

Case Studies: Water-inrushing Accident at Chaohua Mine, Zhengzhou Coal and Electricity Ltd Co.

By Gui Fu, Li Xuandong

China University of Mining and Technology-Beijing

Abstract: In this paper, what was described in detail is the rescuing process of a water-inrushing accident occurred on 11 April (i.e. the “411” accident as it is called), at Chaohua coal mine, Zhengzhou Coal and Electricity Ltd Co, Henan Province, Central China. In the accident, 12 miners were trapped. The process described includes underground detection, emergency plan optimization, and the rescue process itself as well. For this case, what is very important for the successful rescue are the things like orderly organization, rescue professional’s high-level rescuing skills, trapped miners’ excellent self-escaping abilities. The author suggests that: (1) the underground water situation, hydrogeological conditions must be thoroughly investigated in the process of mining; (2) Miners and engineers, and managers must keep safety awareness/consciousness at any time, fully trained; (3) enhancing emergency evacuation tests; (4) enhancing R&D activities for mine emergency rescue; (5) Improving the level of equipment for mine rescue. The above lessons and experiences maybe useful and helpful for mine accidents that are similar to this case.

Key words: mine water-inrushing accident, China coal mine, successfully rescuing process, lessons and experiences

0 Introduction

On April 11, 2004, around 16:00pm, a water-inrushing accident occurred in the developing process of an air return way for the mining Block 21051 in Chaohua Coal Mine, Zhengzhou Coal and Electricity Ltd Co, 12 miners were trapped underground. Immediately after the accident, under the supervision and directions of the State Council, the State Administration of Work Safety, Henan Provincial government, the company and the mine start the rescue process at once according to the emergency plan prepared long before the accident. Marvelously, as a result of an extremely hard, but orderly organized work, all the miners were successfully rescued after trapped for 109 hours underground at 7:50 am, 16 April, creating a real miracle in the rescuing history for mining industry. Now the miners rescued just wok in the same mine and are working as usual.

1. About the Mine and the Accident

1.1 About the Mine

Chaohua Coal Mine is located in the suburbs of Xinmi, a city 55km to Zhengzhou City, the capital of Henan Province. It was put into operation on 8 December 1994. There has never happened a major accident before 2004. The general parameters for the mine are:

Designed capability: 2.3Mt/a;

Hydrogeologic conditions: medium complicity;

Major water-bearing beds: L7-8 limestone under the floor of the coal seam to be mined and sandstone above the roof for the coal seam.

1.2 About the Accidental Area

Geologically, the coal seam in the Block 21051 belongs to Shanxi Group, Permian system, steadily developed in general, but complex in structure. The thickness of the coal seam in Block 21051 is 9.9m on average, inclining by 10.25° .

The air return gate for the working face in Block 21051 began to be developed on 20 September 2003, with a designed length of 1864m. Before the water-inrushing accident, 1668m of the gate had been developed. Normally, the air amount for the developing work was 300m³/min and the amount of emitted methane is 1.2m³/min.

There exist two small mines near the developing working face in Block 21051. One is 100m to the east side, 200m to the north side of the face, another is 200m to the east and 300m to the north side of the developing face. The specific deployment of the small mines is not clear, but there is no water existing in the room for the developing face in Block 21051.

2. The Accident Developing Process

Around 16:00 pm, April 11, 2004, a miner was drilling holes with auger at a height of 1.8m above the floor the air return gate developing face. When depth of the hole was about 0.7~0.8m, water lined out along the auger stem. The miner stopped drilling, and reported to his supervisor, and the supervisor report to his duty senior supervisor.

At 16:32 pm, the duty senior supervisor report the situation to the central control room after checking the situation, then the duty staff at the control room passed this information to related managers of the mine.

17:20 pm, Mr Zhou Dingshuan, a deputy Engineer-in-chief, and LI Aibin entered the mine and checked the situation at the developing working face for the air return way in Bloch 21051.

19:20 pm, the water-inrush accident suddenly occurred.

