/ Assessment of Fire Protection

### SO 002 Compressor building

#### Fire cell: N1.1

#### INPUT DATA

SPACE No. Name	pn kg/m <sup>2</sup>	kp1n	kp2n	ps kg/m <sup>2</sup>	kp1s	kp2s	S m <sup>2</sup>	hs m	p1	p2	Fire floor
101 kompressor 1	15.0	0.90	1.00	0.0	0.85	1.00	250.00	7.30	0.15	0.055	A
102 kompressor 2	15.0	0.90	1.00	0.0	0.85	1.00	143.00	4.20	0.15	0.055	A

without opening

#### RESULT VALUES

SPACE No. Name	pp kg/m <sup>2</sup>	Fo m0.5	F1 m0.5	F2 m0.5	gama kg/m <sup>2</sup> .5min	Vv kg/m <sup>2</sup> min	Vp kg/m <sup>2</sup> min	Vm	tau min	taue min	taum min	tauem min	Tg °C	hn m
101 compressor 1	13.5	0.0050	0.0050		8.470	0.14			74.5	17.9			450	0.0
102 compressor 2	13.5	0.0050	0.0050		8.470	0.14			74.5	17.9			450	0.0

#### Chosen conditions of the calculation of fire risk:

Calculation of fire risk: accurate

Coefficient k4 = 1.00 given directly

Fire risk has been calculated globally for the whole Fire Section

Parameter calculation Fo: accurate

The area of structure has been identified from Table 2, Note 2 in Slovak Standard STN 92 0201-1

#### Final values for the whole Fire Section

Fire load pp = 13,5 kg/m<sup>2</sup>

Ground area S = 393,0 m<sup>2</sup>

Area of structure = 1341,46 m<sup>2</sup>

Venting parameter Fo = 0.005 m0.5

Duration of fire tau = 74,7 min

Equivalent duration of fire taue = 17,9 min

#### SIZE OF FIRE CELL

Area/Subarea

coeff. p1 coeff. p2

101 compressor 1

0.15 0.055

102 compressor 2

0.15 0.055

Probability of fire occurrence and propagation p1 = 0,15

Probable damage extent p2 = 0.055

Ground Area of Fire section

S = 393,0 m<sup>2</sup>

Included into Fire Section is Electric Fire Alarm + intervention of Fire Brigade Units in accordance with Article 4.4.3, Slovak Standard STN 92 0201-1.

Intervention of Fire Brigade Units within 5 minutes. Coefficient cv1 = 0.25 Coefficient cv = 0.75

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OBJEKT / UNIT:

Number of fire floors of the construction above the ground: 1  
Number of fire floor of the construction under the ground: 0

Fire section in the part above the ground. Coefficient  $k_5 = 1.0$   
Fire-proof structural unit Coefficient  $k_6 = 1.00$ , Coefficient  $k_7 = 2.5$   
Fire height of the structure: 0.0 m  
Permitted number of floors of the Fire unit: 5 in accordance with Article 6 of the Decree of the Ministry of Interior of the Slovak Republic No. 94/2004  
Real number of floors in the Fire Section: 1  
Calculated data:  
Probability Index of fire occurrence and propagation  $P_1 = 0,11$   
Probability Index of damage extent  $P_{2max} = 29240$   
Limit ground area of Fire Section  $S_{max} = 21265,8 \text{ m}^2$   
Total number of floors 1, Number of floors above the ground: 1  
Coefficient  $k_5 = 1.0$   
Structural unit: fire-proof (Article 2.6.2 of Slovak Standard STN 92 0201-2)  
Coefficient  $k_8 = 0.589$   $\tau_{aue} \cdot k_8 = 17,9 \cdot 0.589 = 7,5$

#### Degree of Fire safety of fire section: I

It is a single-floor building, statically independent and Table 1 item 11 of Slovak Technical Standard 92 0201-2 does not specify requirements for fire resistance of building structures.

