IMRB GERMANY 2015
CONFERENCE PROCEEDINGS

7th IMRB Conference
Hanover, Germany
6 – 10 September 2015
MEET EXPERTS AND FRIENDS
Conference Room

09:00 a.m. Welcome of the Organizers and Conference Opening
- Welcome Address
  Helmut Ehnes
  Director Prevention, German Social Accident Insurance Institution for the Raw Materials and Chemical Industry (BG RCI) / Secretary General International Section of the ISSA on Prevention in the Mining Industry (ISSA Mining)
- Welcome Address
  Wolfgang Roehl
  Head of Central Mine Rescue Service, Germany / International Mines Rescue Body Conference (IMRB) Chairman / Manager of German Mines Rescue Committee
- Welcome Address
  Regine Kramark
  Mayor of Hanover, Germany
- Welcome Address
  Stefan Dräger
  Dräger, Germany

Key Notes

09:20 a.m. RAG's Way to „Zero Accidents“
Peter Schlimp
Deputy Chairman of the Board RAG Aktiengesellschaft, Germany / Vice President International Section of the ISSA on Prevention in the Mining Industry (ISSA Mining)

10:00 a.m. Vision Zero and the Seven Golden Rules – the Global Prevention Strategy of ISSA for Rescue and Beyond
Helmut Ehnes
Director Prevention, German Social Accident Insurance Institution for the Raw Materials and Chemical Industry (BG RCI) / Secretary General International Section of the ISSA on Prevention in the Mining Industry (ISSA Mining)

10:30 a.m. Coffee Break

IMRB 2015 CONFERENCE

TUESDAY, 8 SEPTEMBER 2015

11:00 a.m. Mining and Metal Material Risk Management: The progress, Focus, Success, Challenges and Way Forward
Hannes Struyweg, Director Health and Safety International Council on Mining & Metals (ICMM), UK

11:30 a.m. Achievements / Experiences and Challenges for OSH in Mining in Latin America
Roberto Morrison, Soletanche Bachy Chile S. A., Chile

12:00 a.m. A Look beyond the Garden Gate: New Solutions for Rescue in Offshore Windenergy-Fields
Dr Markus Stuhr, BG Accident Clinic Hamburg, Germany

Exhibition Floor

12:30 p.m. Lunch Break

Conference Room

01:30 p.m. For Miner’s Life and Property – How China Increases its Capability to Cope With Mining Emergencies
Zou Wei Gang, China

02:00 p.m. Soma Coal Basin and Mining Operation
Metin Aktan, Turkey

02:30 p.m. Getting Mine Rescuers to the Action Faster and Safer
Markus Uchtenhagen, Goldcorp Inc, Canada

03:00 p.m. Coffee Break
03:45 p.m.  
Session 1 “Mine Rescue Management System and Effective Operations”

No. 1.1  
Lassing Mine Disaster  
Dr. Alfred Maier, Austria

No. 1.2  
Experiences From Exogenous Fire Incident Rescue Operations at 1C Coal- Seams – Trangbach East Area of Dongvong Coal Mine Company in Vietnam  
Pham Van Huyen, Vietnam

No. 1.3  
Mine Re-entry Assessment System (MRAS) – A Decision Makers Tool  
David Carey, Australia

03:45 p.m.  
Session 2 “Emergency Preparedness”

No. 2.1  
Collegiate Mine Rescue: The Intangible Benefits  
Prof. Jürgen Brune / Lewi Rawling / Alexander Robles, USA

No. 2.2  
Mines Desaster and Mine Rescue Training Courses in Modern Academic Mining Engineering Programmes  
Prof. Helmut Mischo, Germany

No. 2.3  
SCBA Training for Rescue Workers on Tunnel Construction Sites  
Martin Rauscher, Germany

03:45 p.m.  
Session 3 “Future Trends”

No. 3.1  
Mine Rescue and Command System Base on Panoramas Technology and Three Dimensional Linkage  
Prof. Liu Yongli, China

No. 3.2  
ONE SEVEN Mining, an Innovative System for Firefighting and Prevention in Mining  
Max Stöttner, Germany

No. 3.3  
Development of a Specialised UAV (Unmanned Aerial Vehicle) for „Remote“ Coal Mine Exploration  
Matthew Fellows, Australia

09:00 a.m.  
Session 1 “Mine Rescue Management System and Effective Operations”

No. 1.4  
Mutual Aid System – a Multi Jurisdictional Response Between Several Different Companies  
Lex Lovatt, Canada

No. 1.5  
A Framework For Crisis Management at Mine Accidents With a Special Focus on the Prevention of Posttraumatic Stress Disorders  
Dirk Bergmann, Germany

No. 1.6  
Mine Rescue – a New Way  
Wilhelm Schön, Austria

09:00 a.m.  
Session 2 “Emergency Preparedness”

No. 2.4  
Emergency Preparedness in South Africa  
Christo de Klerk, South Africa

No. 2.5  
Rope Access in German Mines Rescue, Equipment, Devices, Training and Recommendations  
Jens Schulz, Germany

No. 2.6  
Adjusting Mine Rescue to the Requirements of Small Mining Enterprises  
Matthias Kuhn and Dr Walter Hermülheim, Germany

09:00 a.m.  
Session 3 “Future Trends”

No. 3.4  
Enhancing Mine Rescue Communications  
Phil Carrier, USA

No. 3.5  
Mine Rescue Alert System RAG Deutsche Steinkohle  
Christian Brendenahl and Manuela Asam, Germany

No. 3.6  
Using an Hierarchical Approach for the Dilution of Gases after Gas Outbursts  
Dr Elisabeth Clausen, Germany

10:30 a.m.  
Coffee Break
**Session 1: Mine Rescue Management System and Effective Operations**

No. 1.7 A Comparison Between Traditional Timbers and Rescue Struts for Emergency Ground Control
Katherine N. Jennings, USA

No. 1.8 Deployment of a Rescue Team Under NSW Emergency Preparedness and Mines Rescue Guidelines
Peter Conford, Australia

No. 1.9 Modern Escapeway Alternatives
John Murdoch, Australia

No. 1.10 Study on Numerical of the Smoke Flow Regulation and its Application during the Roadway Fire Emergency Rescue in Coal Mines
Dr Wang Kai, China

**Session 2: Emergency Preparedness**

No. 2.7 Emergency Preparedness in Complex Industrial Plants
Raimund Bücher, Germany

No. 2.8 Regulation for Romanian Mining Rescue Teams Intervention
George Artur Găman, Romania

No. 2.9 Safe Control of Spontaneous Combustion Goaf Fires in Longwall Mining
Dr Walter Hermelheim, Germany

**Session 3: Future Trends**

No. 3.7 Fire Prevention in Underground Mining – Requirements for Equipment in Germany and Europe
Christoph Müller, Germany

No. 3.8 New Zealand Underground Mines Emergency Protocol – a Multi Stakeholder Policy For Managing Underground Mine Emergencies
Trevor Watts, New Zealand

No. 3.9 Technical Equipment and Operation of an Underground Refuge Room in the Konrad Mine
Stefan Schneider, Germany

No. 3.10 Making Mines Safer: Early Detection of Smouldering Fire on Belt Conveyors and Their Surroundings
Dr Stephan Großwig, Dr Ulrich Palzer, Andreas Scheid, Germany

**Exhibition Floor**

12:30 p.m.
Lunch Break

01:30 p.m. Cave Rescue from Riesending-Höhle
Rudi Hiebl, Germany

01:50 p.m. European Mines Rescue – Research Results of the I² Mine Project
Felix Lehnen, Germany

02:10 p.m. A Polish Perspective: International Mines Rescue Competitions and Their Impact on Safety Development in Underground Mining
Adam Nowak, Poland

02:30 p.m. A Canadian Perspective: Mines Rescue Competitions – A Valuable Evaluation Tool
Alex Gryska, Canada

03:00 p.m. Coffee Break

03:30 p.m. Session Reports, Conclusions, Evaluation of Presentations

04:00 p.m. Closing Ceremony
Concluding Remarks
Ulrich Meesmann, Germany

Presentation of the Next Organizing Team from Russia, Hand-over of the IMRB-Flag to Russian Representatives

04:30 p.m. End of the Last Conference Day
Transfer to the Conference Hotel
Words of Welcome to IMRB Conference 2015

Since 1921, as a result of difficult mine rescue operations without any coordination, representatives of the German mining authority, the statutory accident insurance for miners in Germany and trade unions decided to establish and coordinate preventive measures by evaluating mines rescue operations and by providing responsible mine managers with recommendations. Emerged from the former „Prussian Committee for Mines Rescue“ nowadays the “German Mines Rescue Committee” takes care for mutual assistance among mines nearby, participates in the development of new rescue strategies and rescue device as well and promotes exchange of knowledge referring to emergency management.

The Prevention Department of the Statutory Accident Insurance for Raw Materials and the Chemical Industry (BG RCI), which is organizing the 7th IMRB Conference 2015, is running four Main Mine Rescue Stations in Germany. Managers of these four Main Mine Rescue Stations in collaboration and cooperation with experts of the mining authority are basically the source of expertise of the German Mines Rescue Committee.

I congratulate the Prevention Department of BG RCI, especially its Competence Centre for Emergency Preparedness, for the long-term eagerness to promote mines rescue activities and for the willingness to organize such an important and challenging conference worldwide.

