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MSHA/OSRV

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MSHA
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Draeger Safety's Comments:

B. Breathing Apparatus

1. U.S. mine rescue teams use devices by Draeger and Biomarine. What other types of breathing apparatuses are currently in use by foreign mine rescue teams?

Draeger BG 174 and BG4's are used in the following countries:

USA	Norway	South Africa
Canada	Great Britain	R. of Africa
Mexico	Netherlands	Tanzania
Australia	Sweden	Ghana
China	Denmark	France
India	Russia	Spain
Japan	Greece	Belgium
Singapore	Finland	Italy
Hong Kong	Portugal	
South Korea	Turkey	
Taiwan	Iran	
Pakistan	Israel	
Germany	Middle East	
Austria	Argentina	
Switzerland	Bolivia	

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Poland	Brazil
Czech Rep.	Chile
Slovakia	Columbia
Slovenia	Peru
Bulgaria	Venezuela
Romania	
Serbia / Yug	

3. Do these apparatuses incorporate the best available technology? Can they be readily obtained? Do they meet U.S. approval and certification standards?

- **The only Rebreathers which meets US standards are manufactured by Draeger Safety and Biomarine. In addition, the Draeger BG4 is the only Rebreather in the market that meets both US standards and EN European standards.**

4. How can they be improved? How long would it take and at what cost?

- **Apparatus improvements are possible in size (smaller), weight (lighter) and wearing comfort. A new development can be estimated with roughly 3 million dollars and 3 to 4 years of development time.**

C. Self-Contained Self-Rescuers (SCSR)

1. Is there more effective technology to protect miners than the SCSRs currently available? If so, please describe.

No. Oxygen Self-Rescuers provide the best chance of escape, since they are independent from the ambient air. The combined technology of a small belt-worn oxygen device in combination with larger stored devices located in strategic locations in the mine would enhance escape and rescue.

As a result of long lasting and continuous product studies and basic development nothing can be found with a better cost / benefit relationship.

Note:

There are 2 types of oxygen sources that can be used for oxygen self-rescuers. One is Compressed Oxygen, which requires a scrubber chemical to remove exhaled CO_2 (Carbon Dioxide). The other is Chemical Oxygen, which makes use of one or more chemical oxygen sources. The primary chemical oxygen source is KO_2 (Potassium Super oxide), which reacts chemically with moisture and CO_2 in the exhaled air of the user to absorb the CO_2 and generate oxygen.

Another source of chemical oxygen is Sodium Chlorate which is used on some passenger aircrafts to generate oxygen. This is generally used as a "starter" in the Self-Rescuer lasting for only several minutes after which time the primary chemical, KO_2, performs the O_2 generating function. KO_2 also has the unique feature of being demand responsive, which means it will provide automatically more or less oxygen to the user depending on his or her breathing rate. Thus Oxygen Self-Rescuers, with NIOSH/MSHA approval for 60 minutes, can last 3 hours if the person is in a rest position, waiting for rescue.

2. Should an SCSR be developed that provides more than one hour duration of oxygen?

For SCSR's that are worn, SCSR's with durations longer than one hour are too heavy and bulky. Longer rated units (90 minutes or 120 minutes) could be developed as cache units along escape routes.

2. *continued.* What duration is feasible considering that miners must carry the SCSR? The smaller the unit, the higher the willingness to wear the unit.

15 minutes to 1-hour:

- **Bodyworn SCSR (15-30 Min) in combination with rescue chamber / container.**

- **Bodyworn SCSR (15-30 Min) in combination with cache units (60-90 Min,) in combination with a rescue container.**

- **Combination of the above three points depend on rescue concept of mine and the environmental circumstances. e.g. Mine (1,000 feet deep): Bodyworn SCSR (15-30 Min) in combination with rescue chamber / container or for deeper mine: cache units.**

- **In Australia (New South Wales and Queensland), they make use of Quick-Fill Stations underground. These are banks of compressed air cylinders stored in a metal box at strategic locations underground. At each station are 60-minute SCBA's (Self-Contained Breathing Apparatus) that the miners can don to make their escape or wait for rescue. The cylinder banks allow the miners to quickly refill the cylinders on their breathing apparatus without doffing the breathing apparatus as they make their escape. The stations are located every 500 meters or 1,000 meters. Air is considered by some to be more stable than oxygen in event of a fire or explosion.**

See Draeger Quick-fill Station attachment

2. *continued.* Would it be desirable to require smaller and lighter SCSRs with less oxygen capacity to be worn on miner's belts while at the same time requiring longer duration SCSRs to be stored in caches?