#### INSPECTION OF ESCAPE ROUTES IN THE BUILDING

Place of assessment: exit Type of escape routes: Unprotected  
Probability of fire occurrence and propagation  $p_1 = 0,150$   
Escape Direction : on the plane  
Evacuation mode of persons: Simultaneous  
Number of evacuated persons capable of moving alone: 5 Coefficient  $s: 1.0$   
Number of escape routes in Fire Section : More than one

#### EVACUATION TIME CONTROL:

Length of escape route  $l_u = 22.0 \text{ m}$  Real evacuation time  $t_u = 0,8 \text{ min}$   
Permitted evacuation time  $t_{ud} = 5,00 \text{ min}$  Speed of movement of persons  $V_u = 30 \text{ m/min}$   
Permitted evacuation time of escape  $K_u = 40 \text{ persons/min}$  Number of escape lanes  $u = 1.0$

#### INSPECTION OF ESCAPE ROUTE LENGTH :

Real length of escape route = 22.0 m Permitted length of escape route  $l_{ud} = 190.0 \text{ m}$   
Permitted evacuation time  $t_{ud} = 5,00 \text{ min}$  Speed of movement of persons  $V_u = 30 \text{ m/min}$   
Permitted evacuation time of escape  $K_u = 40 \text{ persons/min}$  Number of escape lanes  $u = 1.0$

#### DETERMINATION OF FIRE WATER NEEDED according to Slovak Standard STN 73 0873

Ground area of fire section: 393  $\text{m}^2$  Walled area of fire section : 4230  $\text{m}^3$   
Conversion of  $\tau_{aue}$  into  $p_v$ : 17,9  $\text{kg/m}^2$  Needed fire water  $V$ : 10,0  $\text{l/s}$

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OBJEKT / UNIT:

Probability index P1: 0,11 Real SPBPÚ: I Coefficient N: 1.2  
Total need for Fire water Q: 9,9 l/s = 594.0 l/min

**Suggested fire extinguishing instruments in accordance with Slovak Standard STN 92 0202-1**

Coefficient p1 of Fire Section : 0,15 Floor: 1 above the ground

Floor ground area: 393 m<sup>2</sup>

Mc: 9.2 kg Mcsk: 12.00 kg

Type of fire extinguisher	Fire extinguish. filler weight [kg]	Number of fire exting.	Mci [kg]
Powder	6.0	2	12.00

**Distances**

Peripheral jacketing is made of concrete panels without openings; distances are zero.

**SO 001 LOW TEMPERATURE BLOCK**

**FIRE CELL: N 1.2**

		I N P U T D A T A											
Space		pn	kp1n	kp2n	ps	kp1s	kp2s	S	hs	p1	p2	Fire	
Number	Name	kg/m <sup>2</sup>			kg/m <sup>2</sup>			m <sup>2</sup>	m			floor	
101	analytick room	30.0	0.90	1.00	5.0	0.85	1.00	29.00	3.00	1.40	0.150	A	
102	building of turbine	15.0	0.90	1.00	0.0	0.00	0.00	72.00	6.60	1.40	0.055	A	

Without opening

**R E S U L T V A L U E S**

Space		pp	Fo	F1	F2	gama	Vv	Vp	Vm	tau	taue	taum	tauem	Tg	hn
Number	Name	kg/m <sup>2</sup>	m0.5	m0.5	m0.5	kg/m <sup>2</sup>	min	kg/m <sup>2</sup>	min	min	min	min	min	°C	m
101	analytick room	31.3	0.0050	0.0050		8.470	0.19			131.1	24.0			496	0.0
102	building of turbine	13.5	0.0050	0.0050		8.470	0.19			56.5	15.3			428	0.0

**Chosen conditions of the calculation of fire risk:**

Calculation of fire risk: accurate Coefficient k4 = 1.00 given directly

Fire risk has been calculated globally for the whole Fire Section

Parameter calculation Fo: accurate

The area of structure has been identified from Table 2, Note 2 in Slovak Standard STN 92 0201-1