Let’s have some memorable presentations, interesting discussions and an impressive stay at Hanover.

May this conference will contribute across all national borders to minimize the number and the seriousness of emergencies in the mining section and to ensure fast and effective rescue operations whenever needed.

Matthias Kuhn
(Head of German Mines Rescue Committee)
Glückauf!

When we warmly welcome you to Germany with the traditional miner’s greeting “Glückauf!” we are doing as miners here did for 500 years. Mining looks back on a long tradition in Germany, and is a very safe profession these days. It has not always been like that though. Most people in Germany know of the “Miracle of Lengede”, where in 1963 eleven trapped miners have been rescued 14 days after a mine collapse, just 40 miles away from Hanover. Lengede, Copiapó, Soma: whenever evaluating emergency operations we recognize there is one factor all rescue operations have in common: cooperation and the exchange of knowledge and experience are the keys to success. Collaboration will save lives, as it will become clear once more when we will hear of the impressive rescue operation at the Riesending cave a good year ago, almost 1,000 meters below surface and involving more than 700 persons from different nations. The will to collaborate also laid the foundation of the IMRB following the death of six mine rescuers due to heat stress at the Niwka-Modrejow mine in Poland in 1998: understanding and preventing tragedies like this from reoccurring is the aim of the experts united in IMRB.

We are very glad for the opportunity to co-host this year’s edition of the IMRB conference as a joint project of BG RCI, ISSA Mining and the IMRB in close cooperation with Dräger. Our aim of the Vision Zero prevention strategy carries a clear message. We assume that a working world can be achieved in which nobody is killed, falls gravely ill or is so seriously injured at work that their health is impaired for the rest of their life. And mine rescue is high risk work. Mine Rescuers are facing collapsed structures or mine workings, falls of ground, rock bursts or subsidence. Explosions and fires. Toxic atmospheres. They rescue from heights and depth. Each mine rescuer needs to know how to manage risks and make good decisions under extremely hazardous circumstances. Mine rescuers save lives, but let us never forget about their own safety and health.

We wish all of you inspiring days here at IMRB 2015, and are very positive that we all will benefit tremendously from the intense exchange of expertise. After all, it is all about life – let us never forget that.

Glückauf!

Helmut Ehnes
(Director Prevention of BG RCI
Secretary General of ISSA Mining)

Wolfgang Roehl
(Head of Central Mine Rescue Service, Germany)

Ulrich Meesmann
(Executive Board Member of BG RCI
Designated President of ISSA Mining)

Theodor Büllhoff
(President of ISSA Mining)
Dear IMRB Conference Delegates,

On behalf of all the Dräger people and organizations around the world, I would like to extend a warm welcome to you at the International Mines Rescue Body Conference 2015 in Hanover, Germany.

This is the 7th conference organized by the International Mines Rescue Body (IMRB) with the goal to bring mine rescue professionals and volunteers as well as researchers and experts from the field of mine rescue and emergency response together in order to share their expertise and experience. “Meet experts and friends in Germany” is this year’s theme of the conference and it strengthens the original idea and the tradition of the IMRB concept.

For more than 110 years since the introduction of the first Dräger Closed Circuit Breathing Apparatus by my forefathers Heinrich Dräger and Bernhard Dräger in 1904, Dräger has been proud to be able to contribute to the development of mine rescue and emergency response. Thanks to your valuable input and the continued dialogues we had with mine rescue brigades and mining related regulatory institutions around the globe, we are able to develop innovative, reliable safety equipment and solutions. One of those solutions you can first witness here in Hanover this week – the Mine Rescue Vehicle.

I am delighted to have the opportunity to attend this conference and meet with you here in Hanover and hopefully later this week in Lübeck. Further I would like to extend my sincere appreciation to the conference organization committee, led by Helmut Ehnes and Wolfgang Roehl, for their commendable efforts in staging this important international event. Dräger’s role is to support the IMRB to organize the conference, but it is truly your conference and it is your participation that makes it worthwhile attending. I hope all delegates will be able to take advantage of this platform, meet experts and friends and help to further increase the safety level in mining.

Finally I wish the IMRB conference 2015 in Germany every success and all the participants a fruitful and enlightened experience at the Conference.

Thank you for being part of the IMRB Conference 2015!

Best regards,

Stefan Dräger
Dräger Safety AG & Co. KGaA
(Chairman of the Board)
# Table of Contents

- **Soma Coal Basin and Mining Operation** .................................................. 16
- **Mine Rescue Alert System. RAG Deutsche Steinkohle** .......................... 18
- **New Zealand Underground Mines Emergency Protocol** ....................... 20
- **Crisis Management at Mine Accidents** A conceptual framework with a special focus on the prevention of post-traumatic stress disorders ................................................................. 22
- **One Seven® MINING** An innovative system for firefighting and prevention in mining ..................................................... 24
- **Collegiate Mine Rescue: The Intangible Benefits** .................................. 26
- **Emergency Preparedness in Complex Industrial Plants** ...................... 28
- **Mine Re-Entry Assessment System (MRAS) – A Decision Making Tool** 30
- **Enhancing Mine Rescue Communications** ............................................ 32
- **Using an Hierarchical Approach for the Dilution of Gases after Gas Outbursts** ................................................................. 34
- **The Role of Mines Rescue in NSW Coal Industry** .................................. 36
- **Emergency Preparedness in South Africa** .............................................. 38
- **Modern Escapeway Alternatives** ............................................................ 40
- **Vision Zero and the Seven Golden Rules - The Global Prevention Strategy of ISSA for Rescue and Beyond** ......................... 42
- **Development of a specialised UAV (Unmanned Aerial Vehicle) for „remote“ coal mine exploration** ............................. 44
- **Regulation For Romanian Mining Rescue Teams Intervention** ............. 46
- **Mine Rescue Competitions – A Valuable Evaluation Tool** .................. 48
- **Adjusting Mine Rescue to the Requirements of Small Mining Enterprises** 50
- **Safe Control of Spontaneous Combustion Goaf Fires in Longwall Mining** 52
- **Cave Rescue from Riesending-Höhle** ...................................................... 54
- **A Comparison Between Traditional Timbers and Rescue Struts for Mine Rescue Ground Control** .............................. 56
- **Fat Miners’ Life and Property – How China Increases Its Capability to Cope with Mining Emergencies** ......................... 58
- **Study on Numerical of The smoke Flow Regulation and Personnel Escape During the Roadway Fire Emergency Rescue in Coal Mines** .................................................................................. 60
- **European Mine Rescue - Research Results of the 1³Mine Project** ............ 62
- **Mutual Aid System - a Multi Jurisdictional Response Between Several Different Companies** ................................................. 64
- **With the 1998 Lassing Mine Disaster in the Rear View Mirror** ............. 66
- **Mine Disaster and Mine Rescue Training Courses in Modern Academic Mining Engineering Programmes** ................. 68
- **Fire Prevention in Underground Mining – Requirements for Equipment in Germany and Europe** .............................. 70
- **Achievements / Experiences and Challenges for OSH in Mining in Latin America** ................................................................. 72
- **International Mines Rescue Competitions and Their Impact on Safety Development in Underground Mining** A. Nowak, Central Mines Rescue Station in Poland ................................................. 74
- **Making Mines Safer: Early Detection of Smouldering Fire on Belt Conveyor and Their Surroundings** ....................... 76
- **SCBA Training for Rescue Workers on Tunnel Construction Sites** .......... 78
- **Technical Equipment and Operation of an Underground Refuge Room in the Konrad Mine** ................................................. 80
- **Mine Rescue – a New Way** ................................................................. 82
- **RAG’s way to „Zero accidents”** ............................................................. 84
- **Rope Access in German Mines Rescue. Equipment / devices, training and recommendations** ............................. 86
- **Mining and Metal Material Risk Management: The Progress, Focus, Success, Challenges and Way Forward** ................. 88
- **A Look beyond the Garden Gate: New Solutions for Rescue in Offshore Windenergy-Fields** .......................................... 90
- **Getting Mine Rescuers to the Action Faster and Safer** .......................... 92
- **Experiences from Exogenous Fire Incident Rescue Operations at 1C Coal-Seams Trangbach East area of Dongyong Coal Mine Company in Vietnam** ................................................................. 94
- **Mine Rescue and Command System Based on Panorama Technology and Two–Three Dimensional Linkage** ............... 96
SOMA COAL BASIN AND MINING OPERATION

METIN AKTAN, DR NEVZAT KAVAKLI, MEHMET UYGUN

Turkey is a country which consumes 1% of total world energy consumption and dependent of energy in lack of petroleum and natural gas over 90%. Turkey’s export revenues are used to compensate energy imports. For that reason it is vital that using lignite in highest efficiency as a domestic resource for energy production.