19:30 pm, a deputy manager of the mine entered the mine to inspect the water situation. He organized the miners to reinforce the roadway and control water flood. All the other miners were informed to leave the mine underground.

21:25 pm, when counting the number of the personnel working underground, it was found that 12 people including Deputy engineer-in-chief ZHOU Dingshuan were absent from their fellow workers, trapped underground.

3 The Rescue Process

3.1 Detection

On 11 April

19:57 pm: the company general control room received the information about the water-inrush accident at the air return gate developing face in Block 21051 from Chaohua mine manager; the company started the emergency programs immediately. A commanding center for “411” accident was established, and 6 working groups were also formed immediately under the commanding center, including

technology team, rescue team, logistics, security service, recovering team, counseling team. The main task of the commanding center was to call for and to organize mine rescue teams from other near mines to carry out rescue task both on the surface and underground at the same time.

21:10 pm: two rescue teams under the direct command of Zhengzhou Coal and Electricity Ltd Co, 12 brigadesman arrived at the Chaohua Mine.

22:00 pm: the rescue team entered the mine and detected underground. They found that the slugged coal was about 80m away from the east side of mid-connecting roadway, only 200mm space between the slugged coal and the roof of the air return way, and the water flow rate was 350m³/h. So they have to start to clear the gate in order to proceed in the gateway.

On April 12

2.00 am, the rescue team inspected once again and reported the primary conditions of the disaster to the commanding centre.

3.2 The Rescue Planning

On April 12, the commanding center worked out a rescue plan based on the information from detecting. (A simplified map of “411” accident in Chaohua mine is shown in Fig 1). The several available approaches were:

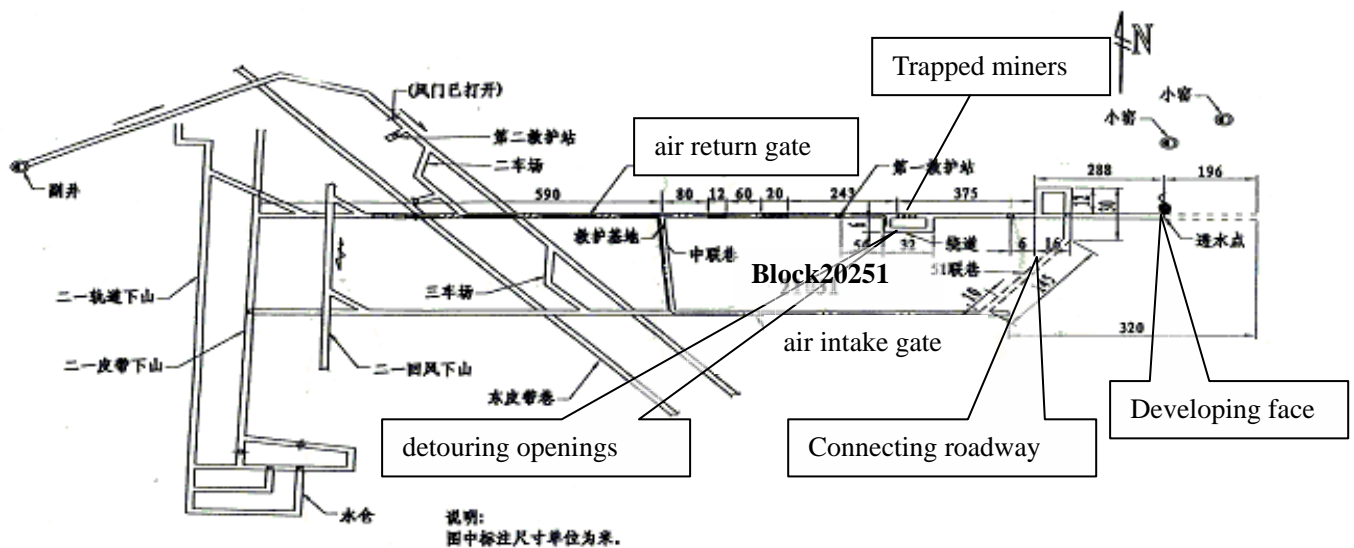


Fig. 1 the area for the “411” accident

(1) Drifting a 50m opening from the air return way detoured the fallen zone, where the 12 miners may be trapped, at the same time, fresh air were being blown into the fallen zone through dust removing pipes to improve the living conditions inside the fallen zone.

