



The Process of Closing of Ventilation Areas of the Paskov Mine, OKD a.s. – Czech Republic

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Abstract

On the 31st March 2017, the mining of hard coal in the last active mine in the Ostrava part of Ostrava-Karviná Coalfield was completed according to plan. Based on the decision of management of the company OKD, a.s. concerning the closure of the Paskov Mine, a plan of gradual closure of individual ventilation areas of the mine was prepared. Currently, the Paskov Mine is, from the point of view of mining legislation, in the stage of treatment and, in accordance with this plan, operations connected with the closure of individual areas are being performed. The decommissioning of main mine workings can be commenced after obtaining a necessary permit from the District Mining Authority for the area of the Moravian-Silesian and the Olomouc Region. In the article, information on the current process of closing of ventilation areas of the Paskov Mine and the expected subsequent process of mine closure is summarised.

Key words: underground mine, ventilation, main fan, mine safety, mine decommissioning

Introduction

In the year 1994, the separate Paskov and Staříč Mines were merged to the group Paskov Mine. By the 30th June 1999, the Paskov Mine consisted of two mine plants, namely the Paskov and Staříč plants. Since the 1st July 1999, when the Paskov Mine was included into the organisational structure of OKD, a.s., Odra Mine, o.z. (phase out of mining), the Paskov Mine, renamed to Důlní závod Útlum-Jih on the 1st April 2017, has consisted of a single mine – the original separate Staříč Mine. To make the text clearer, the name Paskov Mine is used in description.

In the middle of the year 2018, the commencement of closure of the Paskov Mine due to economic reasons is expected. In connection with the termination of mining activities, a gradual phase-out will take place in the localities of Staříč, Sviadnov and Chlebovice – removal of equipment that could cause environmental damage, closure of ventilation areas, closing of main mine workings open to the surface and demolition of buildings situated in the safety zones of shafts [1, 2].

The Paskov Mine, in which a deposit of hard coal of Carboniferous age was mined in the framework of the Ostrava-Karviná Coalfield, is there about 15 km south of Ostrava. It is situated in the Příbor part of the Czech Part of the Upper Silesian Basin. Owing to its comparatively large extent, the Paskov Mine is internally divided into three localities, namely Staříč I at Sviadnov, Staříč II at Staříč, and Staříč III at Chlebovice. The mining claim (42.5 km²) is neither adjacent to any other mine of the company OKD, a.s., nor interconnected with another mine by means of mine workings.

Here, seams of the Petřkovice and Hrušov Members of the Ostrava Formation, characterised by a relatively small thickness and complicated tectonic pattern making development and mining operations difficult, were mined.

Reduction in the Paskov Mine Ventilation Network

The Paskov Mine Closure Plan, including the closure of localities of Sviadnov, Staříč and Chlebovice, in the order as given here, was originally proposed with simultaneous operation of main fans (henceforth referred to as HV) in the localities of Staříč and Chlebovice for the duration of closure of the localities of Sviadnov and Staříč. In the course of implementation of the closure, specialists of the Paskov Mine designed a mine closure method with the temporary shut-down of HV in the locality of Chlebovice [5, 6].

According to the newly designed method of mine closure, only one HV, namely the fan in the locality of Staříč will be in operation. It will ensure the ventilation of the mine field in the course of closure of the localities of Sviadnov and Staříč. The HV in the locality of Chlebovice will be temporarily shut down. At the time of commencement of closure of shafts in the locality of Staříč (commencement of shaft backfilling), the operation of the HV in the locality of Chlebovice will be resumed and the HV in the locality of Staříč will be shut down permanently.

In the following chapters the newly proposed method of reduction in the mine workings and the ventilation network of the mine is described [3, 4].