One of the most important coal resource basin named as Soma Coal Basin and it is located in Manisa province. It has an important amount of Turkey’s 14,5 billion tons of lignite resources and coal quality is pretty good. Beginning from the year of 2005, to contribute to the economy of the country by producing underground coal reserves mostly in Soma basin, many private companies have started coal production activities thanks to such models as public + private partnership and royalty. Before and during beginning royalty and PPP model, TKI (Turkish Coal Enterprises) has made some studies at the Soma Coal Basin by collaborating local and foreign universities and institutions to support and guide private companies to make them produce safer with a higher efficiency. Those studies were especially related to define geological structure, gas content, spontaneous combustion, gasification of coal etc. In the light of those studies, best producing method offered to be applied. In those new underground mine ventures, TKI tried to encourage fully mechanized operations if applicable, and tried to avoid labor-intensive coal production. After privatization activities of TKI, Soma Coal Basin’s annual production and employment have increased, migration receiving of Soma County has doubled and contribution to economy had the highest records.

But the day after 13th May of 2014, everything suddenly changed. Turkey was faced with the greatest accident in which 301 miners died and 496 miners were survived. The largest accident to occur in recent years took place in the Soma County of the Manisa Province in the Eynez Region. Even though TKI has the license of coal mine, a private company was operating the mine with a full responsibility. The coal area which the accident happened, wasn't suitably for fully mechanized production operations. So the private company was working with a method of half classical and half mechanized. In addition to giving known details about the accident, aim of this study is to give some technical information about Soma Coal Basin and mining operation at the area, explaining the technical and legislation works which have been made by the guidance of Ministry of Energy and Natural Resources (MENR) after the accident. Keep in mind that judicial process of the accident still going on. After the accident, expert investigation technical report published. In addition to this report, a parliamentary investigation committee was established by the Turkish Parliament and a report was published by the committee after finishing the investigation.

Independently of the accident, technical and legislative works are still being continued by the guidance of MENR. TKI gives a great attention to apply those best high tech applications which is used in mining at other improved countries. Lots of technical improvements applied at coal mines and some important legislation amendment to the law changed. Of course there are some ongoing legislation works waiting to be changed. Turkey has devoted itself in serious ongoing studies not only in Soma Coal Basin but also in all of the mines to prevent accidents and to achieve the world standards of OHS towards the ISSA Mining’s philosophy of “Vision Zero” and improving the productivity by using best modern techniques.

NOTES
MINE RESCUE ALERT SYSTEM
RAG DEUTSCHE STEINKOHLE

For managing an emergency the alert system „Fact 24“ of RAG Deutsche Steinkohle is suited to include several groups of persons involved. Rescuers, mine rescue team leaders, staff officers, responsible persons, mining authority, main mines rescue station managers etc. The contribution includes how the system works, which technical equipment is necessary for the effective use, which past experience has proved the function of the system and which lessons we learned for future operation. Finally the audience will take part in a demonstration (concrete example) how to handle the alert system simple and safe.
NEW ZEALAND UNDERGROUND MINES EMERGENCY PROTOCOL

Emergencies in underground mines and tunnels can present as minor, static events through to catastrophic, dynamic events such as a major fire. The level of emergency management required is usually dependent on a number of factors including the scale, complexity and duration of the event. In many incidents a multi-agency response is required, particularly in events where life is at risk and mineworkers require aided rescue.

Like many countries throughout the world, New Zealand has a structured emergency management framework based on consistent principles, structures, functions, processes and terminology that agencies can apply in an emergency response. New Zealand’s framework is the Coordinated Incident Management System (CIMS) and was first introduced in 1998. CIMS was reviewed in 2014 in response to a number of large scale and complex emergencies which occurred in New Zealand from 2010-2012 and included the Canterbury earthquake in 2011 which claimed the lives of 185 people and the 2010 Pike River coal mine explosion in which 29 men were killed.

The Royal Commission of Inquiry on the 2010 Pike River coal mine tragedy in New Zealand resulted in sixteen primary recommendations. Recommendation 14 stated „The implementation of the Coordinated Incident Management System in underground coal mine emergencies should be reviewed urgently“. The New Zealand Government responded to the Royal Commission report by establishing a Government lead implementation team which had the responsibility for the implementation of all sixteen recommendations.

In response to Recommendation 14, a multi-agency working group of senior officials from across Government and emergency services was formed and consulted on the agreed Principles to include in the new emergency management system that would mirror those set out in Recommendation 14. This resulted in an agreement to establish the Underground Mines Emergency Protocol comprising an agreed model which could be used by stakeholders to manage major underground emergencies.

This presentation will provide an oversight into the development of the Protocol, the working principles of the protocol and how it has been implemented across the underground extractive sectors in New Zealand. The presentation will also provide some background to what formed the basis of the Royal Commission recommendation regarding emergency management.
CRISIS MANAGEMENT AT MINE ACCIDENTS

A CONCEPTUAL FRAMEWORK WITH A SPECIAL FOCUS ON THE PREVENTION OF POST-TRAUMATIC STRESS DISORDERS

Abstract: In a short presentation, we introduce a conceptual framework that RAG Aktiengesellschaft uses regularly to take a look on their efforts in the prevention of post-traumatic stress disorders probably caused by mine accidents.

The framework focuses on four fields of action: corporate culture, organization within the company, training efforts and corporate health management, as well as cooperation with external partners. In addition, the concept takes into account two main storylines: primary prevention and second level / third level prevention. For each of the so defined areas of action we will give examples from the prevention work in this field of the RAG Aktiengesellschaft. Even though effective measures for crisis management at mine accidents are normally already introduced, the special aspects for the prevention of stress disorders are often missed out. So the presented framework helps to integrate easily a defense program against acute and / or post-traumatic stress disorders in existing processes.

Using the framework we find good solutions for additional means in the prevention of psycho-mental disorders before and in the aftermath of mine accidents without expensive efforts. In addition, we detect major issues or options for action every time we review our crisis management system for mine accidents. So the presented framework helps us to do the right things in the right way.
ONE SEVEN® MINING
AN INNOVATIVE SYSTEM FOR FIREFIGHTING AND PREVENTION IN MINING

By adding a special foam concentrate and compressed air to water the One Seven MINING system produces compressed air foam, also known as CAF. The foaming agent is a surfactant and not a flammable substance like phenol or polyurethane. The foam has strong penetrating and lasting inhibitory properties. By inundating a mine space with foam it displaces any explosive gases and depletes oxygen contact with the fuel. The MINING 6000 machine is capable to produce up to 6,000 liters foam per minute.

In a 20 days continuous engagement (07/16 – 08/03 2014) a covered mine fire in the Kalın Damar seam, whose development 5.5 months lagged, could be extinguished by using a One Seven MINING 6000 machine and the Class A foam-concentrate AM. A total amount of about 91,000 m³ wet and dry foam was brought into the dammed fire area. The water consumption was 4,200 m³, the foam-concentrate consumption was 6,320 liters.

Finally, it was found that by use of the OS MINING 6000 and the foam-concentrate One Seven AM a fire area could be regained which had to be abandoned using the conventional method (nitrogen inering). The equipment was recovered and the excavation of the Kalın Damar seam could be continued.

NOTES
COLLEGIATE MINE RESCUE: THE INTANGIBLE BENEFITS

In the United States, mine rescue teams (MRTs) must be made available at all underground mines. Larger mining companies usually train and maintain one or more mine rescue teams at each of their mines, while smaller mine operators contract with teams formed from other operations or state-sponsored teams.

In recent years, several university mining engineering programs have developed student mine rescue teams. These universities include the Colorado School of Mines (CSM), the South Dakota School of Mines, Montana University of Technology, Missouri University of Science and Technology and the University of British Columbia (Canada).

Student mine rescue programs are organized as university clubs and governed by the students. Students organize training, set their own training priorities and raise funds from the industry to support the purchase of rescue equipment, supplies, and travel.

In the United States, the fitness of mine rescue teams is demonstrated through official mine rescue contests supervised by the U.S. Mine Safety and Health Administration (MSHA). All mine rescue teams are required to participate in at least one contest per year. Contests follow official rules and are judged by MSHA experts. MRTs compete in the following disciplines:

1. Field exercise, where a full mine rescue team explores a staged mine emergency scenario, searching a mine for victims, providing first aid and transporting survivors out of the mine.
2. First Aid: A team of first aid specialists examines one or more victims, triages and prioritizes emergency medical treatment and readies patients for transportation.
3. Technician: A team of two MRT members examines and repairs breathing equipment, calibrates gas meters and tests communication equipment, preparing it to be ready for use.

Since 2009, CSM student mine rescue teams have participated regularly in official mine rescue contest and have won or placed in numerous competitions. In 2013 and 2015, CSM students organized and hosted student mine rescue competitions with participation from U.S., Canadian and German universities at the CSM Edgar Experimental Mine, where students conducted the field competition in smoke.

Student mine rescue educates participants not only in the specifics of underground mine rescue but in general emergency management, safety and health management, technical rescue, fire fighting, vehicle extrication and working with rescue helicopters.

The conference presentation will highlight the student mine rescue experience at the Colorado School of Mines.
EMERGENCY PREPAREDNESS IN COMPLEX INDUSTRIAL PLANTS

Industry – the diversity and variety is hardly captured – the presentation tries an insight on interaction between fire hazards and fire safety in complex industrial plants. All measures gain acceptable risks in all facilities. Business continuity is the main task of industrial fire protection and emergency preparedness because fires and other emergency acts disturb the flow, charge persons and the environment.

