The decommissioning of main upcast shaft of the Barbora mine in Karviná, Ostrava-Karviná Coalfield, Czech Republic

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Vyradenie výbuchom bane Barbora z prevádzky v uhoľnom revíri Ostrava – Karviná v Českej Republike

This contribution solves the problems of decommissioning the main mine working of underground mine, namely the upcast shaft of closed Barbora Mine in the Ostrava-Karviná Coalfield. It deals with explosion-proof sealing of the decommissioned shaft by stoppings on individual mine levels, the dismantling and removal of shaft equipment, the demolition of shaft building, the preparation of shaft itself for backfilling operations, the installation of safety monitoring sensors, the establishment of sites for air composition sampling, the technology for shaft backfilling and the construction of safety gas-tight slab on the surface.

Key words: *Mining, shaft – main mine working, mine atmosphere, stopping, sampling, backfilling material, cement-fly ash mixture, safety cap, vent pipe.*

Introduction

The main upcast shaft (henceforth referred to as MUS) together with the downcast shaft TJ No. 2 of the Barbora Mine is situated in the Karviná II–Doly mining claim and, organizationally, it came under the company OKD, a.s. – Darkov Mine, branch plant. The mining claim of the area of 483.1912 hectares is there in the following cadastral areas: Prostřední Suchá, Horní Suchá and Karviná-Doly, and has a shape of irregular polygon. MUS is of circular cross-section and is 787 m deep; in a section from the shaft mouth to the depth of 373 m, the shaft has the diameter of 5.8 m, from 373 m to the bottom, the shaft has the diameter of 6.13 m.

The management of mining company OKD, a.s. Ostrava decided about closing down the underground mining of hard coal in the Barbora Mine in the year 2003. To change the method of mine ventilation, the main mine fan (MMF) was stopped in October 2003 and mine workings of Barbora Mine were only used for the intake of fresh air into a part of the mining field of adjacent Darkov Mine, under which the Barbora Mine organizationally belonged.

Subsequently, by the Resolution of the Government of the Czech Republic No. 395 of April 23, 2003 the Barbora Mine was transferred under the administration of the state enterprise, DIAMO, s.p., branch plant, ODRA, o.z., with the head office in Ostrava-Vítkovice on January 1, 2004. It performed the closure of this mine.

A Decommissioning Project for the Upcast Shaft of Barbora Mine

In the time of transferring the Barbora Mine from OKD, a.s. to DIAMO, s.p., these levels were opened: 6, 7, 8a, 8, 9a, 9. The situation is illustrated schematically in Figure 1.

With reference to the fact that the Darkov Mine (part of OKD, a.s., Ostrava) requires for its activities the intake of fresh air into a part of the mining field "Gabriela" through mine workings on the 9th level of the Barbora Mine for a certain time (about by the year 2008), an agreement was closed between the organizations concerning the maintenance of these mine workings necessary for securing the supply of fresh air into the mining field of Darkov Mine in operating conditions.

Subsequently, ODRA, o.z. of DIAMO, s.p. began to prepare the decommissioning of the former upcast shaft MUS that was of no use. A decommissioning project and an application for permitting the mining activity consisting in the decommissioning of MUS and levels of no use (6, 7, 8a, 8, 9a, part of 9th levels) of the Barbora Mine were elaborated.