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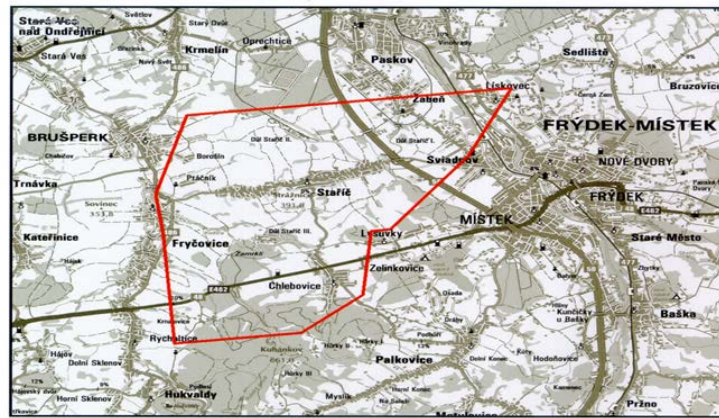


Fig. 1. Topographic situation of the Staříč mining claim
Rys. 1. Sytuacja topograficzna kopalni Staříč

Paskov Mine Ventilation System

The Paskov Mine consists of three localities opened always by means of two central shafts with a finished cross-section of 7.5 m². The locality of Staříč I (Sviadnov) is opened by a pair of central shafts ST I/1 and St I/2, the locality of Staříč II (Staříč) is opened by a pair of central shafts II/3 (return shaft) and II/4 (intake shaft) and the locality of Staříč III (Chlebovice) is opened by a pair of central shafts III/5 (return shaft) and III/6 (intake shaft).

Since the 2nd May 2014, the Paskov Mine has consisted, from the ventilation point of view, of two ventilation systems, namely ventilation area of the return shaft No. II/3 (locality of Staříč) and ventilation area of the return shaft No. III/5 (locality of Chlebovice). By shutting down main fans placed at the return shaft No. I/1, the ventilation area of the return shaft No. I/1 ceased to exist on the 2nd May 2014. Both the shafts in the locality of Sviadnov (shaft No. I/1 and shaft No. I/2) have remained in existence and fulfil the function of parallel intake shafts in the Paskov Mine ventilation system. With the ventilation area of the locality of Staříč, at the level of Level 3 they are interconnected by means of cross-cut 2033 with explosion-proof insulation by a pair of dams with dam doors. Individual localities of the mine have separate central ventilation systems with one intake shaft and one return shaft. The localities of the mine are isolated from each other at the level of Level 3 on the cross-cuts 2032/4 and 2033 by means of pairs of dams with dam doors, on the cross-cut 2032 by a dam with a passage through it and the system of created inter-area diagonally connected separate ventilation splits with inlets in the locality of Staříč and outlets in the locality of Chlebovice, based on the approval granted through Decisions of the District Mining Authority for the Moravian-Silesian and the Olomouc Regions. In the Paskov Mine ventilation system, the following 14 separate ventilation splits (henceforth referred to as SVO) existed on the 1st April 2017 (see Fig. No. 2):

in the locality of Staříč – 4 SVOs:

1. SVO of seam 074 (21a),
2. SVO of face 084 273 in seam 22f,
3. SVO of seam 082 (22d),
4. SVO of face 080 211 in seam 22b.

in the locality of Chlebovice – 10 SVOs

Six splits were created in the locality of Chlebovice, namely:

1. SVO of face 112 408 in seam B4,
2. SVO of main entries in seam B4,
3. SVO of development workings in seams 059, 063 (16),
4. SVO of face 121 761/1 in seam B7,
5. SVO of face 112 751 in seam B4,
6. SVO of face 145 436 in seam B14.

Four SVOs were formed as inter-area SVOs diagonally connected between the locality of Staříč and that of Chlebovice:

7. SVO of face 041 626 in seam 10a,
8. SVO of face 077 782 in seam 21d,
9. SVO of face 063 608/1 in seam 17b,
10. SVO of face 059 607 in seam 16.

Other interconnections between the localities (ventilation areas) have the character of “short-circuit” interconnection and are explosion isolated in accordance with Art. 94 and Art. 93, par. c) of Decree of the Czech Mining Authority No. 22/89 Coll., as amended.

