Experimental Mine ‘BARBARA’ in Mikołów (Poland)

VAM - MRV related activities and possibilities

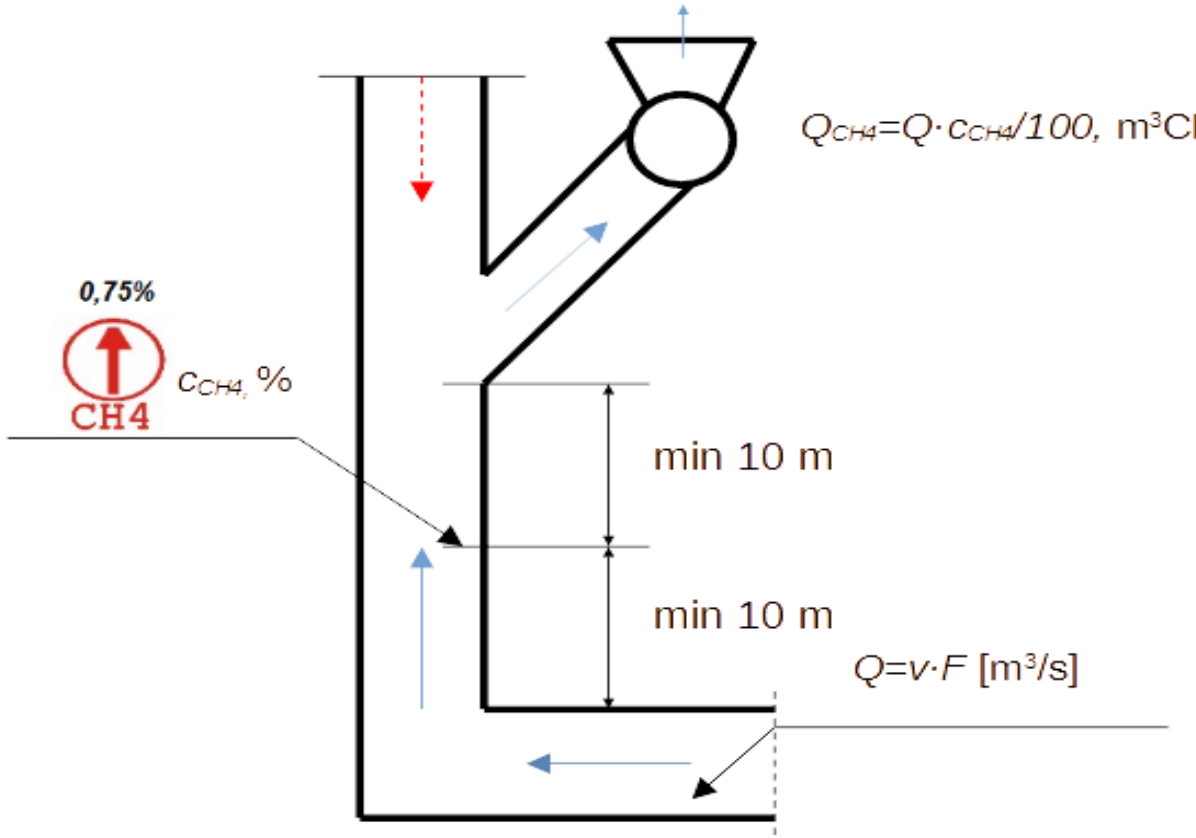
National Research Institute

POSSIBLE VAM TESTS TO BE PERFORMED- AREAS OF COOPERATION

- Assesment of **so far** VAM emissions measurements accuracy with the use of:
    - drones
    - planes
    - satellites
- Verification of VAM emissions' measurements in mine ventilation shafts (exhaust) - by installing extra methane sensors in additional locations of the exhaust shaft cross-section

Methodology for measuring exhaust shaft's air outflow and methane (VAM) concentration in it

Schematic diagram for measuring methane emissions from a ventilation shaft



Państwowy Instytut Badawczy

Gas and air monitoring system

Controller desk

Transmission lines

Ground surface

Underground

Underground air flow equipment

% CH_4

kPa, °C, % wilg.

m/s

56V, 40 mA DC

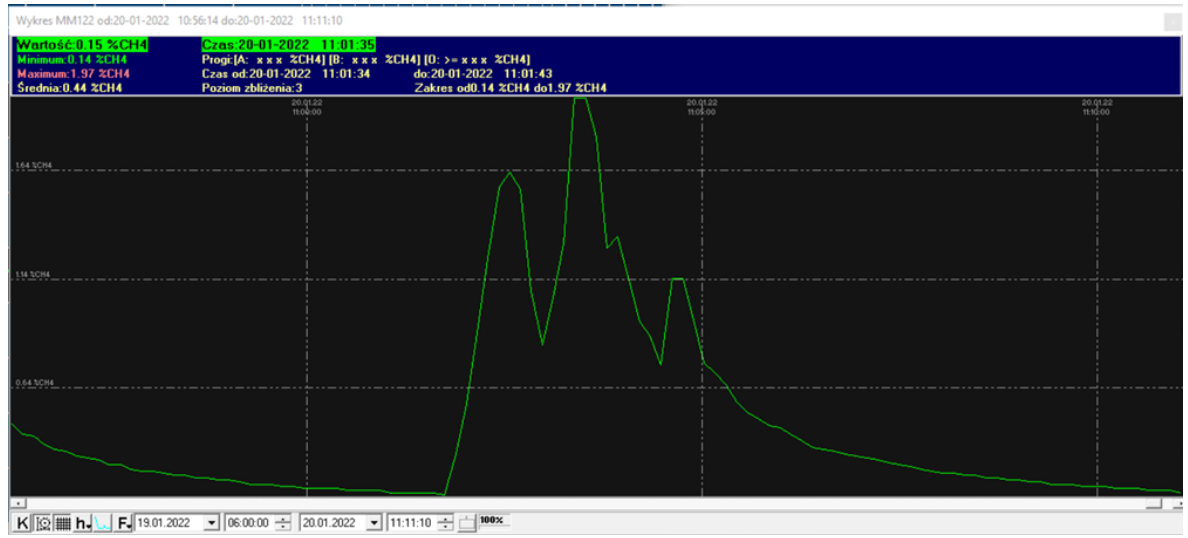
CO

O_2

m/s

kPa, °C

Typical methanometer installed at EM „Barbara” mine and widely used in Polish mines