Lecturer is the chairman of Association of German Industrial Fire Brigades.
It has long been recognised that knowledge of the conditions existing in a mine after an incident is essential in deciding whether or not to deploy Mines Rescue teams as part of the incident recovery process. Applying this knowledge in a structured manner to the assessment and the acceptability of the risks likely to be faced by those teams during rescue activities before authorising their deployment is an onerous task incumbent upon the person controlling the incident response. A recommendation from the inquiry into the Moura No2 mine disaster was for industry to develop an effective computer based emergency decision support system for incident management and training and this remained unresolved for a number of years.

From 2008 the Queensland and New South Wales Mines Rescue Services in association with representatives of industry conducted risk assessments relating to mines rescue operational mine re-entry and mine explosibility hazards. From these in 2010 came the Mines Rescue Operational Guidelines and in 2011 the prototype Information Management Software, MRAS, to support the decision making process to deploy rescue resources in accordance with the operational guidelines.

MRAS assists decision makers to make considered decisions; it does not make decisions for you. When fully set up it allows the information that already exists within a mine’s Safety Management System that is relevant to the incident to be accessed and considered rapidly within the pressured environment of an emergency. Secondly the incident specific questions contained within MRAS focus the management team on gathering and assessing information relevant to the incident as it progresses. Qld Mines Rescue utilises MRAS to plan and control training and competition activities.

At any time during the event the management team can generate reports to assess what information is currently known and what still needs to be gathered. They can generate a running log of the status of the incident and can provide situation update emails to selected people from within the program. As gas data is obtained and analysed by appropriate computer systems this information can be imported to MRAS for the assessment of the explosibility risk and the acceptability of deploying rescue teams in accordance with the mines rescue operational guidelines.

MRAS provides a process to formally consider the adequacy of the information available upon which decisions have to be made, to formally consider and acknowledge the explosibility hazards of the environments within or adjacent to which a mines rescue team will need to work and to acknowledge and formally authorise the entry of teams into or for teams to remain within a mine either during or post an incident occurring.
ENHANCING MINE RESCUE COMMUNICATIONS

A portable wireless communication system has been developed that enables rapid deployment of rescue personnel in mine emergency operations. Reliable communications among all Inby team members and the Fresh Air Base (FAB) and/or Command Center (CC) eliminates errors caused by relaying of messages. The scalable system also enables automatic transmission of gas detector readings over the wireless network from Inby spotters as well as "leave behind" detectors Outby the FAB. Communications over the wireless network between the FAB and CC enables tracking of personnel – improving operational efficiency and safety.
Using an Hierarchical Approach for the Dilution of Gases after Gas Outbursts

Elisabeth Clausen

In order to ensure the safety of underground workers, especially in the case of gas outbursts, it is essential to develop ventilation concepts for the necessary dilution of the harmful gases with respect to the occurring gases, gas concentrations and general operational conditions as to cross-sectional areas and existing ventilation systems. Therefore a concept for an Hierarchical approach for the Dilution of Gases was developed, combining Computational Fluid Dynamics (CFD) and Ventilation Network modeling. For the two-phase gas/air flow that occurs during a gas burst a CFD simulation was performed and the behavior of the gas burst and its impact on the existing ventilation was analyzed. Based on the simulation, various measures for the dilution of air dependent upon the severity of the gas burst were tested and evaluated according to their efficiency. A visual presentation and integration of the simulation results into the existing ventilation system calculations can be done with the Mine Ventilation Simulation Software Ventsim, a tool that provides compressible ventilation system calculations and is capable of delivering the requirements for the development of quick, effective and safe ventilation concepts in case of disaster.
The NSW Coal Mining Legislation is focused on the Workplace Health and Safety of all persons in the workplace, and this includes responding Mines Rescuers. The aim is to have no one injured in the workplace and the means to achieve this is by minimising risk.

Operators are required to conduct Design Risk Assessments that address major hazards, such as gas explosions, gas outburst, inrush of water, falls of ground and fire. The major focus of controlling these hazards is on prevention, however emergency preparation is also very important, necessitating the requirement for the operator to have an effective self-rescue strategy in place. Indeed, operators Emergency Management Systems include both a requirement to call out Mines Rescue but also on self-escape and evacuation management systems.

Mines Rescue in NSW Australia plays a critical role in providing not only an effective response capability, whereby risk is mitigated via the use of “Guidelines”, but also in the provision of specialist advice and training in both emergency management and self-rescue to mine operators.

To be proactive in our environment NSW Mines Rescue has been focused on providing training in the NSW coal industry. This has enabled us to train and guide our industry and in some areas issue accreditation that is recognised nationally. Our focus is on educating our industry on issues of safety, we provide induction training to 90% of new starters to the coal industry in NSW and cover self-escape, situational awareness, risk management, decision making and emergency management. We work with industry to train their ‘Safety Leaders’ (highly skilled brigade members), all mine employees including the education of their statutory managers.

This presentation is designed to guide the conference delegates through the process of self-escape in use at underground coal mines in NSW, highlighting not only the role that Mines Rescue plays in the provision of an effective self-rescue strategy, the systems that are in place themselves, but also touch upon the Mines rescue guidelines that define the emergency response capability of Mines Rescue. It covers topic areas including: early warning, decision making, communications, equipment, technology and systems.
EMERGENCY PREPAREDNESS IN SOUTH AFRICA

Synopsis: Mines Rescue Services has provided a rescue service to the South African mining industry for the past 90 years.

South Africa has some of the deepest and hottest mines in the world which requires special training and service.

This presentation will discuss the following:

- Previous accidents.
- Legislation.
- Statistics.
- Specialized rescue equipment such as:
  - 1300 metre mobile rescue winder
  - Colliery Rescue Drill unit including Colliery Mobile Rescue winder
  - Metalliferous Mobile Rescue winder
MODERN ESCAPEWAY ALTERNATIVES

Abstract
The requirement for secondary egress from producing areas of underground mines has been mandated in most jurisdictions around the world for decades. The requirement to have a second way out of a working area in case of a fall of ground or other emergency involving entrapment is very much entrained in the way underground mines work.

In recent years there have been developments in the types of ladders that are used in hard rock mines and as mines become more mechanised and deeper the lengths of these escapeways increase. At the same time industry acceptance of risk has reduced and this has meant higher quality systems need to be applied and mechanisms for enhancing the chance of survival are becoming more complex.

In underground coal mines the application of self escape through long drifts using caches of oxygen generating re-breathers is being identified as a risk that needs to be addressed. There is an urgent need for underground coal mines to reconsider what is an acceptable system of egress from the producing areas of their operations.

Body
Safescape is an Australian company that was started in 2010 to develop, manufacture, market and install a new type of escapeway invented by the author. Safescape Laddertube escapeways provide significant benefits over conventional steel or timber ladderways. They are safer and faster to install, easier and safer to use and they do not corrode or rot with time and exposure to mine water and atmosphere.

In the 5 years since Safescape started Laddertube escapeways have been installed at 60 mines in 6 countries around the world. The use of Safescape ladders has enabled the widespread adoption of static line fall arrest systems within escapeway ladders, something that has traditionally been difficult due to the exposed nature of alternative ladders. Safescape has adopted and modified a climb assist technology from the wind power industry which enables climbers to ascend or descend long ladderways with ease. The climb assist system used by Safescape is the IREX 2000 by PowerClimberWind.

With this new system a moderately fit miner can climb a 400m vertical ladder in 20 minutes without experiencing over-exertion. The system works by effectively reducing the climbers’ weight by as much as 55kg.

Safescape has developed a concept model which utilises both climb assist and fire resistant anti-static materials to enable application of vertical or sub-vertical escapeways to be used within a coal mining operation as secondary egress. This means that with very little additional capital infrastructure miners can quickly remove themselves from the mining environment in the event of an emergency, via a blast proof vent door and into a fresh air escapeway shaft.

Conclusion
By application of new technologies alongside conventional systems it is possible to not only enhance the chances of survival in an emergency but also reduce overall costs to the mining operation. Safescape is an example of a company working towards this goal for the benefit of miners around the globe.
VISION ZERO AND THE SEVEN GOLDEN RULES –
THE GLOBAL PREVENTION STRATEGY OF ISSA FOR RESCUE AND BEYOND. HELMUT EHNES

340 million accidents at work happen worldwide every year, only counting those leading to more than four days absence. 360,000 end fatal. Two million people more die every year due to work-related diseases. To sum this up: around 2.4 million people die every year because of work conditions.

Among many risky industries, mining stands out. While mining represents just 1% of employees globally, it represents 8% of all occupational fatalities.

Mining operations go along with a variety of hazards. Not only in large operations, as they first come to mind, but also in the manifold small scale mines, with an estimated 13 million labourers worldwide are exposed to all kinds of risks from nature, from machinery and vehicles, from various substances such as dust, mercury and other chemicals, while also dealing with poor ventilation, inadequate space and overexertion. What does this mean?

• It means a tremendous loss of productivity and extremely high costs.
• It means enormous problems in quality.
• It means a lack of motivation due to unsafe work conditions.
• It means a disastrous public image of the whole trade, and of many particular businesses.
• And, most of all, it means human suffering, families losing their loved ones – and their suppliers!

We can make mining sustainably safer, but we need a successful strategy to do so. A high potential lies in Vision Zero. Vision Zero is a prevention strategy for a safe future without fatal or serious occupational diseases, work accidents and traffic accidents. Vision Zero’s holistic elements cover technology, workplaces, rules, and people as fields of action. By focusing on severe and fatal accidents, its application increases the level of safety and health overall.