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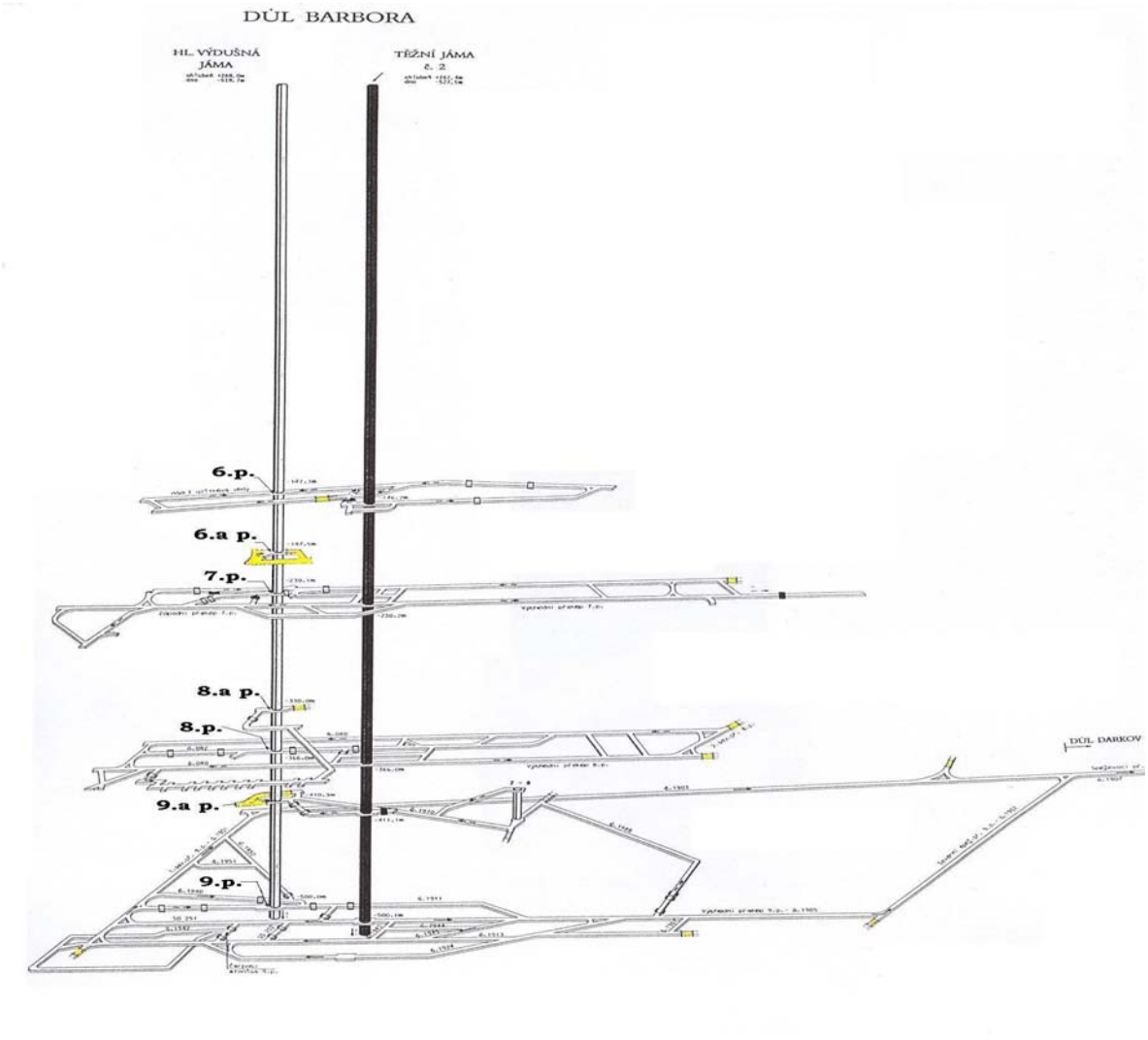

Fig. 1. The isometric layout of main mine workings in the Barbora Mine.

For closing the levels and explosion-proof sealing (Barbora Mine is classed into the category of mines with the methane explosion hazard class II) from abandoned mine workings, 14 stoppings were built.

The Sequence of Shaft Decommissioning Works

The explosion-proof sealing is ensured by stoppings that were produced by filling the space between two temporary stopping brattices with fly ash mixed with water. The temporary stopping brattices are formed by steel bars of the cross-section K 24, to which rough logs were wired; boards of the thickness of 25mm were nailed to them and covered with jute fabrics. The production of fly ash mixture was performed in the surface mixing station consisting of the dry fly ash tank (volume of 100 m^3), the equipment for dosing and feeding into a screw agitator with the supply of water, from which the fly ash, after mixing with water and blending, was discharged into flushing pipes and piped through MUS with branches into individual levels. All stoppings are equipped in accordance with the requirements of valid mining legislation and into chosen stoppings, 800 mm ducts with a manway were installed that served the ventilation and check of closed areas before the beginning of MUS decommissioning by backfilling.