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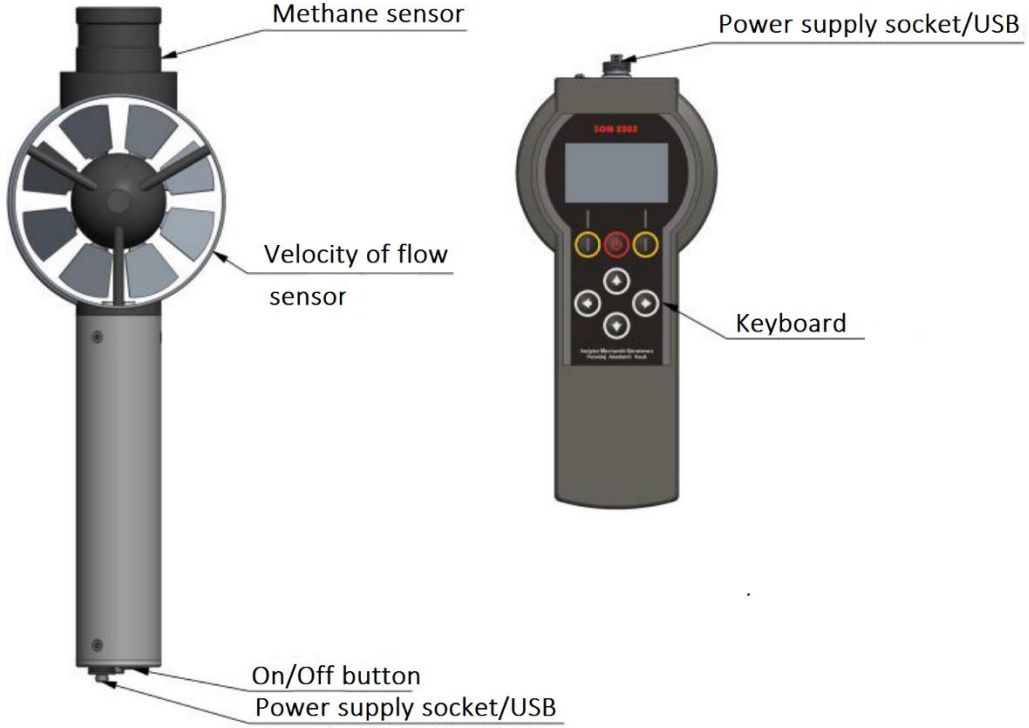
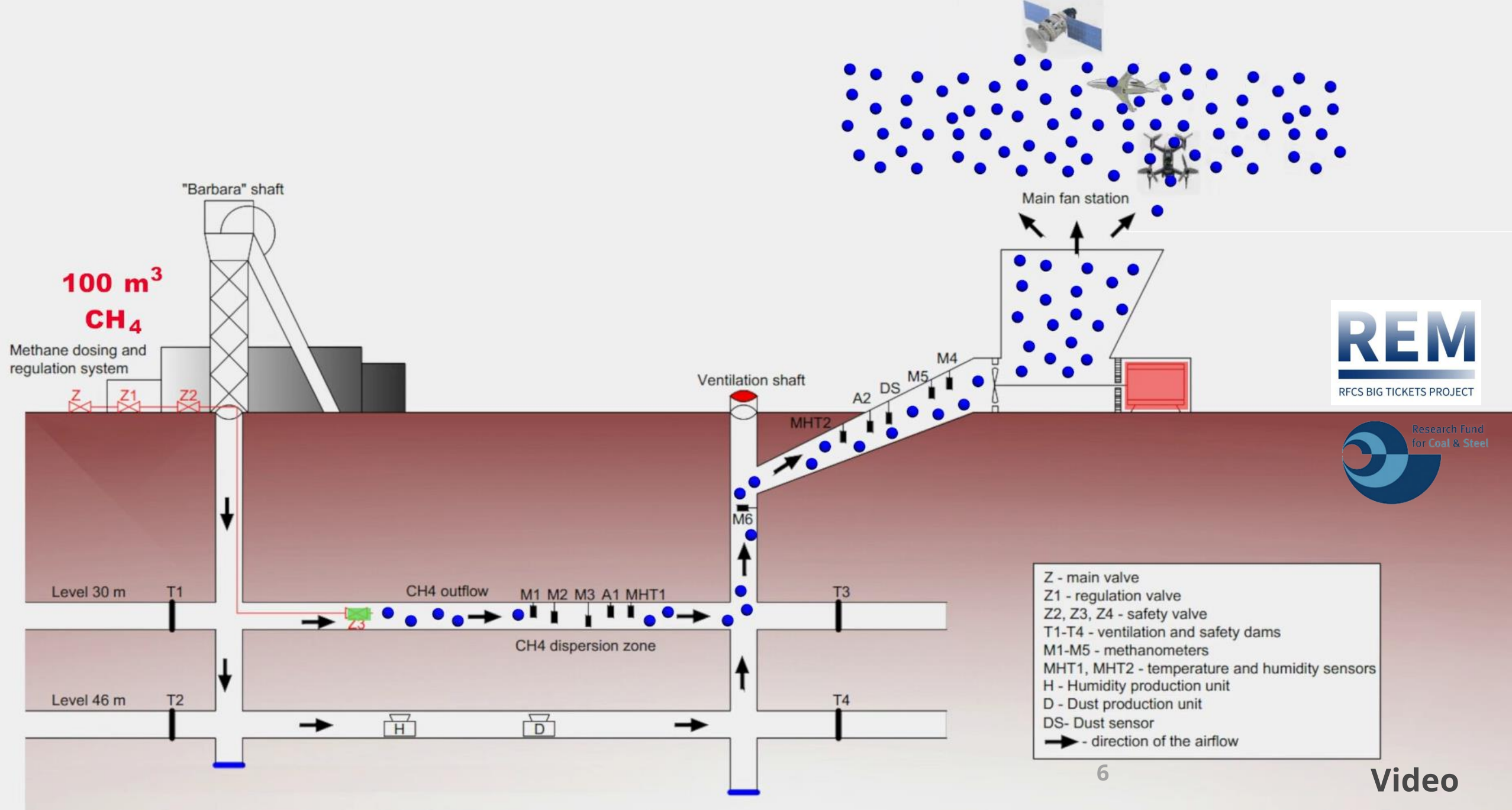
METHANEAMOMETER SOM 2303
A COMBINED METER OF VELOCITY AND METHANE