(2) Developing a 145m connecting roadway from the air intake way to the air return way for the Block 21051, by which the brigadesman can enter the fallen zone to rescue the people trapped (not to proceed because of the cutting through of the detouring opening);

(3) Detecting the water situations in the small mines near the developing face, cutting off the water flow from the small mines.

(4) Sinking a hole with the high-speed technique of drill from the mine surface to the air return way underground to provide food and fresh air to the possible hiding-places for the miners waiting for rescue. (not to proceed because of the cutting through of the detouring opening);

(5) To facilitate the drifting of the detouring opening and provide fresh air and food to the miners trapped, another choice for rescuing is drilling a 300mm in diameter borehole with a drilling machine borrowed from neighbor mines Pingdingshan Mining Co from the air intake way to the air return way where the accident happened. (not to proceed because of the cutting through of the detouring opening);

3.3 Implement of the Rescue Plan

April 13

0:00 am, began to drift the detouring opening from the air return way and developing the connecting roadway from the air intake way.

8:00 am, began to drill from the mine surface.

April 15

13:16 pm, miners responsible for drifting heard the GREAT shouting from the people waiting for rescue and some sounds of knocking the pipes in the process of drifting. This excited sign was reported to the commanding center. According to those signals, the commanding center asked the drifting people change the direction of drifting in order to get to the people trapped quicker. At the same time, a fresh air base was established underground near the mine exit, providing necessary medical treatment and medicines for the people to be rescued out, and on the surface, 14 numbered ambulances were ready for the people from underground.

April 16

5:40 am, oxygen concentration in the drifting opening near the cutting face was 14.6%, and methane concentration 2.5%. The commanding center think this was a positive situation for cutting through to the air return way.

6:30 am, when the drifting team finished the drifting and got through into the air return way, they met the people who are trapped inside for 5 days.

7:20 am, 12 people were all escorted from the fallen zones to the first underground rescue station, intaking oxygen and warming up, then they were medically treated and were carried to the second underground rescue station, accepting more medical treatment including physical examination such as pulse or heart checkup.

9:30 am, all the 12 miners were lifted to the surface of the mine.

In the whole rescuing, 22 rescue teams, 219 brigadesmen, 14 numbered ambulances, 13 stretchers and lots of rescue medicines and apparatus were used. 12 people trapped underground were safely rescued, the process is a successful campaign.

4 Experiences

4.1 Orderly Organized Rescue

(1) After the accident was reported, the national State Council has given high priority to the rescue. Also after the water-inrushing accident, experts team were sent to the accident site for directing rescue by the State Administration of Coal Mine Safety. Plenty of rescue materials and lots of brigadesmen were sent to the mine by Henan Provincial government, and the local government also paid much attention to the rescuing activities.

(2) In March 2004, Zhengzhou coal and Electricity, the mother company for Chaohua Mine, worked out The Emergency Plan for Major Mine Accidents, an emergence response plan for Chaohua mine was also put in place. Included are specific provisions about the rescue organization, system, logistics and response plan for emergency. So in the rescuing process of “411” accident, organizations were set up rapidly; task for each attended people was clear. All the essential work provided a guaranteed.

(3) The commanding member knew well about the true accidental conditions and made a series of accurate decisions. All the measures were carried out thoroughly during the rescue process. According to changing situations of the action, the rescue organizations were adjusted timely and the schemes were modified again. Many similar approaches were carried out in the same time because of the uncertainties in the accidental situation in case of being delayed and to increase the living opportunities for the people in danger. It was proved that the key points for successful rescue was carrying out several measures immediately and keeping them optimized continually to shorten the rescue time.