Simultaneously, with the construction of stoppings in the mine, other works on the preparation of MUS for the decommissioning were done. Subsurface passages connected to the MUS- mine escape way, airways leading to the main mine fans and the energy conduits were flushed with fly ash. Necessary adjustments of pipes in the shaft were done, the electrical equipment was dismantled, the shaft lining preventing the backfill material from passing through the shaft was removed. After that, transport vessels of hoisting equipment of MUS were drawn and modifications of shaft building were done to ensure its effective ventilation in the course of backfilling. At the same time, a monitoring system was installed

for the observation of air composition in the shaft and the safety area of the shaft and for the measurement of depth of the backfilling material level in the shaft – see Figure 2.

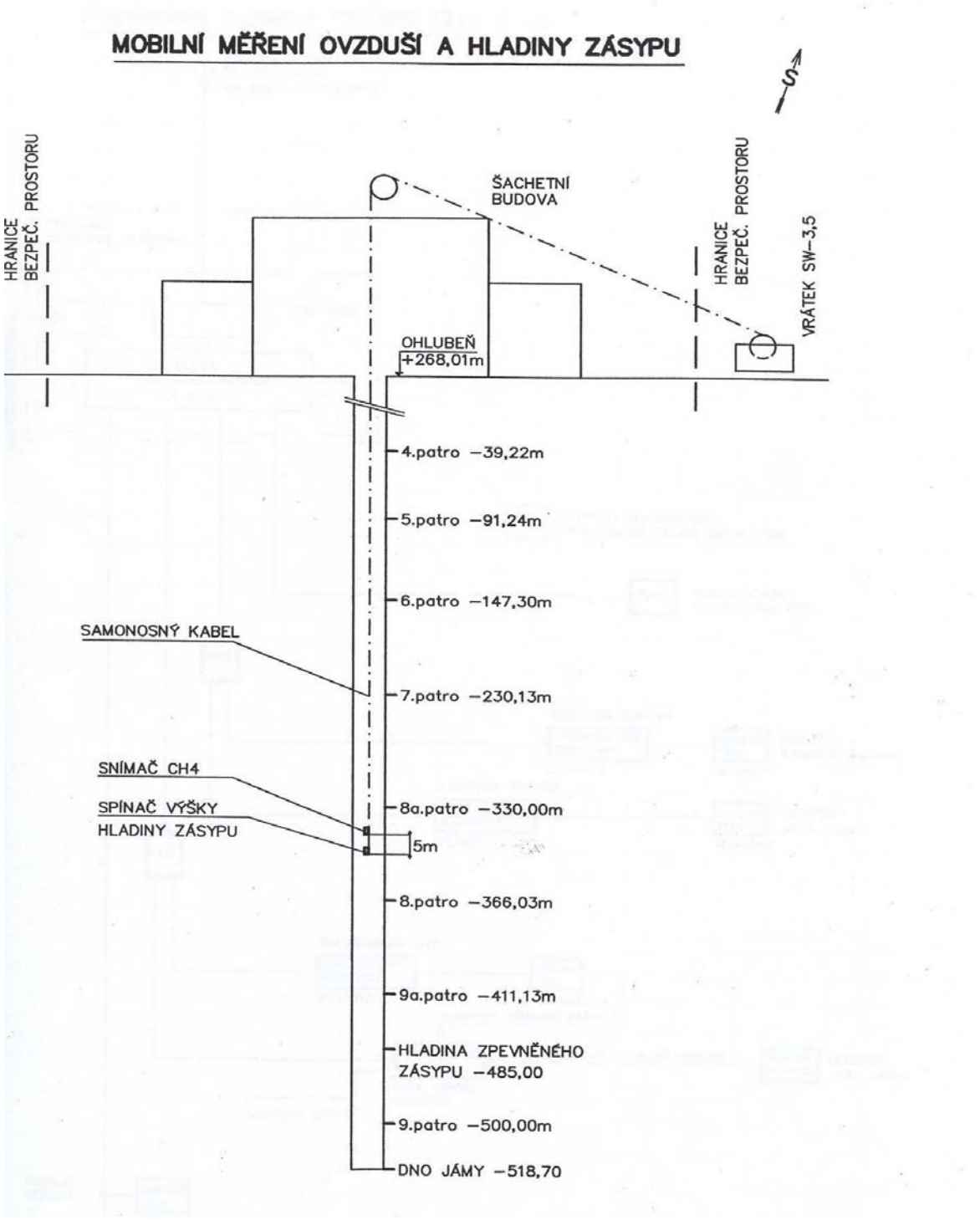

Fig. 2. Measurement of air composition and backfill level in the course of upcast shaft backfilling.

Backfilling Materials

To a temporary storage site in the MUS vicinity, 22 000 m^3 of unconsolidated backfilling material was delivered (the calculated volume of material for the shaft backfilling amounted to 21 890 m^3) by lorries and a transport line was installed that consisted of one scraper conveyor of the TH 601 type with the length

of about 30 m and one belt conveyor of the TP 630/1000 type with the length of about 70 m. The material was tipped into the shaft through a so-called "technological window" in the masonry of shaft building.