Instytut Mechaniki Górotworu PAN



Velocity sensor:
Range of velocity: ± (**0,16 ÷ 10,0 m/s**)
Velocity measurement error: ± (**0,5% rdg* + 0,02 m/s**)
Resolution for velocity measurement : 0,01 m/s
Sensor type: rotating vane

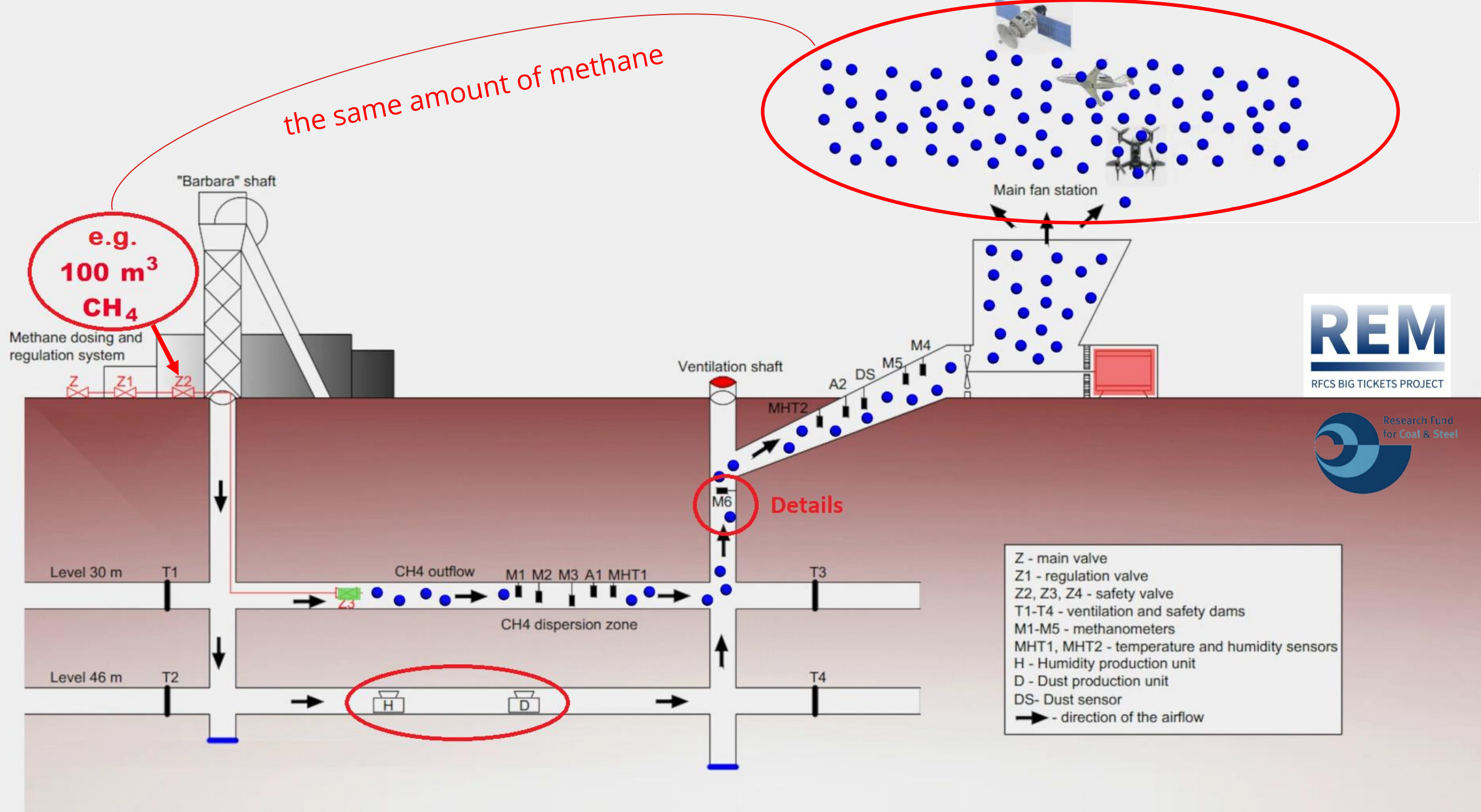
Methane concentration sensor:
Range of methane concentration: 0 ÷ 100% V/V**
Sub-Ranges : 0 ÷100% LEL***; 5 ÷100% V/V**
Methane concentration measurement error::
0,1% for range 0 ÷ 2% V/V**
5% for range 2 ÷ 5% V/V**
3% for range 5 ÷ 60% V/V**
5% for range 60 ÷100% V/V**
Low concentration sensor type: catalytic
High concentration sensor type: conductometric
Response time **T90: < 3 s**
Resolution of measurement: **0,1%**
for range 0 ÷ 100% V/V**
*Abbreviations: * rdg – reading, ** V/V – volume fraction in percent (volume/volume) *** LEL- Lower Explosive Limit.*
1.3 Measurement frequency: **1 Hz**
1.4 Wireless connection: Radio module 868 MHz, SRD, 14 dBm
1.5 Cable connection: USB 2
1.6 Power supply: Ni-MH 4,8 V/ 1,5 Ah rechargeable battery
1.7 **Duration of continuous operation: 10 h**
1.8 Operational temperature range: -20oC < Ta < 40oC
1.9 Operational relative humidity : < 95% rH (no condensation)
1.10 Ingress protection: IP 54
1.11 Dimensions of Bi-sensor unit: 313 x 40 / 102 x 60 mm
1.12 Carrying case dimensions: 330 x 110 x 90 mm
1.13 Bi-sensor unit mass: 0,75 kg
1.14 Mass with carrying case: 1,51 kg
1.15 Additional functions:
Real time clock.
Calibration of the methane sensor via a computer.
Autonomous operation mode (standalone recorder).
1.16 Memory of measured data:
74 measurement sessions, exclusively in the autonomous mode.
Session duration limit: 138 hours.
Cyclic buffer overwriting the oldest data.
Automatic session numbering (incremental).
1.17 Intrinsic safety category: **I M1 Ex ia I Ma**
1.18 Mechanical damage prevention: Protect from shocks and vibrations
1.19 Dust concentration limit: 1000 mg/m3