(4) Due to careful and conscientious detection, the commanding center made right decisions. They computed the survival time according to the conditions underground, the method of each other's assistance or by oneself, the depletion rate of oxygen, increasing contents of CO₂ and CH₄. Rescue brigadesman took measures as quick as possible because the people in danger may die within 70 minutes under a extremely bad condition while they never gave up the rescue actions because the possible living time for the people in danger may be as long as 16 days. A series of measurement were proposed by the rescue team such as blowing air into the fallen zone etc. The rescue team contributed greatly to the successful rescue.

(5) Each rescuing and recovering approach was carefully and thoroughly implemented. In the morning of April 15, the commanding centre has examined and approved the rescuing and recovering plans for the accident. Two urgent rescue stations were established, plenty of people were arranged in the necessary place, enough foods, medicines and apparatus were supplied.

4.2 High-level Rescuing Skills for the rescue Brigadesman

(1) The commanding teams at the commanding center are all experts in mine accidents. For example, the general manager of the company is a certified safety engineer and the chairing the Mine Rescue Committee. The skills well contribute to the rescue.

(2) The rescue teams have high level rescuing skills, consummating skills, professional style of work

and are strict in discipline. They have been awarded the first class prize in the national contest for mine rescue.

(3) The major rescuing force is the developing team, “416” team, has been the excellent unit of safety work in Chinese coal industry.

4.3 Excellent survival skills of the trapped people

The trapped people have been kept calm, having the confidence that they will be successfully rescued, and going out to the mine surface.

(1) All the trapped people were organized orderly, keeping together, convenient to help each other. Supervised by deputy engineer-in-chief Mr ZHOU Dingshuan, they avoided the flood and hid in a higher tunnel room timely in stead of running blindly and unsafely.

(2) They set up a barrier to block methane entering their staying room.

(3) The 12 mine lamps were kept together, using them in a planned, energy effective way.

(4) Only two people were on duty while keeping others slept, saving their living capabilities, and regularly detecting methane concentration to keep them in safe position.

(5) Various measures were adopted to pass messages to outside, such as clicking pipes, shouting, putting paper slips or even pouring kerosene to the flowing water to send information outward to the rescue team. All those measures are important for the final successful survival.

5. Lessons Learnt

(1) It is extremely important to clearly detect the hydrogeologic conditions for mining, especially the scope for the gob and gob water from small mines.

(2) Promoting the safety consciousness of all the miners, and remember that there should be no miners working underground, according to the “accident triangle theory” proposed by Heinrich in 1931 and accepted by almost all the contemporary safety professionals in the world.

(3) Making miners being fully trained, in case they are in danger or trapped, they have the ability of applying self-rescue measures, keeping confident, calm, and other surviving skills.

(4) Enhancing emergency evacuating test. The information exchange ways used by trapped people and rescue team should be kept understandable.

(5) Improving the emergency equipment level.

6. Conclusions

The successful rescuing, recovering of this water-inrushing accident in Chaohua mine benefits from a reasonable and practical planning, a firm confidence, a capable and professional rescue team, and an effective coordination by various departments under the leadership of officers at the different levels. But some problems were also encountered in mining operation and management of the mine. The main

conclusions for this paper are:

- (1) Sufficient information and practical rescue plan are basic conditions for an effective rescuing.
- (2) An effective coordination among departments is the supportive conditions for a successful rescuing.
- (3) For trapped people, quality training, sufficient knowledge, a practical, dedicated planned waiting are also important for a successful rescuing.

Gui FU PhD

Professor & Head

Department of Safety Engineering

Faculty of Resources & Safety Engineering

China University of Mining and Technology-Beijing

D11 Xueyuan Road, Beijing 100083, PR China

Email: g.fu@cumtb.edu.cn

Ph/Fax: +86-10-82376219, 62331249etx8405

Mobile: +86-13910798870