Yes! See above.

3. MSHA standards require each mine operator to make available an approved SCSR device or devices to each miner.
Should mines be required to maintain underground caches of SCSRs for miners to use during an emergency, or should each miner have access to more than one SCSR?

Each miner should have access to more than one SCSR via a cache system
A cache equal to the number of miners in that area plus a certain percentage for contractors, visitors & safety, in case someone takes more than 1 or 2 in an emergency.

With changes in approvals, cached units could be built less robust than bodyworn units, therefore reducing the cost to manufacture. Also, longer duration SCSRs could be kept in

cache.

4. SCSRs are currently required to be inspected at designated intervals pursuant to 30 CFR 75.1714-3. Should SCSRs be inspected more frequently than the current requirements?

No, the 90-days test interval is a good procedure coupled with a daily visual inspection. Note: Most countries around the world have longer test periods.

Unless suddenly damaged, SCSR's deteriorate over time by jarring and vibration. Daily inspection coupled with the 90-day tests are fine for determining the condition of SCSR's.

5. SCSR service life is determined by MSHA, NIOSH and the device's manufacturer. The service life can range from ten to fifteen years depending on the type of SCSR. Should the service life of SCSRs be reduced to five years or a different time limit?

10 years service should be the maximum life.
Service life does depend on the degree of utilisation and the mechanical stress during the unit's lifetime. Good indicators of life expectancy are: hours of operation & classification of mechanical stress (light, heavy duty or stored).

D. Rescue Chambers

A rescue chamber is an emergency shelter to which persons may go in case of a mine emergency for protection against hazards. A rescue chamber could provide, among other things, an adequate supply of air, first aid, and an independent communication system.

1. Should rescue chambers be required for coal mines?

Yes, but the function of a Rescue Chamber should be redefined. In an ideal situation the chamber would be used as a muster station similar to how ships function in their emergency plans. Evacuees would gather and asses the situation, put together a plan, and evacuate the mine in a controlled manner, if evacuation is possible.

This is where Draeger would like to change the perception of the Rescue Chamber. We believe that escape from the mine is the primary focus. Taking shelter inside a refuge shelter should be a last resort similar to barricading. We believe that by taking shelter unnecessarily, you place the lives of the miners along with rescue personnel at risk. Our shelters will be designed to allow miners to enter in the event of an emergency, asses their situation, implement an escape attempt, and execute it.

For example with the Sago mine, 12 miners could have gone to the chamber. Once inside they would have:

- **Safe breathing atmosphere**
- **Lighted work area**
- **Communication to the surface**
- **Monitors for determining the atmosphere conditions outside the chamber**
- **Food and Water**
- **First Aid equipment**

- **Maps of emergency evacuation routes. (These would include locations of other chambers, caches of breathing devices, etc.)**
- **Additional breathing devices**
- **Portable gas monitors**
- **Etc.**

With this equipment at their disposal a scout team would be assigned the task to asses whether or not escape is possible, if escape is possible the scout team would return and inform the others. Everyone could then don their breathing apparatus in a safe lighted environment, and escape. Or if escape was not possible, they would have a breathable atmosphere, food and water for a minimum of 24 hours.

2. What characteristics should they have? Should they be mobile?

Draeger Safety Solutions has 4 different configurations of Escape Shelters.

a.) Containerized Escape Shelter:

This system uses an ISO shipping Container as the shelter where our custom built breathing system is installed. This breathing system is designed based on requirements of number of individuals and desired duration inside the shelter. The basic components consist of :

- **Carbon Dioxide Scrubber with Blower**
- **Oxygen replenishing System**
- **Air Banks for allowing the Shelter to maintain a Positive Pressure**
- **Air Conditioning**
- **Battery Backup Power for Lights, Gas Monitors (Internal and External), and CO2 Scrubber**
- **Gas Tight Door with Window**
- **Turnkey system inside an ISO Container**

Options:

- **Ante-Chamber inside the Escape Shelter**
- **Air curtain mounted at entrance door (to reduce contaminants brought into the shelter)**

b.) Assembled Containerized Escape Shelter (Low Coal):

Similar system as the Containerized Escape Shelter, but it is not delivered as a pre-built unit. The mine will have to prepare an area inside that has a roof height of 9 feet, width of around 13 feet, and a length of 24 feet, (Dimensions assume the use of a 20 foot ISO Shipping Container). Once this area is ready the shelter is brought underground in pieces and assembled on site.

c.) Escape Shelter Life Support System:

This system is designed to be used inside a permanent shelter that has been dug into the rib, or constructed in a cross cut. Draeger could design a modular life support system that would provide the number of potential users the specified duration of breathable atmosphere in a designated area.