REM
RFCS BIG TICKETS PROJECT

Research Fund for Coal & Steel

Video


the same amount of methane
e.g.
100 m3
CH4
Methane dosing and regulation system
"Barbara" shaft
Z
Z1
Z2
Ventilation shaft
Main fan station
M4
M5
DS
A2
MHT2
M6
Details
Level 30 m
T1
CH4 outflow
M1 M2 M3 A1 MHT1
T3
Z3
CH4 dispersion zone
Level 46 m
T2
T4
H
D
Z - main valve
Z1 - regulation valve
Z2, Z3, Z4 - safety valve
T1-T4 - ventilation and safety dams
M1-M5 - methanometers
MHT1, MHT2 - temperature and humidity sensors
H - Humidity production unit
D - Dust production unit
DS- Dust sensor
- direction of the airflow
REM
RFCS BIG TICKETS PROJECT
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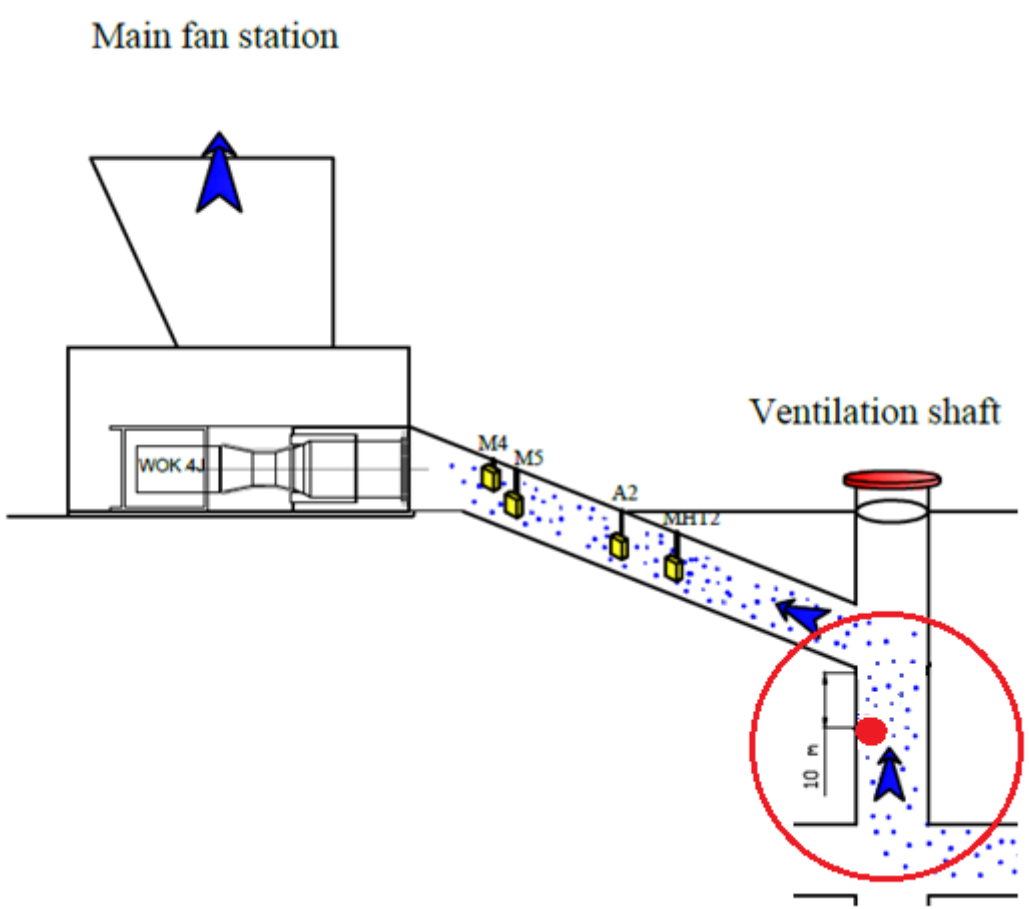
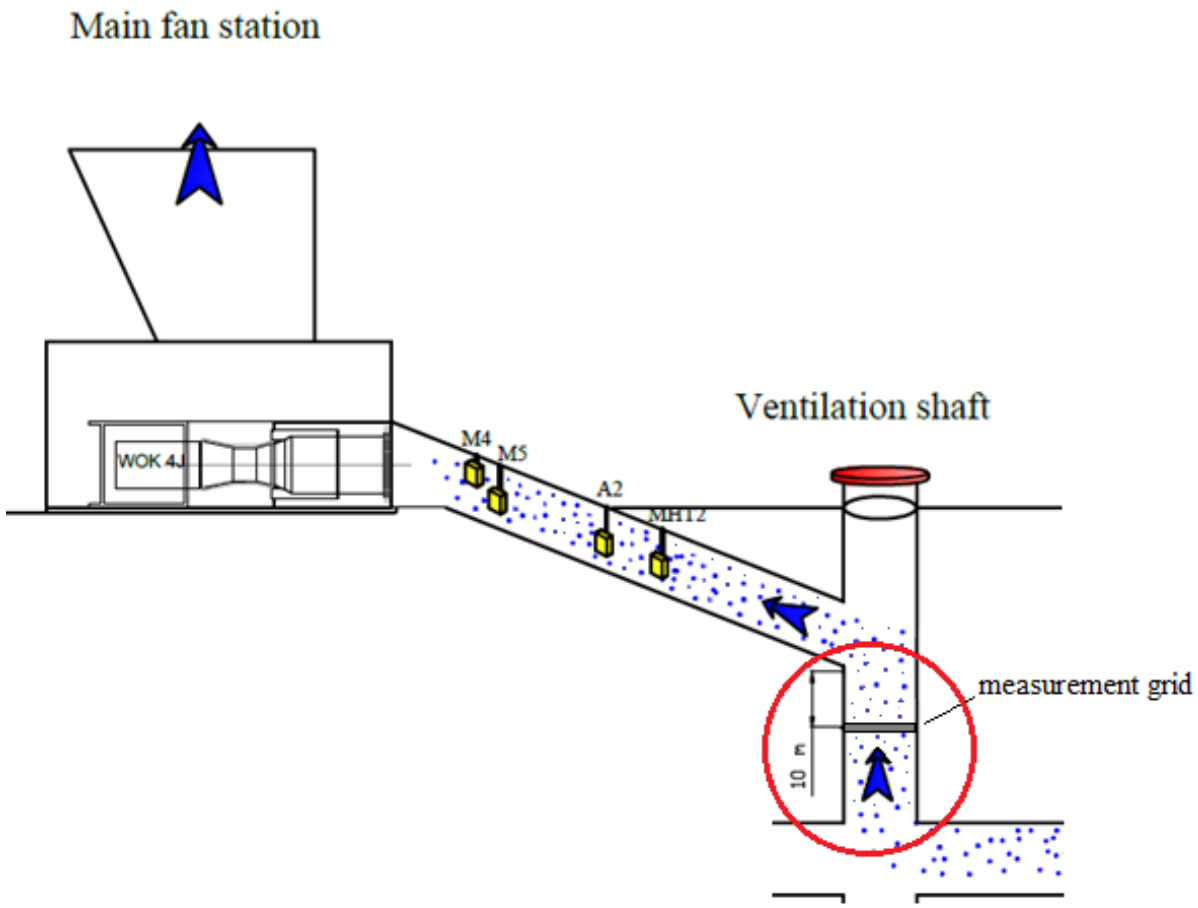
VAM EMISSIONS MEASUREMENT SYSTEM IN VENTILATION SHAFTS