The presentation will discuss well-proven methods and tools to achieve this ambitious, but realistic aim, including the introduction of the “Seven Golden Rules”. Developed by ISSA Mining and meanwhile adapted by all thirteen Prevention Sections of the ISSA, the "Seven Golden Rules" can help to implement the Vision Zero Strategy worldwide.

The Seven Golden Rules are:
• Take Leadership and Commitment
• Identify Hazards and Risks
• Set Safety and Health Targets
• Ensure a Safe System
• Use Safe and Healthy Technology
• Improve Qualification of the Miners
• Invest in People

At the end of the presentation some positive examples will show that the Vision Zero strategy is not an illusion but a realistic goal, which can be achieved in mining as well.
Immediate deployment of a Mines Rescue team to an underground incident may be often delayed or prohibited due to unacceptable risks for the response team, e.g. due to insufficient data to confirm safe entry. Unfortunately there are too many examples of this, Sago, USA; Pike River, New Zealand and South Blakefield, Australia. The risks of immediate deployment, where teams have entered and been exposed to a secondary explosion are evidenced at Raspadskaya, Russia, and Box Flat, Australia. Delays in response can put lives at risk and create community angst. This innovation, if successful, would create a “step change” in emergency response with potential to speed up rescue and increase the level of safety. This could potentially impact Mines Rescue response worldwide.

The benefits of such an approach are obvious. Unfortunately, despite our best endeavours and the significant research dollars invested, there has been numerous failed attempts and the technology has proved ineffective (Pike River).

NSW Mines Rescue, using funding from the NSW Coal Industry, is currently developing a proof of concept UAV (‘quad-copter’ or drone), suitable for use in hostile underground environments. The technology will have the ability to search multiple mine roadways, not only in the horizontal plane but also in the vertical axis, by flying up and down ventilation shafts giving the rescue team full three-dimensional search capabilities.

This presentation will update the audience on the progress of the project; highlight some of the challenges and the technologies being considered. Ultimately, the vision for the UAV will be to collect images and real time data inbye the Fresh Air Base (FAB) for Incident Management Team decision making.
REGULATION FOR ROMANIAN MINING RESCUE TEAMS INTERVENTION

This paper aims to provide specialists from the field with an advanced and efficient tool for the management of crisis situations induced by the occurrence of major accidents in the mining industry. The regulation details the manner of action of mining rescuers when they work underground in order to liquidate faults and/or to evacuate persons from the affected areas.
MINE RESCUE COMPETITIONS – A VALUABLE EVALUATION TOOL

PRESENTER: ALEX GRYSKA, SECRETARY TREASURER IMRB

Although not legislatively mandated in all jurisdictions, mine rescue competitions have been in existence for decades. Contests have been held in the USA since 1911, in Canada since 1950 and the first biennial International Mines Rescue Competition was held in 1999.

Competitions are held for various reasons including:

- To maintain interest in mine rescue,
- To hone rescue skills including upgrading procedures and standards,
- Provide a venue to evaluate emergency response capability.

Jurisdictions that experience frequent real-life emergencies sometimes question the value of competitions since their rescue teams regularly demonstrate their skills in actual settings. As safety in mining improves and fewer mine emergencies are responded to, team mine rescue skills might be unknowingly eroding to the point where team safety might be compromised.

Well-designed competitions are effective mediums for learning from others and can effectively evaluate team skills during real mine emergencies.

This presentation will describe methodologies used for designing and evaluating effective mine rescue competitions. The need for establishing global best practices and the importance of ensuring scenarios are realistic and the need for consistency in judging and evaluation. In addition the presentation will describe how the International Mines Rescue Competitions have evolved and what to expect from IMRC Canada 2016.
ADJUSTING MINE RESCUE TO THE REQUIREMENTS OF SMALL MINING ENTERPRISES

WALTER HERMÜLHEIM AND MATTHIAS KUHN

Abstract: In revision of former recommendations, the German Mine Rescue Committee (DA GRW) has adopted new guidelines for underground mine rescue brigades in 2014. The guidelines take into account that throughout the last years particularly, the number of mine rescue teams in Germany has been declining and that there is an increasing number of small mining operations that do not have an own full mine rescue brigade, or cannot call mine rescue assistance from close range.

The new guidelines are also intended as a first step towards an amalgamation of the mine rescue rules of non-coal mining with the appropriate regulations of the German coal industry, when in 2019 all German rescue stations as planned will be united under the umbrella of the Central Mine Rescue Service of the Employers’ Liability Insurance Association Raw Materials and Chemical Industry (BG RCI).

In the new guidelines of the DA GRW, especially the following issues have been revised or added, compared to the previous rules:

- Minimum strength requirements for mine rescue brigades in non-coal mining.
- Alternate safety measures in case of inability to meet the required number of personnel.
- Equipment of mine rescue brigades.
- Mine rescue operations under difficult ambient conditions.

In addition to the new guidelines for underground mine rescue brigades, the German Mine Rescue Committee has published recommendations on various other topics of emergency prevention, including surface mine rescue brigades, use and maintenance of oxygen self rescuers and roping (“abseil”) techniques. The current rules and regulations of the DA GRW are available for download from www.deutsche-grubenrettung.de, the mine rescue related recommendations of BG RCI from www.atemschutzzentrum.net.
SAFE CONTROL OF SPONTANEOUS COMBUSTION GOAF FIRES IN LONGWALL MINING

WALTER HERMÜLHEIM

Abstract: Due to adequate preventive measures, mine rescue work has become rare in the coal mining industry of the developed countries. The main field of activity of the rescue brigades today comprises the prevention of damage to property. Besides being responsible for the safety of the underground workforce, mine rescue brigades can contribute in this context to reduce production losses. It should be agreeable that mine rescue work for the prevention of damage to property should not be more hazardous than ordinary underground work. This requires a regular check of safety regulations for risk-related work, e.g. as to high climatic loads, or to the fighting of fire types which include the potential risk of an explosion.

This paper points out the experiences of the German coal mining industry gathered on the latter subject during the last four decades. Special emphasize is put on ignition hazards related to spontaneous combustion fires. Based on particular safety regulations, spontaneous combustion fires in longwall mining are fought with large quantities of building material or rigid foam. Building material for fire fighting is used above all in the case of fires suspected to be located more deeply within the goaf area of a longwall face, by means of individual drillings or in the form of so-called building material wedges. For the sealing of a goaf area close to a longwall face or to a gate roadway, however, synthetic resin rigid foam is increasingly used instead of concrete-injection.

In case of a suitable combination of injecting measures, mine gas monitoring as well as a parallel goaf inertization with nitrogen, production can restart under safe conditions while fire fighting work is still going on. For occasionally emerging unexpected or sudden explosion hazards, a full space inertization from a safe distance is available as a preceding intermediate step.
CAVE RESCUE FROM RIESENDING-HÖHLE

June 2014, cave rescuers from five European countries managed to rescue a critical injured cave explorer from a depth of more than 1000 meters with a distance of about 6.5 kilometers in the Bavarian Alps / Germany.

Structure of Cave Rescue in Bavaria
- 8 cave rescue stations: Material is stored in followers for a quick start
- Special feature and training: Training by different modules (only for mountain rescue man with operational experience)

Disadvantages and resulting problems
- Cave rescue is only small part of mountain rescue: not all rescuers are well known with special problems (Cave rescue is a task of mountain rescue only since 2009)
- At the beginning of the rescue it was necessary to give a lot of information to leading persons
- It was difficult to imagine the course of this rescue: duration, needed human resources
- different languages, mentalities
- different methods/equipment and standards (safety, personal protective equipment)
- Integration and leadership of 728 persons (202 cave rescuers), around 60 permanently in the cave
- long duration with a lot of helping persons

The sequence of rescue
- Accident: Sunday, June 8, 2014 at 1:30 a.m.
- Emergency call: Sunday, June 8, 2014 at 2:40 p.m. at Stührhaus 1.894m "Accident in Riesending-Höhle at Untersberg, around minus 1000m, distance 6 km…"
- Alarm for rescuers: Sunday, June 8, 2014 at 2:42 p.m. from ILS Traunstein (Integrated Command Center)
- „Alarm for mountain rescue Marktshellenberg, cave rescue Chiemgn, cave accident, time of the accident 1:30 a.m. …“
- End of rescuing: Thursday, June 19, 2014 at 12:19 p.m., patient is in helicopter
- End of the whole operation: Thursday, June 19, 2014 at 5:00 p.m. "End of the operation - patient in hospital, all rescuers are safe or back in the valley …"

Total time
31 days–10 hours–14 minutes for rescuing the patient, but we are still working to clean the cave from the traces of rescue

Involved organizations came from Germany, Austria, Switzerland, Italy, Croatia
- Bergwacht Bayern, BBK Kreisverband BGL, Malteser, Deutsches Rotes Kreuz
- Bundespolizei-Fliegerstaffel, Bayerische Polizei, Bundeswehr
- Landkreis Berchtesgadener Land, Feuerwehr Berchtesgaden
- Verband der deutschen Höhlen- und KarstforschereV.