Reduction in the Paskov Mine Ventilation Network before Decommissioning the Shaft No. I/1 and the Shaft No. I/2 for Excluding the Locality of Sviadnov from the Paskov Mine Ventilation Network

Before preparation operations connected with detaching the locality of Sviadnov from the ventilation network of the mine plant Důlní závod 3, the ventilation network must be simplified by means of temporary closures, it means that marginal areas in the mining field

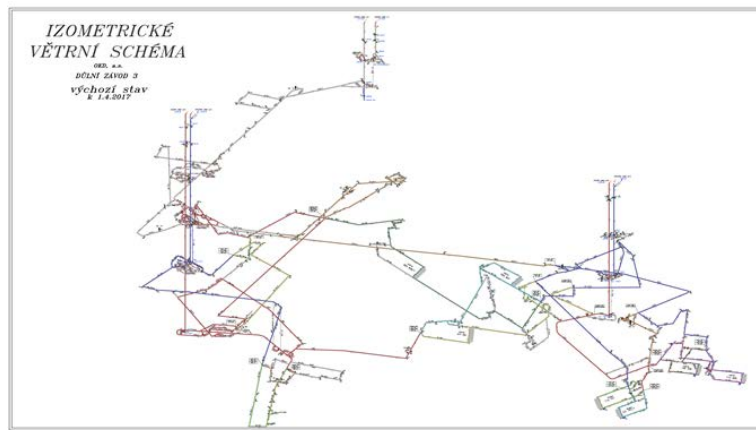


Fig. 2. Isometric diagram – as of 1 April 2017
Rys. 2. Diagram izometrii – stan 1 kwietnia 2017

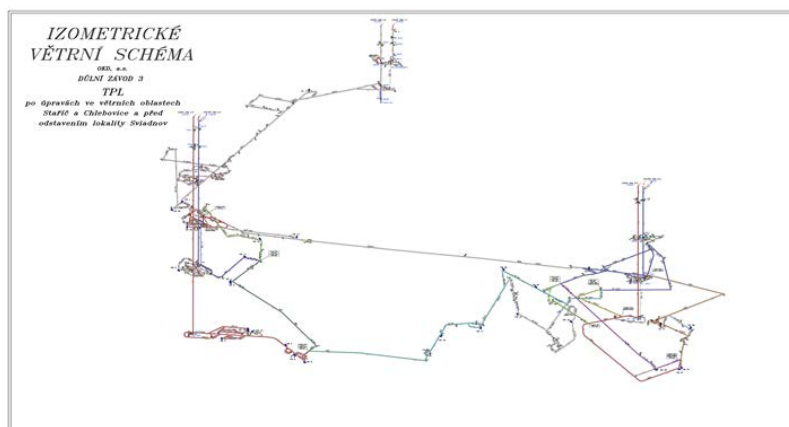


Fig. 3. Isometric diagram – before detaching the locality of Sviadnov
Rys. 3. Schemat izometryczny – przed odłączeniem kopalni Sviadnov

of the locality of Staříč and the locality of Chlebovice must be closed by means of closing dams (henceforth referred to as UH) to be proof against explosion. It is the case of the following areas (see Figures 2 and 3):

- area of SVO of face 080 211 and SVO of face 084 273 (UH 2 to UH 8)
- area of SVO of seam 074 (UH 9 to UH 11)
- area of SVO of face 063 608/1 and SVO of face 041 626 (UH 12 to UH 15)
- area of SVO of face 077 781 (UH 16 to UH 18)
- area of SVO of face 145 436 (UH 45 and UH 46)
- area of SVO of face 112 751 and SVO of face 121 761/1 (UH 47 and UH 48)
- area of cross-cut 2234 and cross-cut 2234/1 (UH 55 and UH 56)
- area of SVO of face 112 408 (UH 57 and UH 58)
- area of face 059 607 (UH 59 and UH 60).

After the above-mentioned temporary closures of marginal areas in the mining field of the locality of Staříč and the locality of Chlebovice, preparation operations may be commenced for decommissioning the shaft No. I/1 and

the shaft No. I/2 and for excluding the locality of Sviadnov from the Paskov Mine ventilation network, see Fig. 3.

Exclusion of the Locality of Sviadnov from the Paskov Mine Ventilation Network

The main fans at the return shaft No. I/1 were shut down on the 2nd May 2014, and since then both shafts in the locality of Sviadnov (shaft No. I/1 and shaft No. I/2) have been preserved, interconnected at the level of Level 2 by by-passes; in the Paskov Mine ventilation system they fulfil a function of parallel intake shafts.

The intake shaft No. I/1 is sunk to the level of Level 2 and is interconnected between Level 2 and Level 3 via an inter-level large-dimension borehole No. 13 with a diameter of 2360 mm.