Current methane measurement system



Proposed methane measurement system for the research

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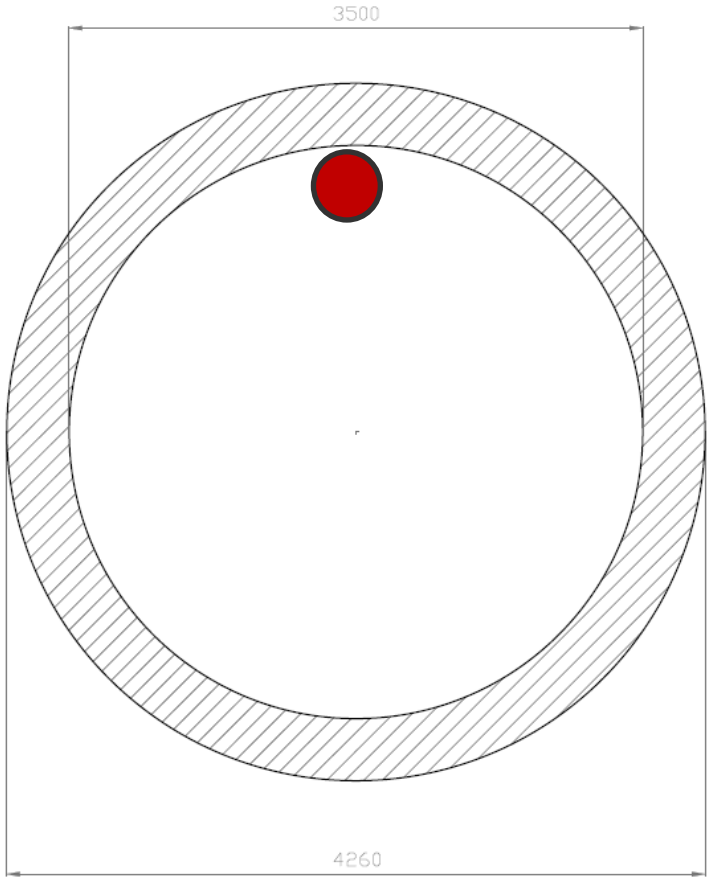
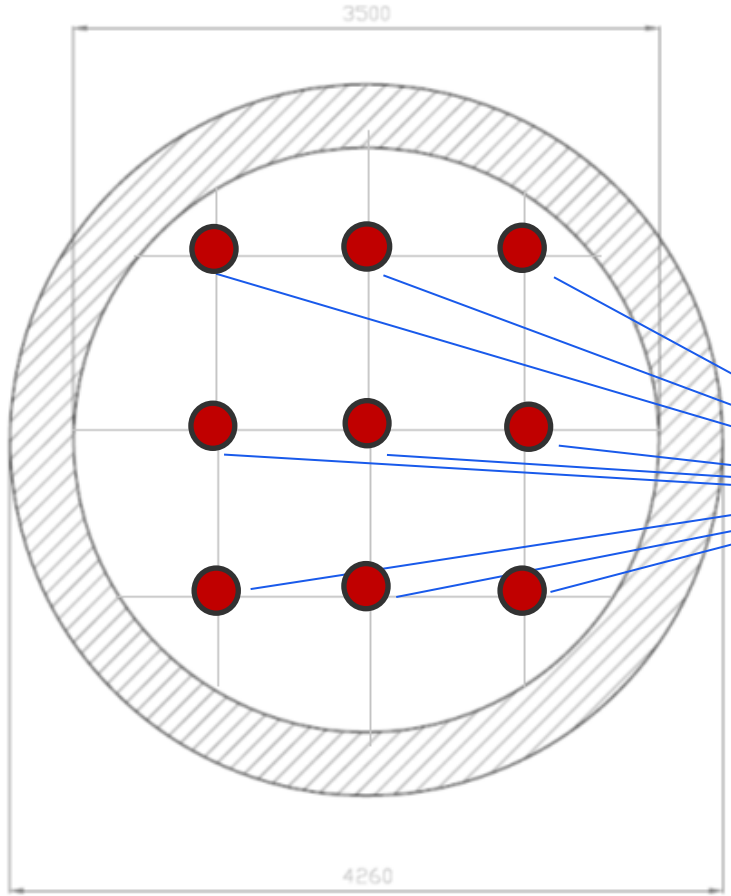
CROSS-SECTION OF THE VENTILATION SHAFT



Current methane measurement system
(are the measurements correct?)