NOTES
A COMPARISON BETWEEN TRADITIONAL TIMBERS AND RESCUE STRUTS FOR MINE RESCUE GROUND CONTROL

BY: KATHERINE JENNINGS, ALEX ROBLES, JANET TORMA-KRAJEWSKI

Timbering has been the primary ground support method in the mining industry since the 1500s. This study compares the traditional method of timbering with that of Paratech Rescue Support Systems as it pertains to temporary ground support in the case of mine emergency response. The study, conducted at the Edgar Experimental Mine in Idaho Springs, CO, was intended to determine the strengths and weaknesses of each method including total time for installation, total support strength and ease of use. The cost of each option was also investigated. The emergency response sector of the mining industry is at a turning point and this presents a great opportunity to take a look at some of the technology that is currently in use by the fire service for stabilization of vehicles and collapsed structures and determine if it would be an option to integrate into modern mine emergency response.
FOR MINERS’ LIFE AND PROPERTY –

HOW CHINA INCREASES ITS CAPABILITY TO COPE WITH MINING EMERGENCIES

The Chinese government attaches great importance to emergency response capability during mine emergencies. It views this capability as an essential element of governance, and integrates this capability into the modernization of governance system. To improve the mining enterprises’ emergency response capability, China’s central government takes the following measures.

Firstly, it requests local governments and mining enterprises to abide by the bottom line of “development should never be achieved at the expense of human lives”. Moreover, China’s government requires that first priority should be given to the safety of miners and their property.

Secondly, it establishes a five-level hierarchy to allocate responsibilities among province, city, county, township and village. Through this hierarchy, the central government strengthens the emergency response functions of local governments at all levels, and urges mining enterprises to take main responsibilities for improving emergency management as stipulated in Law of the People’s Republic of China on Work Safety and the departmental rule entitled Nine Clauses of Emergency Management in Enterprises.

Thirdly, it allocates major resources to build national, local and mine enterprise emergency rescue teams, taking in professional and part-time elements that complement one another. Such teams form a solid basis for emergency rescue operations.

Fourthly, it adheres to the principle of “combining emergency preparedness and emergency rescue while focusing mainly on preparedness”. It requests continuous improvement of emergency preparedness. It also demands prompt, responsive, coordinated and efficient emergency responses.

Lastly, it persistently streamlines the emergency response system, emphasizes site control during rescue operations, and aims at carrying out the emergency response operations in a scientific, safe, organized and effective way, so as to protect miners’ life and property.

(Abstract of paper presented to the International Mines Rescue Body Conference 2015)
STUDY ON NUMERICAL OF THE SMOKE FLOW REGULATION AND PERSONNEL ESCAPE DURING THE ROADWAY FIRE EMERGENCY RESCUE IN COAL MINES

Abstract: After the fire happened in the mine, extinguishing the fire and evacuating people is the key to disaster relief. The safe personnel evacuation is particularly important. This article applies the method of numerical modeling, and conducts the numerical modeling on the fire disaster on the roadway through setting the same proportion model with FDS software. By simplifying processes of the roadway network model and using the fire dynamics simulation software FDS to carry out numerical modeling, thus the laws of fire spread, smoke flow movement and temperature distribution under the conditions of ignition source and line source will be simulated. With a lot of simulations of the evacuation behaviors of personnel, the selection of the shortest path for the escape of the staff in the mining area and the minimum time of every site for the evacuation of personnel after a fire occurs in the main roadway are obtained. The evacuation network is activated through using EVAC, and the smoke polymer from the fire simulation will affect the movement and decision making of the evacuees. Simulate the evacuation of personnel in the situation of fire to quantitatively calculate out the time of evacuation, and evaluate the possibility and effectiveness of escape with personnel lives in the situation of fire.
EUROPEAN MINE RESCUE – RESEARCH RESULTS OF THE I²MINE PROJECT

European Mining is going to greater depths than before. In order to provide "Innovative Technologies and Concepts for the Intelligent Deep Mine of the Future", the I²Mine project has started research in 2011. The task "deep mine rescue" has worked on the scenario of miners trapped underground. Results of this 4-year work are going to be presented. Especially road-heading operations carry the risk of long-lasting entrapments. The state-of-the-art in drilling and tracking technology has been assessed regarding I²Mine's challenge of great depths. Furthermore, nowadays mobile rescue chambers have been re-designed in order to provide a preventive measure to support miners trapped underground. On surface, a long-lasting rescue mission would be of new dimensions, as well. Here, international cooperation has been identified as a key to provide experienced and cost-efficient mine rescue capacities. Accordingly, the idea of building up a web-based European Mine Rescue Platform was born within the I²Mine project.
The discussion will include the development of an inter-jurisdictional mine rescue manual, mutual aid and development of off-site response capabilities in remote locations.

The Western Canada Mine Rescue Manual was developed with input by regulators and operators from four jurisdictions. Both surface and underground mining operations were represented. The project took about three years from concept to completion and included peer and regulatory review.

Mutual Aid has been a part of mine rescue for many years in the mining industry. Over the last few years, the mines in Northwest Territories and Nunavut have developed a system through a series of Memorandum of Understanding (MoU’s) and mutual aid training exercises that develop a state of preparedness for emergency response.

During the summer of 2014, at the Dome Lake Fire, Emergency Response Teams were able to provide protection against a wildland fire that threatened one of the primary maintenance and construction camps on the Tibbet to Contwoyto Winter Road. This road is the major supply link and services mines and exploration activities in NWT & Nunavut. The 600 km long road is the world’s longest heavy haul ice road and only operates for eight to ten weeks starting in late January. Dome Lake Camp is a $15,000,000 asset and is the first of three camps where crews are based to construct and maintain the winter road. Emergency Response actions there prevented delays in the road construction. In 2015, there were 9000 northbound dispatches that moved approximately 300,000 metric tonnes of freight.
A disaster occurred in 1998 in the Lassing talc mine in Austria. After a heavy water and mud inrush (~7,000 m³) into the upper parts of the mine around midday, one miner was trapped; the others had already been evacuated according to the emergency plan. A second mud inflow in the evening (~70,000 m³) buried ten miners engaged in support work. Only the first trapped miner could be saved.

The main cause for the disaster was detected to be the failure to maintain a sufficient barrier to saturated ground.

The collapse of Communications and incomplete, mistaken or false information should always be expected. It should be assumed that the affected Organisation will be put into a „state of emergency“ by a crisis. There should be a division into the area „business as usual“ and the area „crisis management“. Considering the risks attached to rescue measures, the aim should be defined „it should not get worse“. This may seem modest, but would represent progress. In the crisis itself, it is not only necessary to overcome the incident itself but also to dose off the danger area, create an „inner zone“.

Due to the dynamics and complexity of the situation the first hours of a crisis are the most dangerous. But people tend to engage in particularly risky activities in dangerous situations. The features of a mining disaster include a potentially dynamic risk situation, a worsening of the Situation have to be expected.

When an inflow of water occurs, the displacement of air by the incoming mass is of considerable significance and it is not easy to predict where and how (pressure and quantity) air bubbles will form in the mine. High points in the mine represent possible locations of air bubbles. They can be located as theoretical chances and tested in practice by drilling. The outbreak of chaos at the start of a crisis is normal. Stop the chaos, establish a crisis management and achieve an overall view.

When a certain stress level is exceeded, the performance of humans sinks rapidly and faulty perception and blocked thought processes are caused by emotional reactions, leading to inevitable mistakes.

Post-traumatic stress disorder can develop months after a traumatic event and creates a need for psychological support. Good risk management should avoid risky crisis management.
MINE DISASTER AND MINE RESCUE TRAINING COURSES IN MODERN ACADEMIC MINING ENGINEERING PROGRAMMES

BY H. MISCHO, J.F. BRUNE, J. WEYER, N. HENDERSON

Synopsis: The mining industry worldwide is currently facing a significant restructuring process. In most underground mines, widespread mechanization of the mining processes increases production while reducing staff numbers. At the same time, the mining depths as well as the lateral spread of the mine workings are increasing. This ever-changing mining environment is requiring sophisticated solutions for the design and operation of the underground mines. In fact, a reduced number of mining engineers is taking responsibility over ever-increasing mine operations. This does not only apply to the excavation of the minerals, but also to all other aspects of the mining operation, including health and safety, disaster management, and mine rescue organization.

Most mining engineering graduates entering the industry lack experience in mine emergency management. Young engineer trainees must learn mine emergency management and rescue work in addition to their normal training experience on the job. Often and unfortunately, emergency and rescue training at different mining companies is not carried out to the highest level and standard and with the best possible training outcomes. The tasks and challenges a young engineer is facing while being trained in a new position do not leave much room for additional training in mine rescue and emergency management. At the same time, experienced "old hands" are retiring and cannot easily be replaced due to limited graduation numbers.

Strategies are being developed at mining universities worldwide to train mining engineering students in handling mine emergency situations and to provide hands-on experience for managing potential accident and disaster scenarios underground. One of these strategies from Germany is presented in this paper. This specific strategy has to be seen under special consideration of the local and regional boundary conditions in Germany, but might serve as case studies for mining schools and universities in other countries.