With the ventilation system of the locality of Staříč, the intake shafts Nos. I/1 and I/2 are interconnected at the level of Level 3 with the connecting cross-cut 2033 with explosion-proof insulation by means of a pair of dams with dam doors (in the sense of Art. 94 and Art. 93, par. c) of Decree of the Czech Mining Authority No. 22/89 Coll., as amended). All other mine workings were closed to be proof against explosion.

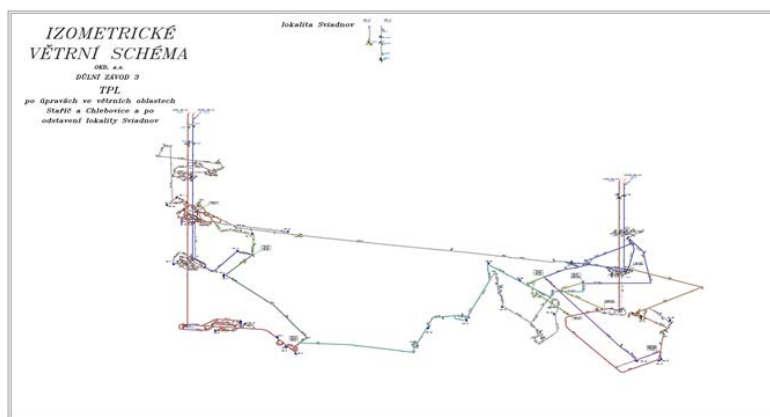


Fig. 4. Isometric diagram – after detaching the locality of Sviadnov
Rys. 4. Schemat izometryczny – po odłączeniu kopalni Sviadnov

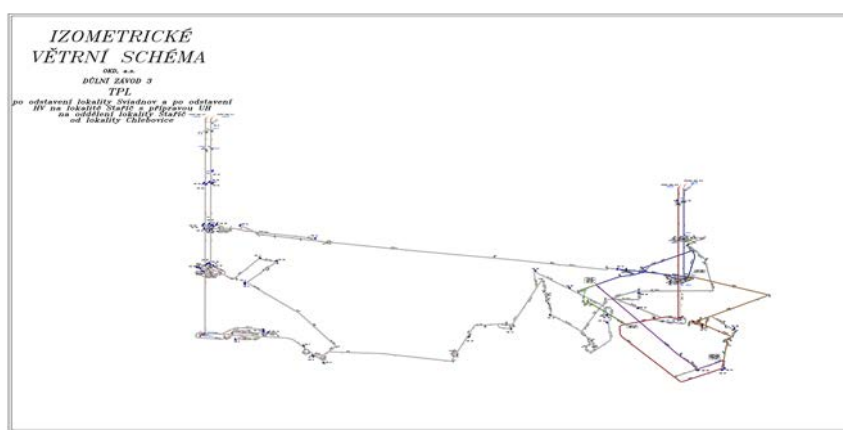


Fig. 5. Isometric diagram – after shutting down the HVs in the locality of Staříč
Rys. 5. Schemat izometryczny – po wyłączeniu głównego wentylatora (HV) w kopalni Staříč

After shutting down the main fans, i.e. after changing the return shaft No. I/1 to the intake shaft, the explosion-proof insulation devices at the level of Level 2 between the intake shaft No. I/1 and the intake shaft No. I/2 (in the sense of Art. 94 and Art. 93, par. c) of Decree of the Czech Mining Authority No. 22/89 Coll., as amended) were removed; the left devices fulfil the function of control ventilation devices for regulating and directing air currents. After the implemented temporary closures of marginal areas in the mining field of the locality of Staříč and the locality of Chlebovice, stated in chapter “Reduction in the Paskov Mine Ventilation Network before Decommissioning the Shaft No. I/1 and the Shaft No. I/2 for Excluding the Locality of Sviadnov from the Paskov Mine Ventilation Network” (see Figure 2), operations connected with decommissioning the shaft No. I/1 and the shaft No. I/2 with subsequent excluding the locality of Sviadnov from the Paskov Mine ventilation network will be commenced.