Proposed methane measurement system for the research

gas sampling bag

chromatograph

methane sensor

gas sampling hosepipes

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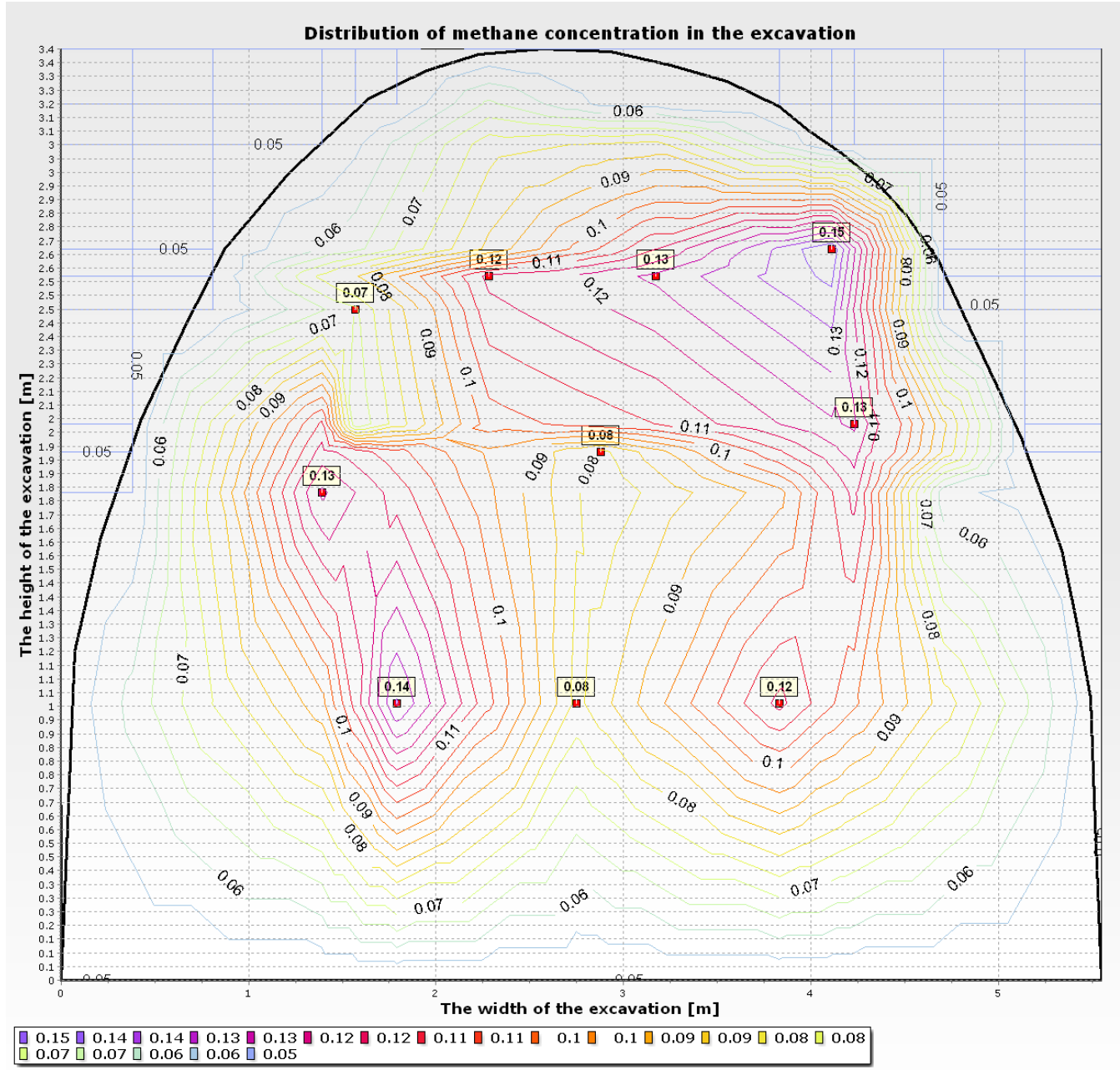
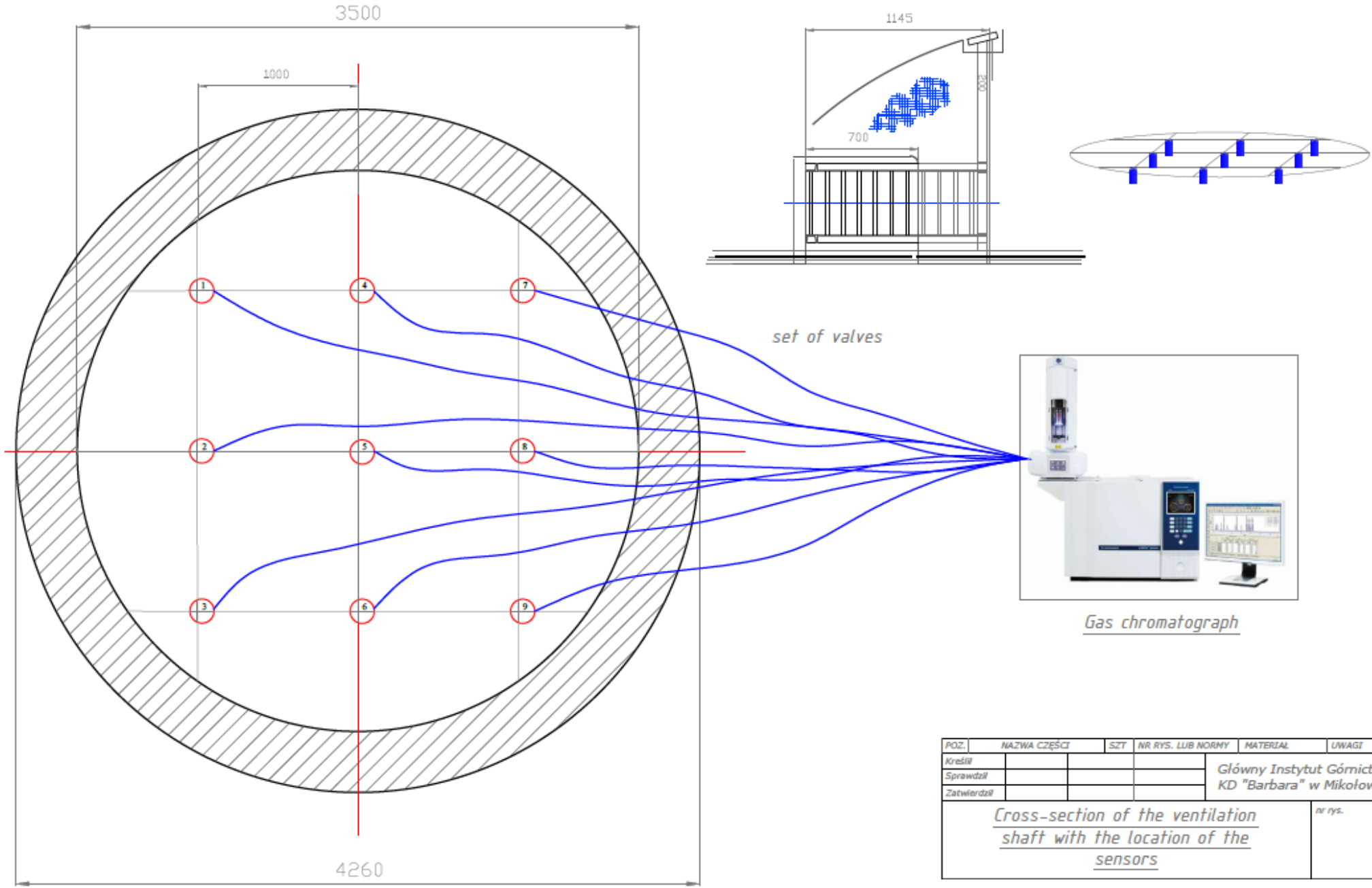