The basic components of this system would be:

- Carbon Dioxide Scrubber with Blower
- Oxygen replenishing System
- Air Banks for creating and maintaining a Positive Pressure
- Air Conditioning
- Battery Backup Power for Emergency Lights, Gas Monitors (Internal and External), and CO2 Scrubber
- Central control of system from a Single Operating Panel

d.) Mantrip Escape System

The Draeger Mantrip Escape System is a unique way to have a mobile Escape Shelter at the working face at all times. A mantrip vehicle would be outfitted with an oxygen supply along with a carbon dioxide scrubbing system and breathing equipment for 8 – 10 persons. The system would be designed to supply each miner with approximately 8 hours of breathable atmosphere.

In the case of an emergency, miners would enter the mantrip and begin breathing from a mouthpiece. They would then drive to the exit of the mine or to the nearest Escape Shelter. Once at the Escape Shelter, miners could asses the situation and plan their escape route.

This system could be used at all roof height conditions. It is recommended that Escape Shelters still be located inside the mine at distances that are recommended below with question 5. The Mantrip Escape System would be utilized until the recommended distance from Shelter to Shelter is made. Once this condition occurs another Escape Shelter would be erected, and the cycle would continue using the Mantrip Escape System as a temporary Escape Shelter.

2.*continued* Should they be mobile?

If roof height permits using a mobile shelter, it is a good practice to have a shelter system large enough for all personnel at the working face. In addition to a mobile shelter it is a good practice to have multiple chambers at fixed locations for familiarity reasons.

These systems are primarily designed to protect the users from an IDLH environment. Each system provides a specified number of users, a designated time duration of breathing air.

These systems will not protect the user from a direct fire, or a roof collapse directly onto the shelter itself.

With this being stated, a mobile shelter is a good source of safety while working at the face. If gas levels were to rise dramatically, miners could go to the Escape Shelter while the levels were diluted by ventilation. If a large uncontrolled fire were to break out at the working face it would not be advisable to enter this Shelter.

At the same time additional shelters should be located in the mine and not be moved so that miners can be familiar with their location at all times. Incidents can and have occurred in all parts of a mine and focus should not be concentrated at the working face. For example; if a fire were to break out at the face and escape from the mine was not possible, miners could find one of the auxiliary shelters and designate a scout team, determine that escape is not

possible and wait for rescue personnel.

With fixed locations operators can form an escape route using the location of each Escape Shelter. If a long extended rescue operation was needed and additional chambers were accessible by miners, they could move from shelter to shelter extending their possibility of being rescued dramatically.

2. *Continued* Should the rescue chamber be semi-permanent, or built into the mine?

This is all dependent on the mine itself and the operation. If the mine is gassy, a semi permanent Escape Shelter would be recommended. This is due to the fact that they are sealed to the outside atmosphere by a man made barrier coupled with the positive pressure maintained inside the Escape Shelter. The semi-permanent Escape Shelter also allows the user more control over the breathable atmosphere inside the Escape Shelter because of its smaller volume. A built-in Escape Shelter allows for potential leaks in the walls themselves unless they are properly sealed which can be expensive and labor intensive.

If the mine is not gassy, and it has a large number of miners underground, then built-in Escape Shelters would be recommended. These systems allow for a larger number of people than the semi-permanent Escape Shelters and are easily located along the ribs of a mine. A great example of a proven Built-In Escape Shelter working was the Esterhazy, Saskatchewan Pot Ash mine, where 72 miners were rescued.

3. How long should they support a breathable environment?

Typically our systems are designed to maintain a breathable atmosphere for 24 or 48 hours, whichever is specified by the customer. This duration can be made longer or shorter. At the Sago mine it took rescuers 41 hours and 46 minutes to reach the miners. At the Alma Mine #1 fire it took rescuers about 43 hours to reach miners. An analysis of past rescue and recovery efforts would help to answer this question along with a factor that takes into consideration the length and area of a particular mine. For larger mines it should be required that longer durations of air be supplied.