On the cross-cut 2033, after the branch with the cross-cut 2234, an explosion-proof dam UH 1 with a pair of ventilation tubes with a diameter of 800 mm (LPO 800) will be constructed, in the shaft No. I/2 at

the level of Level 1 a shaft plug Z 1 with a pair of ventilation tubes with a diameter of 600 mm will be constructed, and in the channel of the main fans at the shaft No. I/1, a counter dam OZ 1 will be built to ensure the ventilation of the shaft No. I/1 and the shaft No. I/2, including their by-passes and the cross-cut 2033/1 and part of the cross-cut 2033 by means of a through-circulating current. In the shaft No. I/2 from the surface to the constructed shaft plug Z 1 with a pair of ventilation tubes with a diameter of 600 mm at the level of Level 1, ducts of separate ventilation will be laid, which will be put into operation after commencement of closure of the shaft No. I/2, i.e. after the loss of through-circulating current (after closing the ventilation tubes in the shaft plug Z 1). On the surface, entrances of the shaft house of the shaft No. I/1 will be modified for installation of belt conveyors for backfilling the shaft No. I/1.

After commencement of backfilling the shaft No. I/1 and loss of the through-circulating current at the level of Level 2 of the shaft No. I/1, the pair of ventilation tubes with a diameter of 800 mm in the UH 1 on the cross-cut 2033 (after the branch with the cross-cut 2234) will be closed; as well, the pair of ventilation

tubes with a diameter of 600 mm in the shaft plug Z 1 at the level of Level 1 of the shaft No. I/2 will be closed and separate ventilation in the shaft No. I/2 (for ventilation of the shaft No. I/2 as far as the shaft plug Z 1) will be put into operation. In this way the locality of Sviadnov will be excluded from the Paskov Mine ventilation network and decommissioning of the shafts Nos. I/1 and I/2 will be possible to be performed independently of the Paskov Mine ventilation system (see Figure 3).

Excluding the Locality of Staříč from the Paskov Mine Ventilation Network

The phase before shutting down the main fans at the return shaft No. II/3 in the locality of Staříč

This phase is based on the situation of Paskov Mine ventilation network after excluding the locality of Sviadnov from the Paskov Mine ventilation network with decommissioning the shafts No. I/1 and No. I/2 independently of the Paskov Mine ventilation system (see Figure 3). In this phase, modifications as well as reduction in the Paskov Mine ventilation network is expected so that the main fans at the return shaft No. II/3 in the locality of Staříč could be shut down and the return currents ventilating mine workings in the mining field of the locality of Staříč could be transferred to the return shaft No. III/5 at the level of Level 3 in the locality of Chlebovice. It is above all the case of by-passes of the shafts No. II/3 and No. II/4 above Level 2, at the level of Level 2, part of by-passes at the level of Level 3, below Level 3, part of by-passes at the level of Level 4 and above Level 4, namely in the following places:

- intersection with the shaft No. II/3 above Level 2 (UH 19),
- intersections with the shafts Nos. II/3 and II/4 at the level of Level 2 (UH 20 to UH 23),
- closures of by-passes and intersections with the shafts Nos. II/3 and II/4 at the level of Level 3 (UH 24 to UH 28),
- closure of by-pass and intersection with the shaft No. II/3 below the level of Level 3 (UH 29),
- closure of interconnection of the shafts No. II/3 and No. II/4 below the level of Level 3 (UH 30),
- closures of main entries connected with the by-passes of the shafts No. II/3 and No. II/4 at the level of Level 3 (UH 31 and UH 32),
- closure of the large-dimension borehole ŠPV 14 with a diameter of 1340 mm between Level 3 and Level 4 at the shaft No. II/4 (UH 33 and UH 34),
- closures of by-passes and intersections with the shaft No. II/3 at and above the level of Level 4 (UH 35 to UH 39).

Together with gradual implementation of the above-mentioned closures, the operating point will

be gradually moved according to the verified operating characteristics of the main fans placed at the return shaft No. II/3 in the locality of Staříč. The shift of the operating point of the main fans will be compensated by artificial increasing the auxiliary intake of airs from the surface and by measures concerning the “short-circuit” interconnections in the ventilation network. The position of individual closing dams and the situation of ventilation network of the mine plant Důlní závod 3 after realization are shown in Figure 4. By the implementation of the above-mentioned closures of mine workings, the Paskov Mine ventilation network will be prepared for shutting down the main fans at the return shaft No. II/3 in the locality of Staříč and transferring the return air currents ventilating mine workings in the mining field of the locality of Staříč to the return shaft No. III/5 at the level of Level 3 in the locality of Chlebovice.