Distribution of methane concentration in the excavation
The height of the excavation [m]
The width of the excavation [m]
0.15 0.14 0.14 0.13 0.13 0.12 0.12 0.11 0.11 0.1 0.1 0.09 0.09 0.08 0.08
0.07 0.07 0.06 0.06 0.05



set of valves

Gas chromatograph

POZ.	NAZWA CZĘŚCI	SZT	NR RYS. LUB NORMY	MATERIAŁ	UWAGI
Kreślił				Główny Instytut Górnictwa KD "Barbara" w Mikołowie	
Sprawdził					
Zatwierdził					

Cross-section of the ventilation shaft with the location of the sensors

nr rys.

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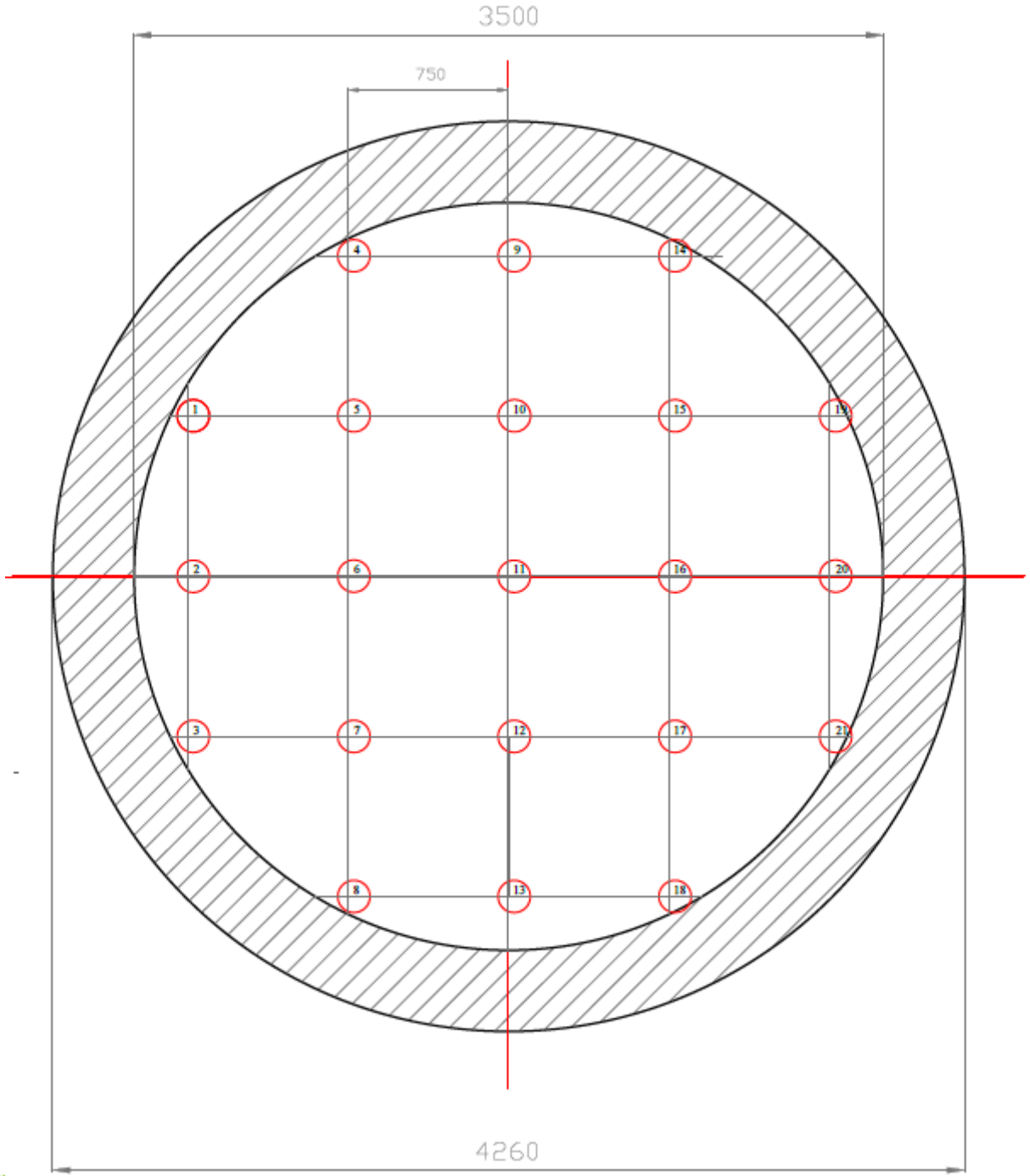