Reference Documents:

MASHA (Guidelines for Rescue Refuge Stations, December 1998)

"Be of a size that will afford all anticipated occupants 10 cubic yards (7645 litres) of per person per 8 hours; or or, be provided with compressed air sufficient to sustain the occupants for 8 hours; or, be serviced by a compressed airline."

United States Department of the Interior, Bureau of Mines
(Development of Guidelines for Rescue Chambers, October 1983)

"A reasonable design time for rescuers to reach entrapped miners is 2 weeks via drilling an escape shaft. Only if a reasonable alternative plan exists which offers a shorter rescue time can a chamber air supply be designed for less than 14 days. If a plan exists and a shorter design time is used, the air supply must be sized to provide at least 2 days more air supply than the period of the plan."

Government of Western Australia
Department of Industry Resources Safety and Health Division
(Refuge chambers in underground metalliferous mines 2005)

"The technologies exist to provide this level of support and it is recommended that the 36-hour standard be adopted as the minimum duration for which a refuge chamber is equipped."

4. How many people should they support?

A 20 foot Draeger Containerized Escape Shelter is typically designed for 20 persons for a 24 hour duration. If a Containerized Escape Shelter is the desired approach, and the mine has the need for sheltering more than 20 people, we can use a 40' container or use multiple containers. Built-in Shelters can shelter more people than an individual Containerized Escape Shelter.

These Escape Shelters should be designed to support all persons in the mine. This would include miners, visitors, contractors, and all other persons that would have the potential to be underground at any one time.

As far as responsibility for providing the Escape Shelters it will be a discussion for contractors, mine operators, and governing bodies as to whom is responsible for supplying these systems for whom.

5. How many rescue chambers should be required--how far apart should they be located?

The location of these systems should be based on length of ground covered per unit of time. Currently a 1- hour SCSR is required by all persons underground. Thirty to forty five minutes duration to reach an Escape Chamber would give personnel time to enter the Escape Shelter, start the air system while still under apparatus, and remove apparatus when the interior atmosphere is clear. Once inside the Escape Shelter caches of breathing apparatus will be available. Miners would have time to work out an escape plan, don another apparatus, carry an additional apparatus, and attempt to escape from the mine or make it to the next Escape Shelter which would be located 30-45 minutes away. Miners would repeat this scenario until they reach the exit of the mine, or until they determine that the exit is blocked.

Distance traveled would have to depend on roof height. We believe that MSHA has conducted studies indicating escape times for mines with various seam lengths which would help to determine the position of the shelters.

Reference Documents:
MASHA (Guidelines for Rescue Refuge Stations, December 1998)
"The maximum length of time to walk to a refuge station should be less than 30 minutes."

United States Department of the Interior, Bureau of Mines
(Development of Guidelines for Rescue Chambers, October 1983)
"It must be within 1 hr of foot travel of the face areas it is to protect. This assumes that miners have access to a 1 hr O2 or filter self-rescuer."

Government of Western Australia
Department of Industry Resources Safety and Health Division
(Refuge chambers in underground metalliferous mines 2005)
"It is recommended that the maximum distance separating a worker from a refuge chamber be based on how far a person, in a reasonable state of physical fitness, can travel at a moderate walking pace, using 50% of the nominal duration of the SCSR. If it is assumed that workers are equipped with SCSRs of nominal 30-minute (minimum) duration, at a rate of 30 l/min, then no one should be expected to travel farther than 750m to reach safety."

E. Communications

1. What types of communication systems can be utilized in an emergency to enhance mine rescue?

Voice amplifiers and radio systems fitted to facemasks are suitable for certain scenarios. Telemetry systems such as Draeger's Merlin which transmit data such as cylinder pressure, time remaining, PASS alarms, evacuation signals. The current Merlin works in conjunction with BG4's and Draeger SCBA's, however, underground environments will in most cases require intact leaky feeders for effective signal propagation.

F. Robotics

1. Besides providing video, gas readings and temperature readings, what other uses can be made of robotics in mine emergencies?