The phase after shutting down the main fans at the return shaft No. II/3 in the locality of Staříč and excluding the locality of Staříč from the Paskov Mine ventilation network

This phase is based on the situation of the Paskov Mine ventilation network in “the phase before shutting down the main fans at the return shaft No. II/3 in the locality of Staříč”. In the phase, shutting down the main fans at the return shaft No. II/3 in the locality Staříč and other modifications and reduction in the Paskov Mine ventilation network are expected so that the locality of Staříč could be excluded from the ventilation network of the mine plant Důlní závod 3 with decommissioning the shafts Nos. II/3 and II/4 independently of the Paskov Mine ventilation system (see Figure 5).

For the shutting down of the main fans at the return shaft No. II/3 in the locality of Staříč and the ventilation of the remaining mine workings in the locality of Staříč by means of “short-circuit” air current, explosion-proof dams with a pair of ventilation tubes with a diameter of 800 mm (LPO 800) will be constructed that will also be used for excluding the locality of Staříč from the Paskov Mine ventilation network, namely in the following places:

- intersection with the shaft No. II/3 on Level 3 (UH 40),
- at the level of Level 3 on the cross-cut 2032 at cross-cut 2334/7 (UH 41),
- on the roadway 063.7342 at the roadway 063.7340/2 (UH 42),
- on the roadway 084.7344/1 at the roadway 084.7344 (UH 43).

For the explosion-proof insulation of air currents in the ventilation networks after excluding the locality of Staříč from the ventilation network, an explosion-proof

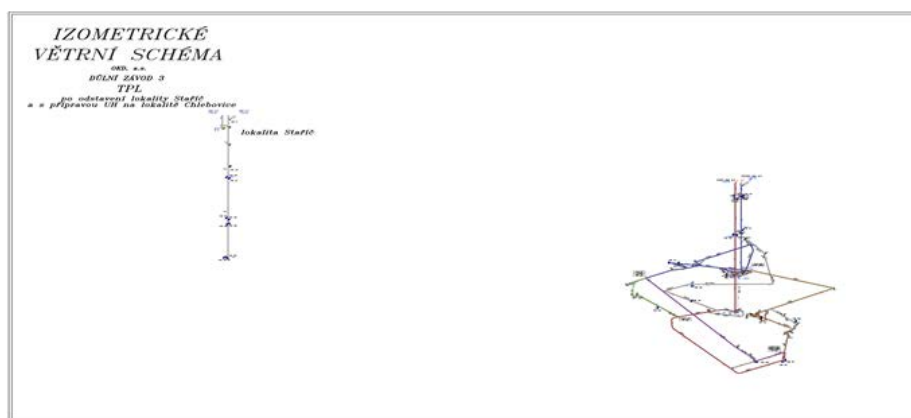


Fig. 6. Isometric diagram – after detaching the locality of Staříč
Rys. 6. Schemat izometryczny – po odłączeniu kopalni Staříč

Fig. 6. Isometric diagram – after detaching the locality of Staříč
Tab. 1. Parametry głównego wentylatora

Parameter	Units	Original variant		New variant
		II/3	III/5	II/3
Fan total volume flow rate	m ³ .s ⁻¹	195.5	130.2	213.8
Power consumption	kW/h	505	540	530
Static pressure in the intake duct	Pa	2142.8	1748.9	1780.4
Setting of control device blades	degrees	-30	-60	-30
Total equivalent cross-section	m ²	5.06	3.73	6.08
Mine equivalent cross-section	m ²	4.12	3.40	5.39
Auxiliary intake	%	23.0	10.8	18.6

dam with a ventilation tube with a diameter of 800 mm will be built on the cross-cut 2342/6 (UH 44).

In the shaft No. II/4 at the level of Level 0, a shaft plug Z 2 with a pair of ventilation tubes with a diameter of 600 mm will be constructed and also ducts of separate ventilation will be laid here, which will be put into operation for closure of the shaft No. II/4 only after the loss of through-circulating current (after closing the ventilation tubes in the shaft plug Z 2). On the surface, entrances of the shaft house of the shaft No. II/3 will be modified for installation of belt conveyors for backfilling the shaft No. II/3 and in the channel of main fans at the shaft No. II/3, a counter dam OZ 2 will be built to ensure the stability of ventilation of the shaft No. II/3 (see Suppl. No. 5).