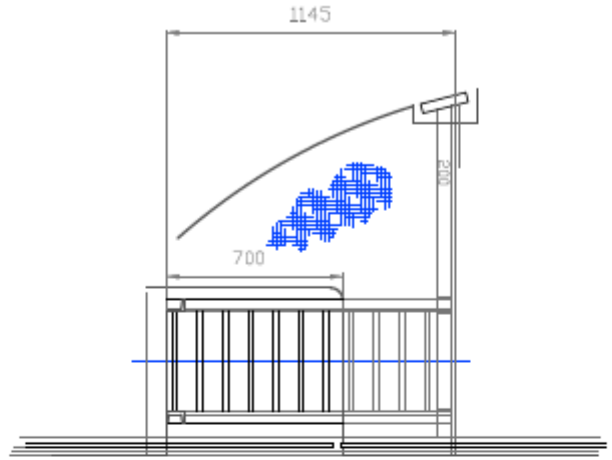

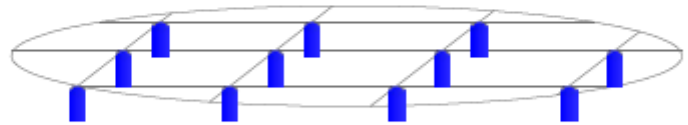

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Cross-section of the ventilation shaft with the location of the sensors

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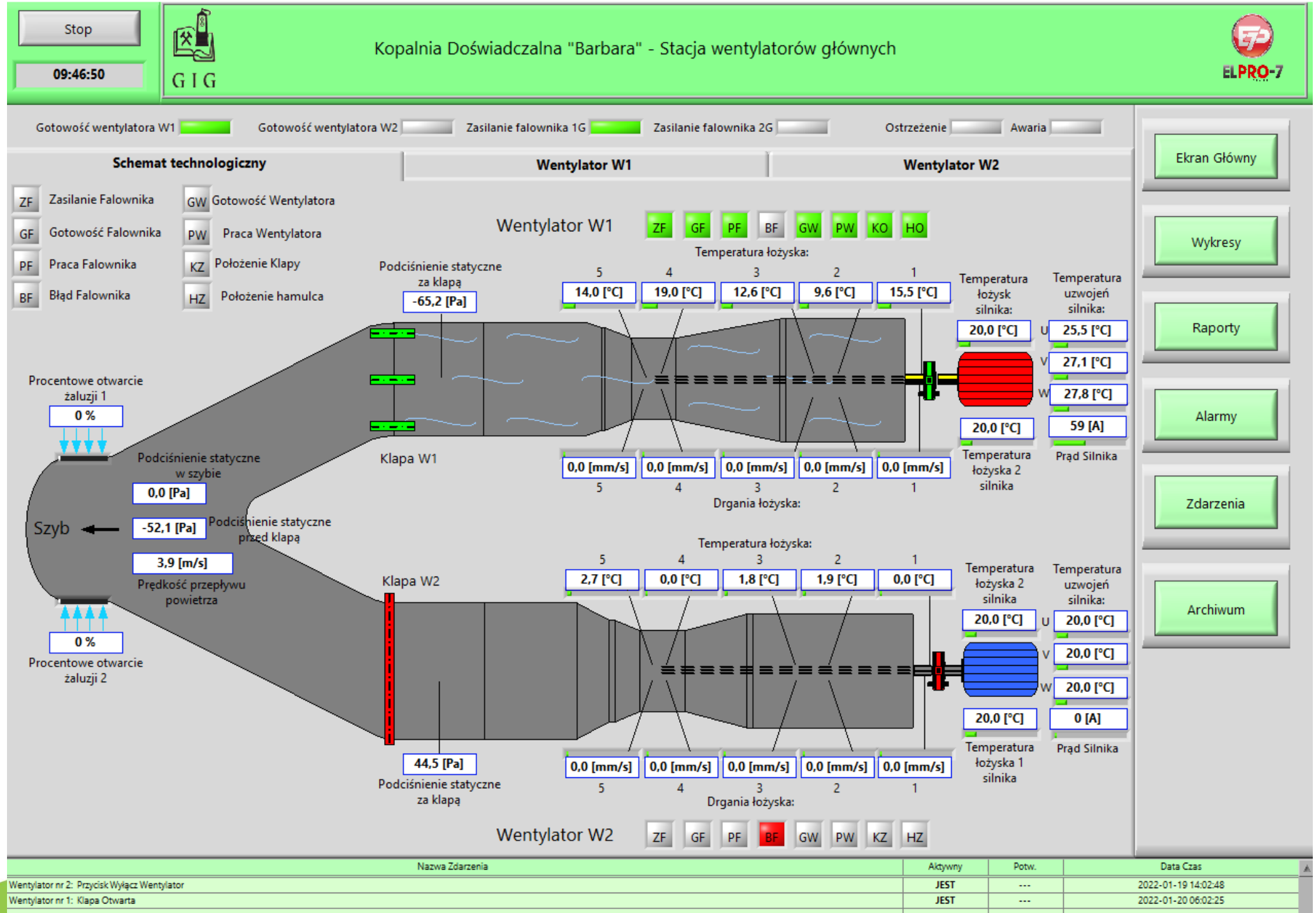

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POSSIBILITIES OF RESEARCH AT EM „BARBARA”

The underground and surface infrastructure of EM "Barbara" allows the establishment of in-situ conditions identical to those in operating mines and therefore enables:

Verification of methane measurements in mine ventilation shafts

It can be achieved by:

- comparing the readings of the sensors currently used in the shaft (1 sensor on the sidewall opposed to averaged value from the grid)
- installing a measuring grid with several methane and air velocity sensors and later confirming the readings of these sensors by chromatography
- based on the indication of the grid measurements results, a comparison of the calculated value of a total amount of methane released from the ventilation shaft with the total amount of methane input

Assessment of methane emission measurements precision

It can be achieved by:

- emitting a specific quantity of methane over a specified time interval (e.g. 1 tonne of CH_4 in 24h) to verify the accuracy of indications from 3 types of measuring devices (satellite, plane, drone),
- the possibility of obtaining a certain concentration of methane 0 – 2% (even 4%),
- adjustable airflow (0 – 4000m^3/min),
- possibility to simulate dust conditions,
- possibility to simulate humidity conditions,

Potential advantages of the planned research:

- certainty of the emitted methane amount,
- possibility to study the influence of seasons and weather conditions (wind, fog)
- the possibility of developing an accurate measurement system (e.g. laser methane sensors at the outlet of the diffusers)

THANK YOU FOR ATTENTION

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