For the MUS decommissioning, a technology of combining consolidated and unconsolidated backfilling materials was chosen. With the consolidated backfilling material, the section of decommissioned shaft from the bottom to the height of 15 m above the lowest level (9^{th} level) was filled. In this plug formed by the cement-fly ash mixture CP-5 (compressions strength of 5 MPa), pipes DN 200 were left to ensure the ventilation of shaft section between the plug and the closest opened $9a^{th}$ level.

The cement-fly ash mixture was produced on the surface similarly to the fly ash mixture, into which the cement grout was added at a determined ratio by a dosing pump into the mixing machine. The formed mixture was transported to the place of delivery by pipes DN 150 running through MUS and disconnected on the level of 20 m above the 9^{th} level. The plug was formed layer by layer and, after maturing the last layer, passages through the stoppings on the 8^{th}, $9a^{th}$ and 9^{th} levels were closed on September 5, 2005; the ventilation pipe leading through the plug was closed on the 9^{th} level, and backfilling with the unconsolidated filling material was started.

The unconsolidated backfilling material (size of 50-250 mm) consisting of refuse from the preparation plant of Darkov Mine was loaded on the scraper conveyor by wheeled and belt loaders. The shaft backfilling itself was performed continuously, only with interruptions for taking measurements of the depth of backfill level, the composition of atmosphere in the shaft under decommissioning and the carrying out of necessary repairs and maintenance of equipment.

In the course of a night shift on September 22, 2005, the shaft backfilling was completed by reaching the determined backfill level depth of 22 m below the MUS mouth, see Figure 3.