After commencement of backfilling the shaft No. II/3 and loss of the through-circulating current at the level of Level 4 of the shaft No. II/3, the pair of ventilation tubes with a diameter of 800 mm in the UH 40 (intersection with the shaft No. II/3 on Level 3), in the UH 41 (at the level of Level 3 on the cross-cut 2032 at the cross-cut 2334/7), in the UH 42 (on the roadway 063.7342 at the roadway 063.7340/2) and in the UH 43 (on the roadway 084.7344/1 at the roadway 084.7344) will be closed; as well, the pair of ventilation tubes with

a diameter of 600 mm in the shaft plug Z 2 at the level of Level 0 of the shaft No. II/4 will be closed and the separate ventilation in the shaft No. II/4 (for ventilation of the shaft No. II/4 as far as the shaft plug Z 2) will be put into operation. In this way the locality of Staříč will be excluded from the ventilation network and the decommissioning of the shafts Nos. II/3 and II/4 will be possible to be performed independently of the Paskov Mine ventilation system (see Figure 5).

Economic Evaluation

In the table given (Table No. 1), HV basic operating parameters for both variants in the phase of preparation for decommissioning the mine from the closure of mine workings in the marginal parts of the mining field to the commencement of closure of the shafts in the locality of Staříč are evaluated for comparison.

Shut down main fan at Chlebovice

- Monthly power savings of about 370 000 kW
- Total power savings of about 4 820 000 kW

Conclusion

The commencement of decommissioning the mine is expected after obtaining all valid permits in July

2018. The decommissioning will take place underground as well as on the surface in the safety zones of the shafts in accordance with proposed schedules for about 2.5 years.

The original variant of Paskov Mine closure considered the operation of HVs in the localities of Staříč and Chlebovice. Gradual closure of marginal parts of the mining field resulted in adequate reduction in equivalent cross-sections of ventilation areas with transferring the operating points of HVs to the areas of unstable operations in their verified operating characteristics. The stated shifts of the operating points were compensated by artificial increasing the auxiliary intake from the surface and by controlling the volume flow rates in the ventilation network.

The newly proposed variant with the operation of one HV in the locality of Staříč will avoid the need

for artificial increasing the auxiliary intake from the surface; thus better HV operating efficiency will be achieved. Moreover, it will bring savings in power consumption (by HV temporary shutting down in the locality of Chlebovice) for 13 months, i.e. that period of time in the original schedule for which the simultaneous operation of both HVs was considered.

The temporary shutting down of the main fan in the locality of Chlebovice represents a substantial change in Paskov Mine ventilation (Art. 113 of Decree of the Czech Mining Authority No. 22/1989 Coll., as amended, will represent a substantial change in Paskov Mine ventilation). For the given reason, after the stated change, a pressure image of the mine will be obtained and subsequently, an air balance in the mine will be prepared and submitted to the District Mining Authority for the Moravian-Silesian and the Olomouc Region.

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Proces zamykania obszarów wentylacyjnych Kopalni Paskov, Okd A.S. – Republika Czeska

W dniu 31 marca 2017 r. wydobywanie węgla kamiennego w ostatniej czynnej kopalni w Ostrawskiej części Zagłębia Ostrawsko-Karwińskiego zakończono zgodnie z planem. Na podstawie decyzji zarządu firmy OKD, a.s. w sprawie zamknięcia Kopalni Paskov przygotowano plan stopniowego zamykania poszczególnych obszarów wentylacyjnych kopalni. Obecnie Kopalnia Paskov jest z punktu widzenia przepisów górniczych na etapie likwidacji i zgodnie z tym planem prowadzone są działania związane z zamknięciem poszczególnych obszarów. Likwidacja głównych wyrobisk górniczych może zostać rozpoczęta po uzyskaniu niezbędnego zezwolenia od Powiatowego Urzędu Górniczego na obszar województwa morawsko-śląskiego i olomunieckiego.

W artykule podsumowano informacje na temat aktualnego procesu zamykania obszarów wentylacyjnych kopalni Paskov oraz oczekiwanego późniejszego procesu zamykania kopalni.

Słowa kluczowe: kopalnia podziemna, wentylacja, wentylator główny, bezpieczeństwo kopalni, zamykanie kopalni