- **Mapping concentrations of oxygen, carbon monoxide, carbon dioxide, and methane concentrations. This data would be used to evaluate safe entry for the rescue team or safe exit for the trapped miners.**
- **Access into areas too unstable to send mine rescue personnel**
- **Transportation of emergency escape units**

2. What could be the role of a robot in mine rescue operations?

- **Transportation of water, food, medicine**
- **Wireless transmission of data from the actual site in the mine**
- **Use in conjunction with noise monitors to local trapped miners**
- **Plotting safe escape routes**

3. What information could the robot supply to the Command Center?

- **Audio/Video of the actual site – tunnel integrity, somewhat condition of the miners, extent of damage from fire, explosion, cave in**
- **Levels of oxygen, carbon monoxide, methane**

4. What tasks could robots be built and programmed to perform?

- **See attachment for DIEHL ASENDRO robot**

G. Thermal Imagers and Infra-Red Imagers

Thermal Imager Description

The Thermal Imaging Camera (TIC) is designed as a hand held tool to assist rescue personal to see and locate people, hot spots, and items that give off heat (thermal signature) in a smoke or low visible environment. A TIC detects the thermal energy being radiated or generated from objects and converts this energy into a visual image onto a LCD screen that is mounted on a TIC. This allows rescue team members to view and locate workers, hot spot or items that may be in a dark or smoked filled area.

Thermal imaging cameras (TICs) have been used in the fire service for a number of years with great success. The use of TICs in the fire service has allowed for safer, faster and more successful rescues and identification of hot spots.

The TIC is one piece of rescue equipment that has been able to take full advantage of new technology and improvements. Technology changes / improvements have been;

I. Introduction of new smaller types of thermal cores that capture the thermal image i.e. Vox (vanadium oxide technology) micro bolometer.

II. Size. The overall size of the TIC has been reduced by approximately 30% making the TIC extremely compact and portable. The introduction of new smaller thermal cores and better battery technology has also helped in reducing the overall size of the TIC. Most TICs on the market can be used and operated by one hand.

III. Weight. The weight of a TIC has also be reduced because of the overall size reduction. TIC weights range from 2.4 lbs to 5.5 lbs.

IV. Battery life. Battery life of a TIC ranges from 1.5 hrs to 4 plus hrs.

1. What ``thermal imagers'' and ``infra-red imagers'' outside of those currently available in the U.S. are in use in other countries, and how can these be deployed in a mine rescue?

At this time we not aware of TICs being used for mine rescue applications in coal mines. This may be due to the TICs not being intrinsically safe (IS) approved. Due to the design of the internal thermal core and the large viewing screen the TIC is unable to be IS approved.

TIC's have been used for many years in metal/non-metal mine rescue applications in Canada.

2. Permissible equipment is equipment which is approved by MSHA to be safely used in gassy atmospheres. Should thermal and infra-red imagers be permissible equipment?

Yes, if mine rescue teams are operating in an atmosphere that is not explosive. Then TICs would be a valuable and useful rescue tool for mine rescue. The TIC would assist in locating miners and any items that generate heat in a dark/smoke filled environment. The TIC could be part of the rescue team members' standard safety equipment. TICs could also be deployed as part of the cache equipment.

3. What are the costs associated with these devices?

The Price of a TIC ranges from $9,500.00 to $14,000.00. This would provide a basic TIC, battery, battery charger, neck strap and protective case.

Accessories such as video / picture capture will also add to the cost of a TIC.

4. Should all underground mining operations be required to have one of these devices available on-site?

Yes. The TIC has proved to be an invaluable tool for the fire service and would be an invaluable tool for mines rescue personal. Because of the nature of a mine rescue the type of environment and the lack of visibility, the TIC would help in the aid of rescue and navigation within the mine.

At least one (1) TIC would be required for each rescue team. As the TIC is a small portable unit it can be easily handed over to other members within the rescue team.

The TIC could also be part of the cache equipment that is kept underground. The purpose of this TIC is to locate miners and hot spots immediate to that area.

H. Developing New Mine Rescue Equipment

1. What are the technological or economic problems in developing new equipment such as mine communications equipment or other mine rescue technology?

- **The market size may not be great enough for companies to spend their recourses (the return of investment is a critical factor).**
- **Technology should not be seen as the problem.**

2. Do manufacturers of such equipment have problems with making the equipment permissible for use?

Only if regulations are too restrictive.

3. What are the specific problems?

- **Problems are cost problems which arise because of small ineffective production quantities, sourcing components and cost**

4. Should the approval process for such equipment be streamlined or otherwise changed? Do current approval [[Page 4226]]standards allow the flexibility for developing new technology?