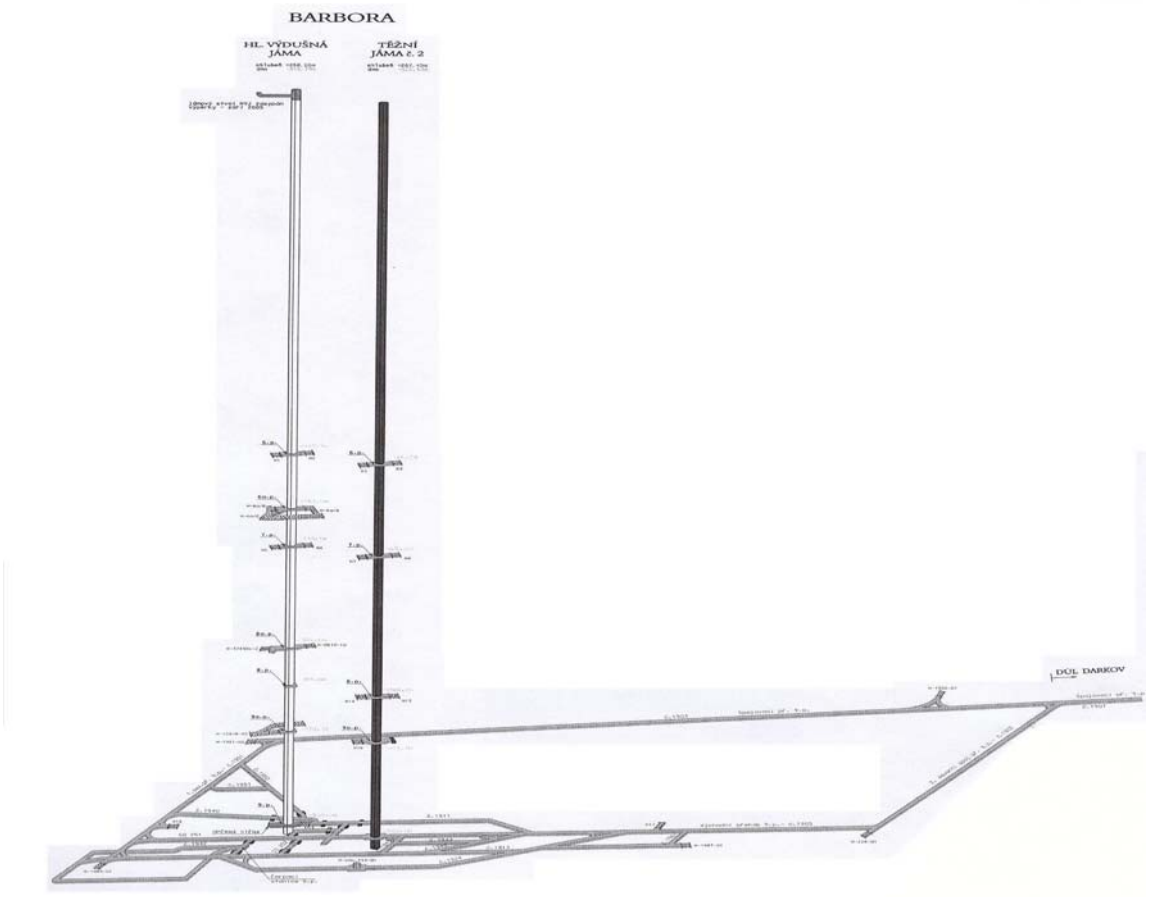

Fig. 3. The isometric layout of shafts of the Barbora Mine after the MUS backfilling.

Surface Safety Plug and Safety Vent Pipe

After finishing the phase of filling with the unconsolidated backfilling material, a shaft top (surface) plug began to be constructed. It consists of a 2 m gravel layer, 2 m B20 concrete layer, 16 m layer of CP 5 cement-fly ash mixture and a 2 m B20 concrete layer. Through all these layers of surface plug, steel

pipes of the diameter of 630 mm for additional filling and pipes of the diameter of 150 mm for degassing run. They were installed into the space of plug before the commencement of plug construction.

In the next phase of decommissioning, the shaft building was demolished and a shaft cap (reinforced concrete slab) of surface size of 13x14 m overlapping the outline of shaft building was constructed, the degassing pipe and the surface vent pipe, on which a point for measuring and sampling the air from the underground mine workings was installed, were interconnected.

After fencing the safety cap, an information plate with identification data on the decommissioned upcast shaft of Barbora Mine was placed on the surface of the concrete slab.

Conclusion

By the construction of safety concrete slab, the shaft history was ended. It had begun by the commencement of shaft sinking that was performed from the year 1908 to the year 1940. After completing the shaft, the Austria Mine was renamed to the Barbora Mine in the year 1910 and, in the year 1951, the Mine was joined with the Hohenegger Mine to form the 1. máj Giant Mine, renamed to the 1. máj Mine on July 1, 1960. On May 2, 1991 this mine became a part of the Darkov Mine having the mine plants Barbora, Mír and Darkov.

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