Keywords: mine disaster and emergency management, education and training, mine rescue training, underground education and training, student education and training, internationalization.
FIRE PREVENTION IN UNDERGROUND MINING – REQUIREMENTS FOR EQUIPMENT IN GERMANY AND EUROPE

Major losses have been caused in Germany and Europe by pit fires until in the mid of the 20th century, such as a fire at Belgien Bois du Canier mine (1956) caused by ignited oil or a fire on a belt conveyor at Schlägel & Eisen coal mine in Herten (1977). Many times small fires were spread because of combustible materials used in underground mines, for example conveyor belts, fluids or basically any kind of plastic.

To improve fire safety in mines, several institutions, for example Versuchgruben-gesellschaft mbH (“Test Mine Ltd.”) which later became DMT GmbH & Co. KG, researched, developed and adopted means to reduce fire hazards. Those means were set down in national test standards and federal regulations. Some of the standards were later harmonized becoming European standards. As of today standards exist for testing and classifying conveyor belts, hydraulic fluids, foams and several other plastic components such as pipes, hoses, break disks or belt scrapers.

On international level, different types of hydraulic fluids are described in ISO 12922. They are distinguished depending on the amount of water or their synthetic components. Regarding fire safety four tests are referenced. While testing the ignitability on a jet spray or on a wick the fluid’s low flammability is verified. Its tendency to self ignite on a hot surface is tested likewise.

Within the EU, requirements for conveyor belts intended for underground use are summarized in DIN EN 14973; belts are distinguished according to their intended application area into five classes (A to C2). Four different tests need to be passed to fulfill fire safety requirements. Besides a small scale laboratory test, a mid scale fire propagation test must be passed as well as a drum friction test and an examination of electrical conductivity. In addition, to achieve class C2 a large scale fire test with 18 m of belt specimen is mandatory.

The German standard DIN 22100-7 contains requirements and test methods for almost any other plastic material which is used underground. The standard contains not only fire but also health safety and electrostatic demands. For example, to evaluate the fire safety of plastic pipes they are impinged by a wood fire with an approximate power of 3.3 MW. The fire propagation is then assessed. The “Gesundheits-chutz-Bergverordnung” (health protection mining resolution) furthermore describes – amongst other things – fire tests for foams which are intended for injections or filling cavities. For some materials a large scale test is mandatory. This includes foaming both sides and the roof of a 13 m long section of the test tunnel and igniting a large test fire.

Fire safety is a big issue for coal mines, especially improving combustion characteristics of plastic materials to take preventive measures against fire emergence and spread. Therefore standards for testing those characteristics have been introduced and have created a high safety level for miners ever since – a reason why a lot of tests are similar or even the same all over the world.
ACHIEVEMENTS / EXPERIENCES AND CHALLENGES FOR OSH IN MINING IN LATIN AMERICA

Robert Morrison
Soletanche Bachy Chile S.A.
Chile
INTERNATIONAL MINES RESCUE COMPETITIONS AND THEIR IMPACT ON SAFETY DEVELOPMENT IN UNDERGROUND MINING

A. NOWAK, CENTRAL MINES RESCUE STATION IN POLAND

Abstract: Mines rescue protection is one of the key tasks in the system of health and safety in the mining industry. Improving the operation of the mine rescue is connected with the increasing of difficult conditions of the working environment and with the need to ensure the optimal emergency operations in the mining plant. An essential element of this improvement are rescue training and exercises which follows to exchange experience. Very important way of those activities are International Mines Rescue Competition. The content of the paper presents the fundamental issues confirming the advisability the implementation of international mine rescue competitions and exchange of experience also in the context of other parallel ongoing international mine rescue projects, as an important element in the development of safety in underground mining.
MAKING MINES SAFER:
EARLY DETECTION OF SMOULDERING FIRE ON BELT CONVEYOR AND THEIR SURROUNDINGS

AUTHORS: DR. STEPHAN GROSSWIG, GESO GESELLSCHAFT FÜR SENSOREN, GEOTECHNISCHEN UMWELTSCHUTZ UND MATHEMATISCHE MODELLIERUNG MBH & CO. PROJEKT KG, JENA

DR. ULRICH PALZER, GIB – GESELLSCHAFT FÜR INNOVATION IM BAUWESEN MBH, WIEMAR

DIPL.-ING(FH). ANDREAS SCHEID, BARTEC SICHERHEITS-SCHALTANLAGEN GMBH, MENDEN

In a confined space, fire can be deadly and remains one of the greatest hazards especially in mechanized mines where belt conveyors are used.

Most Indian coal mines use belt conveyors for coal transport and it is necessary that robust systems of smoke and fire detection and warning are in place if we have to provide a Zero Harm work environment to our miners.

This paper describes the state of art in early detection of smouldering fire in close proximity of conveyor belt systems in coal mines with the help of the temperature related changes of physical parameters of fibre optic wave guides. It describes the physical principles, available equipment and reference installations.

Besides the use on belt conveyors systems in underground coal mines, further applications are also briefly described.
SCBA TRAINING FOR RESCUE WORKERS ON TUNNEL CONSTRUCTION SITES

Hohenpeißenberg Training Centre
Hohenpeißenberg Centre offers expertise in all kinds of breathing apparatus to the industry, for example mining and chemical industry.

Project Stuttgart 21
S21 is a part of the "Magistrale für Europa", a high speed railway link across Europe and located in the south of Germany. Restructuring the Stuttgart rail node.

The new-built Wendlingen-Ulm line encompassing the cities of Stuttgart and Ulm.

On the various construction sites we have two drifting systems

- tunnel boring machines
- drill and blast drifting

Legal situation
The fire brigades are only allowed to enter the construction site up to 200 meters in case of a fire incident. The contractors of the construction sites are obliged to organize the rescue measurements, including the rescue teams.

All main contractors of S21 formed their own rescue teams by recruiting them from their own ranks.

Fire rescue teams in Hohenpeißenberg, our training concept
Resulting from our historical background we have special experience in the usage and the training of special SCBA used in mines.

More than 300 future rescue workers of the construction sites have been trained in Hohenpeißenberg:

- In house training and
- On-site-training

Timetable
- AirElite theory and practice
- breathing physiology
- principles of operation
- advanced first aid e.g. Oxylator and Larynx-tubus
- experience in fire fighting

The teams have to be qualified within less than one year.

Some rescue teams have already been accepted as essential team members of the construction sites, and even proudly take part in special championships.
TECHNICAL EQUIPMENT AND OPERATION OF AN UNDERGROUND REFUGE ROOM IN THE KONRAD MINE

In 1984, the federal government concluded an agreement with the German Company for the Construction and Operation of Repositories for Waste (DBE) and commissioned the DBE with the "planning and construction of federal facilities for the long-term storage and disposal of radioactive waste".

For this purpose the former iron ore mine Shaft Konrad has been undergoing a conversion process since 2010. During the conversion process all above ground facilities, the shafts and the mine will be redeveloped or demolished and rebuilt. Conversion work must take place simultaneously in both shafts whilst the ongoing underground repository construction must also continue. The redevelopment of the Konrad 2 shaft involves the complete removal of all internal fixtures and the demolishing of the hoisting machinery. For the rebuilding process a temporary hoist with a small winding cage was installed.

In Shaft Konrad 1 one half of the shaft is redeveloped at a time, whilst the other half is needed to supply and service the mine. The wooden cage guides will remain in Shaft Konrad 1 as well as four 6 kV power cables as a fire hazard until the end of the conversion work. During the conversion work a fire in the shaft or the shaft building of Konrad 1 is a constant danger for people in the mine.

The law states that there must be two evacuation pathways at all times. Every person in the mine must always carry a personal breathing device in case of emergency.

The personal breathing devices used in the Konrad mine have an operation time of 60 minutes. The evacuation of a maximum of 200 people via Konrad Shaft 2 will take approximately 11 hours. The safe shelter for at least 11 hours is the underground refuge room.

In the case of a fire in the shaft or shaft building of Konrad 1 all people underground proceed to the underground refuge room. The underground refuge room has a capacity maximum of 200 people and is situated close to Shaft Konrad 2. It is situated behind an almost airtight wall. The refuge room has an airlock with flushing function and has a constant overpressure (200Pa). For the flushing process and to ensure the overpressure 1,170,000 liters of compressed air are stored in pressurized bottles. The ambient air is constantly scrubbed and replenished by CO2 absorption and oxygen inflow. Ambient air quality is permanently monitored and an air conditioner cools the room. In the case of a power failure an emergency generator can provide power for the refuge room. If the emergency generator fails all vital systems switch to a powerful battery system. First aid equipment and several communication devices (telephone, two-way radio) are installed in the refuge room.

The mine rescue team is responsible for evacuation from the refuge room via Shaft Konrad 2. Eight people take fresh personal breather devices from the refuge room and are escorted to Shaft Konrad 2 by the mine rescue team and the 11-hour evacuation process from the 1000 m level begins.
MINE RESCUE – A NEW WAY
CENTRAL MINE RESCUE AUSTRIA

Dipl.-Ing. Wilhelm Schön
CEO
Central Mine Rescue, Austria
Phone (+43) 664 13 55 707
E-Mail hauptstelle@speed.at
Web www.hauptstelle.at
RAG’S WAY TO „ZERO ACCIDENTS“

DIPL.-ING. PETER SCHRIMPF
DEP. CHAIRMAN OF THE BOARD OF RAG COMPANY

The most important potential of a mining company are the people working there. Based on decades of experiences the German Hard Coal Mining Industry has been able to increase productivity by improving the development of mine safety, as well as occupational Health and Safety. Despite the demanding deposit and the difficult frame conditions the RAG AG succeeded to reduce the accident rate sustainably, due to considerable efforts in technology, organisation and human affairs.