**Final values for the whole Fire Section**

Fire load pp = 18,6 kg/m<sup>2</sup>

Ground area S = 101,0 m<sup>2</sup>

Area of structure = 455 m<sup>2</sup>

Venting parameter Fo = 0.005 m0.5

Duration of fire tau = 77,8 min

Equivalent duration of fire taue = 18,6 min

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OBJEKT / UNIT:

### SIZE OF FIRE CELL

Area/Subarea                      koeff. p1      koeff. p2  
101      analitick room                      1,4      0.15  
102      building of turbine                      1,4      0.055  
Probability of fire occurrence and propagation p1 = 1,4  
Probable damage extent                      p2 = 0.082  
Ground Area of Fire section                      S = 101.0 m<sup>2</sup>  
Coefficient cv = 1,0  
Number of fire floors of the construction above the ground: 1  
Number of fire floor of the construction under the ground: 0

Fire section in the part above the ground.                      Coefficient k5 = 1.0  
Fire-proof structural unit                      Coefficient k6 = 1.00, Coefficient k7 = 2.5  
Fire hight of the structure: 0.0 m  
Permitted number of floors of the Fire unit: 5 in accordance with Article 6 of the Decree of the Ministry of Interior of the Slovak Republic No. 94/2004  
Real number of floors in the Fire Section: 1  
Calculated data:  
Probability Index of fire occurrence and propagation P1 = 1,4  
Probability Index of damage extent                      P2max = 1139,4  
Limit ground area of Fire Section                      Smax = 5558,2 m<sup>2</sup>

### Degree of Fire safety of fire section: I

It is a single-floor building, statically independent and Table 1 item 11 of Slovak Technical Standard 92 0201-2 does not specify requirements for fire resistance of building structures.

### INSPECTION OF ESCAPE ROUTES IN THE BUILDING

Place of assessment: exit                      Type of escape routes: Unprotected  
Probability of fire occurrence and propagation p1 = 1,4  
Escape Direction : on the plane  
Evacuation mode of persons: Simultaneous  
Number of evacuated persons capable of moving alone: 5                      Coefficient s: 1.0  
Number of escape routes in Fire Section : one

### EVACUATION TIME CONTROL:

Length of escape route lu = 10.0 m                      Real evacuation time tu = 0,58 min  
Permitted evacuation time tud = 2,37 min                      Speed of movement of persons Vu = 30 m/min  
Permitted evacuation time of escape Ku = 40 persons/min                      Number of escape lanes u = 1.0

### INSPECTION OF ESCAPE ROUTE LENGTH :

Real length of escape route = 10.0 m                      Permitted length of escape route lud = 63,5 m  
Permitted evacuation time tud = 2,37 min                      Speed of movement of persons Vu = 30 m/min

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OBJEKT / UNIT:

Permitted evacuation time of escape  $K_u = 40$  persons/min Number of escape lanes  $u = 1.0$

**DETERMINATION OF FIRE WATER NEEDED according to Slovak Standard STN 73 0873**

Ground area of fire section: 101 m<sup>2</sup> Walled area of fire section : 565 m<sup>3</sup>

Conversion of  $\tau_{aue}$  into  $p_v$ : 18,6 kg/m<sup>2</sup> Needed fire water V: 6,7 l/s

Probability index P1: 1,05 Real SPBPÚ: I Coefficient N: 1.3

Total need for Fire water Q: 6,7 l/s = 402.0 l/min

**Suggested fire extinguishing instruments in accordance with Slovak Standard STN 92 0202-1**

Coefficient  $p_1$  of Fire Section : 1,4 Floor: 1 above the ground

Floor ground area: 101 m<sup>2</sup>

**Mc:** 14,3 kg **Mcsk:** 18.00 kg

Type of fire extinguisher	Fire extinguish. filler weight [kg]	Number of fire exting.	Mci [kg]
Powder	6.0	3	18.00

**Distances**

Peripheral jacketing is made of concrete panels without openings; distances are zero.

Košice, March 2006

  
Prepared by: Ing. Plavecki Ján

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