

Slide 1

**The experience of conducting an underground mine rescuing operation using the isolation method followed by the isolated volume reduction**

**Esteemed colleagues!**

I present to you the essential description of the rescuing operation that took place at “Raspadskaya” mine in 2013 in the aftermath of methane flash fire in the goaf of a longwall panel.

Slide 2

The “Raspadskaya” mine had started its operation in 1973. The mine produces up to 7500 tons of coal every year. Absolute methane emission is 48,6 m<sup>3</sup>/min, and the relative emission is 57,9 m<sup>3</sup>/ton.

Three main fans were used for the purposes of delivering fresh air into the mine. The fans were functioning in the compression mode. The air intake quantity was 35028 m<sup>3</sup>/min.

The longwall panel the accident took place at belongs to the seam 9.

Slide 3

Fresh air for the longwall coalface was supplied by the U type ventilation, with return air passing through the bleeder into the methane dilution chamber.

The coalface was supplied with fresh air using two ventilation gate roads.

Return air flowed through the main gate, and then after dilution, through the nearest breakthrough and the tailgate to the ventilation shaft.

The longwall coalface width was 288 m, the length of the panel was 3410 m.

The absolute methane emission at the coalface was 5,92 m<sup>3</sup>/min. The airflow quantity supplied to the coalface was 2090 m<sup>3</sup>/min.

On 6 May 2013 carbon dioxide detector installed near the methane dilution chamber showed the gas concentration exceeding its permissible limit. The

personnel was evacuated from the mine. The gas concentration in the longwall airways was monitored during the following 12 hours.

Mine rescuers inspected the blast proof goaf isolating stoppings.

Analysis of the samples taken from the goaf air through the stoppings showed the presence of fire indicator gases. Maximal fire indicator gases concentrations were  $\text{CO}=0,42\%$ ,  $\text{H}_2=0,11\%$ . Thus, the endogenous fire was detected.

Slide 4

The endogenous fire could have caused an explosion in the mine. In order to ensure mine rescuing operation's safety, the explosion wave impact area was determined. A part of the goaf was presumed to be filled with combustible methane mixture. Based on the impact area computation, the decision was made on the location of the blast proof stoppings isolating the panel. 18 parachute-type stoppings reducing the possible explosion wave impact had been installed in the roadways. The blast proof stoppings were going to be erected under their cover.

Slide 5

In the process of preparation for longwall panel's isolation, freon-R114b2 was supplied through the borehole №1 to the goaf for the purposes of phlegmatization. Through the boreholes №1 and 2 gas nitrogen was supplied.

During the reconnaissance mine rescuers found out that one stopping had been partially destroyed by the explosion wave and one of the parachute-type stoppings had its straps cut off. Mine rescuers were evacuated to the surface. The consecutive monitoring of air contents was performed using the distant control system.

Slide 6

After that, the explosion wave impact area was recomputed using the new data. Part of the maingate inside the goaf was presumed to be filled with combustible methane mixture. The computation showed that the locations of the stoppings determined earlier were inside the impact zone.

Slide 7

Meanwhile, the inertization of the combustible goaf atmosphere continued with the usage of gas nitrogen supply from the surface. A stationary nitrogen supply terminal was installed near the boreholes 1 and 2. A mobile nitrogen supply station was installed on the degassing borehole in order to conduct the nitrogen intake through the degassing tube.

The analysis of the air samples taken from the goaf showed the **ineffectiveness** of the inertization measures. The concentration of oxygen inside the goaf exceeded 15%. The presence of the fire indicator gases implied the continuation of the fire.

The isolation of the goaf was ineffective due to the partially destroyed stopping.

Considering the aforementioned factors, the process of fire extinguishing was divided in three stages:

**stage I:** Roadways isolation at safe distances

**stage 2:** Inertization of the isolated area's atmosphere

**stage 3:** Reduction of the emergency area's boundaries

Slide 8

**Stage one — Isolation**

At the first stage, 11 stoppings erected at safe distances were used to isolate the roadways. Simultaneously, the inertization of the goaf atmosphere using gas nitrogen, freon-R114b2 and inert foam supply through degassing tube and boreholes №1 and 2 continued.

The construction of three stoppings was complicated by the excessive compression in the shafts as well as the resulting reduction of the air quantity supplied to the underlying seam 7.

Slide 9

**Stage two — inertization**

The second stage of the fire extinguishing was conducted by the mine workers.

New boreholes had been drilled from the surface.

The goaf inertization continued using **3 255 kg** of freon-R114b2, **4 483 872m<sup>3</sup>** of gas nitrogen and **596 180m<sup>3</sup>** of inert foam.

The analysis of the air samples taken from the goaf showed that the second stage of the fire extinguishing achieved its goals: the oxygen concentration was below 10%.

|          |
|----------|
| Slide 10 |
|----------|

### **Stage III — Reduction of the emergency area's boundaries**

At the third stage of the fire extinguishing, isolated roadways inertization continued in order to keep the oxygen concentration below 10%.

A stopping was constructed in the breakthrough between the seam 9 roadways and the shaft for the purposes of seams 6 and 7 roadways ventilation. The concrete mixture was supplied from the upper seam 10 through the shaft using a high-pressure hose. The “Tekblend” concrete mixture was used for the stoppings’ construction. Maximal horizontal travelling distance of the mixture from the pump is 300m. Because of this, at first step-by-step boundaries reduction was contemplated, every step being a new stopping construction 300 m from the previous one. Using this method, 31 stoppings had to be erected which would take 5 months.

|          |
|----------|
| Slide 11 |
|----------|

After the thorough study of the “Raspadskaya” mine topology, a new area isolation solution was found: only five stoppings had to be constructed.

The stoppings were erected through the boreholes Ø100mm, drilled from the underlying seam 7.

The distance between the seams was 38 m. The concrete mixture pump was located in the seam 7 roadways. Rubber hoses were lifted with the winch installed in the isolated area of the seam 9 roadways. Stoppings construction was conducted

at considerable distances from the roadways with fresh airflow. The oxygen concentration in the isolated area was below 10%. Travelling time to the stoppings' locations and back was 1,5 hours.

Slide 12

After the fire indicator gases disappearance from the samples, mine rescuers reconnoitered the isolated seam 9 roadways. The reconnaissance showed the absence of high temperature and fire gases. The stoppings were deconstructed and the isolated roadways were ventilated. After the maintenance, the panel's deposits were extracted.

Slide 13

**Thank you for your attention.**