Since the beginning of mechanization the number of accidents per one million working hours has been reduced by more than 97%. The success in the mines of the German Hard Coal Mining Industry is based on technical and organisational conditions as well as conditions, which change the attitude of employees and have been implemented consistently:

- Development of new, innovative technology and procedures,
- Use of standardised technology only,
- Measures to revise or redefine the organisational structure, processes and systems of work,
- Safety work as a self-evident management tool in corporate affairs,
- Realisation of personal related activities as a focus of safety work in order to increase motivation and to change the attitude of each employee for safety issues.

The successes in occupational safety were hard work and unfolded further measures. So accidents and events that occur due to incorrect assessment or underestimation of hazard situations are taken up and processed as part of the concept „safe to 2018“. These measures shall be taken to „sharpen“ the safety awareness of each employee.
ROPE ACCESS IN GERMANS MINES RESCUE

EQUIPMENT / DEVICES, TRAINING AND RECOMMENDATIONS

Abstract of Jens Schulz, BG RCI, Competence Centre Emergency Preparedness, department fall protection

In 1907 the Miners accident insurance (Miners accident insurance, BBG) decided the foundation of main mines rescue stations and one of the station in Halle. After the 2nd world war the new beginning of the mines rescue was continued in Leipzig in 1949. The mines rescue station in Halle was destroyed by the war.

In the year of the political turn in Germany, the Miners accident insurance (BBG, coalescence partner of the BG RCI) took over the main mines rescue station Leipzig.

Reside the duties in mines rescue (education, training, consultation, supervision, self-rescuer beings …) a specialisation took place for the subject PPE against fall from a height and rope access.

The main mines rescue station Leipzig (as department fall protection of BG RCI) is responsible for advising the member companies of BG RCI on the subject of personal fall protection against fall from a height.

Numerous seminars are offered to it in Leipzig and many on site-consultations are carried out.

Many mines rescue teams came on the basis of a risk assessment to the decision, to build specially trained rope access teams and to maintain these teams. The German Mines Rescue Body (DA GRW) passed in Summer 2013 a special recommendation for this topic, which includes the facilities, equipment, theoretical training and practical exercises. The training is developed in 3 steps. Mines rescue station in Leipzig offers training for beginners (basic training - 4 days course), the advanced training (4-day course) and training for occupational trainers (4-day course). As a prerequisite for training as an occupational trainer, at least one basic education, and two further training shall be done with a certificate. Four exercises are provided in the mines rescue teams each year. Thus a uniform equipment and training in the German mines rescue is secured. In case of assistance is thus a rapid mutual assistance, no „misunderstandings“ are possible.

In May 2015, the BG RCI in Leipzig opened a training tower for fall protection. Here we can teach very intensely the basics PPE against fall from the height and also basic and advanced training for rope access.

The training tower has a height of 23 meters and a floor area of 8 x 10 meters. The upper deck is accessible, so the customers can descend from the upper deck to the ground on the outside. The tower is inclined to the south by 7 degrees (thus crooked than the Tower of Pisa). By conditions of inclination a descending without contact to the wall is possible, so here wind influences and possibly twist can be trained in rope under real environment conditions. The training tower is insulated and therefore heatable, so we can offer training all over the year.
MINING AND METAL MATERIAL RISK MANAGEMENT: THE PROGRESS, FOCUS, SUCCESS, CHALLENGES AND WAY FORWARD

HANNES STRUYWEG, INTERNATIONAL COUNCIL ON MINING AND METALS (ICMM), HEALTH AND SAFETY, LONDON, UNITED KINGDOM

Introduction
The global mining and metals industry has made great progress in improving health and safety performance. However, the occurrence of catastrophic and other fatal events continue to be a sad reality in the industry. A process of continuous learning and improvement is needed to ensure a step change in performance.

In the past, the learning was focussed on the analysis of injuries and injury rates. However this was insufficient, with greater success being had more recently with the trend to investigate so called high potential incidents (HPIs). The fundamental issue often revealed in these investigations was that a common cause for incidents relates to a combination of ineffective controls and/or substandard performance of controls.

Methods
Realising that urgent work was needed in the industry, ICMM undertook a collaborative project on health and safety risk management with the objective of developing guidance for the industry on an end-to-end risk management process that delivers reliable and effective controls.

Summary of Results/Discussion
A Good Practice Guidance document on Critical Control Management was published in April 2015. (http://www.icmm.com/document/8570) The document provides practical guidance on preventing the most serious types of health and safety incidents, referred to here as material unwanted events (MUEs).

The document provides advice on how to identify and manage critical controls that can either prevent a serious incident occurring in the first place or minimize the consequence severity if a serious incident does occur. Therefore, this document provides specific guidance on: identifying the critical controls establishing performance expectations assessing their adequacy assigning accountability for their implementation monitoring their performance verifying their effectiveness in practice.

The approach described in the document is called critical control management (CCM). CCM is well established and in use in many high-hazard industries, especially in the oil and gas industry. However, this is the first time this approach has been captured in a single document designed specifically for the mining and metals industry. This would not have been possible without the guidance and support of ICMM member companies.

As with most new organizational initiatives, the successful implementation of CCM requires senior executive support. This support is required in terms of not only establishing CCM within companies, but in its ongoing implementation. The approach enables senior leaders to more effectively exercise their leadership role in health and safety as a result of the transparency brought to bear by applying CCM. It should also empower employees to know exactly what critical controls are, what is deemed to be an acceptable or unacceptable risk, and their role in managing the risks.
A LOOK BEYOND THE GARDEN GATE: NEW SOLUTIONS FOR RESCUE IN OFFSHORE WINDENERGY-FIELDS
GETTING MINE RESCUERS TO THE ACTION FASTER AND SAFER

As underground mining operations evolve, grow deeper, longer, become more complex and continue to expand farther from established infrastructure, travel distances and times increase. As a result alternate methods of performing a mine rescue needed to be considered. Current breathing apparatus durations and physical human limitations do not allow for these increased work times required to respond to some of the farthest reaches of our operations. At several Goldcorp operations we have the need to explore new mine rescue processes and through the working partnership between Goldcorp and Draeger we have developed the MRV 9000. In order to extend the useable work time of the current breathing apparatus, the MRV 9000 will allow rescuers to travel in contamination while still maintaining full use of their breathing apparatus capacity. Positive pressure front and rear seating areas allow for mine rescuers to travel to and from the incident scene in a climate controlled environment. Through the application of currently available technology, the MRV 9000 evolved to improve the safety of our mine rescuers, our workplaces and our operations taking mine rescue into the 21st century.
On January 15th, 2014, an exogenous fire occurred at the position – 105 of 1C coal-seams, Trangbach East area of Dongvong Coal Mine Company in Vietnam. Because of not having appropriate safeguards, 6 people died. Vinacomin Mines Rescue implemented the measures to rescue. Because of large fire development, high temperature so that it had many difficulties in reaching the victims. Analysing the specific characteristics, Vinacomin Mines Rescue had proposed measures of reversible wind flows to rapidly retrieve the bodies of the victims in the opposite direction with the original. After that, the rescuers built retaining walls and pumped Nitrogen gas to extinguish fire and at the same time, the experiences learned to avoid similar incidents occur.

Pham Van Huyen
Director
Vinacomin Mines Rescue
Halong City, Quangninh Province, Vietnam
E-Mail pv_huyen@yahoo.com.vn
MINE RESCUE AND COMMAND SYSTEM BASED ON PANORAMA TECHNOLOGY AND TWO—THREE DIMENSIONAL LINKAGE

LIU Yongli1,2, YANG Mingjun1, HOU Li2, WANG Shouhua1
(1. Key Laboratory of Mining Engineering, College of Heilongjiang Province, Heilongjiang University of Science and Technology, Harbin 150022, China; 2. Longruan Technology Incorporated Corporation, Beijing 100871, China; 3. Mine Rescue Brigade of Shenhua Ningxia Coal Industry Group, Ningxia, Shizuishan 753000)

Abstract: China is one of the most serious mine accident countries in the world. Coal mine safety problem has not been fundamentally solved with serious accidents occurring frequently which causes serious casualties and huge property losses. The mine emergency rescue is the last line of security of production. In order to reduce accident loss, improving the ability of rescue information acquisition, quick response, organize and coordinate, decision-making of command. According to the business process of mine rescue and the optimization of the mine emergency rescue system, based on C/S + B/S architecture, applying Web GIS, 3D and the technology of panorama, constructing the integrated mine emergency information management platform which mainly includes mine rescue team business systems, emergency rescue command system, emergency simulation rescue system and safety production dispatch management system. The mine rescue and command system achieves the digitization of the management of mine rescue plan, and flow, automation, visualization of the rescue and command. The system implements two and three information linkage function of the rescue command with which provides a digital management tools and auxiliary decision-making method for scientific methods of mine rescue.

Key words: mine, emergency rescue, Web GIS, two–three dimensional linkage, information plotting