- **Approvals, sometimes, make it difficult to come up with new or modified equipment, because of extreme demands, that seem to be unrealistic (i.e. breathing resistances, ambient temperatures) in closed circuit SCBAs. Example: Breathing resistances according NIOSH and NFPA don't match, at least not for current equipment.**

- **NIOSH/MSHA could accept international standards e.g. EN145 along with NIOSH standards.**

- **NIOSH/MSHA could certify third party labs to conduct the approval testing. At present approval times for certain respiratory protection products can run up to one year. This is in part due to the Homeland Security approval testing for CBRN (Chemical, Biological, Radiological and Nuclear) protection. Longer approval times discourage new developments in some instances.**

- **NIOSH/MSHA could look at changing or harmonizing some of the test standards to match those of other countries, such as the European standards. This could, in cases, allow smaller and lighter self-rescuers to be approved.**

- **Some of the test equipment at NIOSH/MSHA could be updated. One example is the breathing machines used to simulate human breathing. In order for the manufacturers to develop products that will meet the test**

standards, we must do pre-submittal testing. In some cases, this cannot be done precisely as the test equipment being used by NIOSH cannot be duplicated.

- **If the regulations could be changed to allow a "primary" device that can be approved for 30-minutes, it would give the manufacturers opportunities to put more development time into smaller, lighter devices that could be easily worn by each miner. At present only 60-minute devices are permitted to meet the current standard. Studies were done in the past which demonstrated that 60-minute devices are not necessary for all coal mines. Shorter duration devices could also provide the needed protection in certain mines.**

5. How can equipment manufacturers be encouraged to invest in new technologies for mine rescue equipment?

- **If the return of investment is satisfactory and if the innovation can be utilized in other fields of our business, the manufactures will invest.**

- **If developmental funding is provided by the US via State Grants new technologies could be enhanced and developed.**

I. Mine Rescue Teams.

1. What equipment should an effective team have?

In the event of a mine fire or explosion, there are three primary gases of concern in underground mines, carbon monoxide, oxygen, and methane. Poisoning from carbon monoxide, suffocation from a lack of oxygen, and the explosion potential from methane are serious concerns. Other gases such as hydrogen sulfide, sulfur dioxide, nitrogen dioxide, ammonia, and hydrochloric acid may also present hazards.

An effective team must have a means to monitor levels of carbon monoxide and oxygen. There are two reliable methods that are used in mining today, detector tubes and electronic monitors. A good monitoring strategy is one in which the detection methods are reliable, yet simple and easy to operate.

There are detector tubes suitable for carbon monoxide measurements in mining emergencies. A detector tube commonly used to check levels of carbon monoxide is the Draeger Carbon Monoxide 10/b with a range of 10 to 3,000 ppm for low to midrange CO levels. The Draeger Carbon Monoxide 0.3%/b tube with a range of 3,000 to 70, 000 ppm is used for high levels of CO commonly found during mine fires.

A minimum electronic monitor is a single gas device for carbon monoxide or oxygen. This type of monitor is the simplest to operate and maintain. The Draeger Pac 3000 single gas monitor for carbon monoxide or oxygen is going to last 2 years if used only in case of emergency. The Draeger Pac Ex 2 with a combustible gas sensor featuring 0-100% LEL and 0-100% by volume CH_4 and an oxygen sensor with a range of 0-25% would provide a means to monitor methane and oxygen simultaneously. Another alternative is a multigas monitor with sensors to measure methane, oxygen, carbon monoxide, and hydrogen sulfide. The Draeger X-am 3000 is such a multi-gas monitor. The multigas style of monitor will measure more gases, but requires more training and maintenance.

3. Each station is required to have two gas detectors. Should the number of detectors be changed?

If each team operates with 5 or 6 people two detectors should be enough. Since the

electrochemical sensors do not offer the high range CO measurement necessary for mine fires, a kit concept should be considered. The kit would consist of the electronic monitors and the detector tube equipment. The kit concept would keep all the gas detection equipment in one case, thus reducing chance of human error.

Kit concept (minimum equipment):

- **Durable case (Pelican or like)**
- **Draeger accuro pump**
- **3 meter extension hose for accuro**
- **CO 10/b, CH20601 tubes**
- **CO 0.3%/b, CH29901 tubes**
- **Draeger Pac 3000 CO**
- **Draeger Pac 3000 O2**

4. Where and how should the equipment be maintained?

Equipment should be maintained according to the manufacturer's recommendations. The maintenance could be performed by a properly trained service technician on site or through a service contract with the equipment manufacturer. The "gas man" on a mine rescue team should be responsible for routine maintenance of the monitors and ensuring the detector tubes are within shelf life and the pump is periodically inspected and leak tested. Routine maintenance of the monitors includes verifying calibration cycles are observed, the units are bump tested prior to use, and the units are in good physical condition. Each monitor should be bump tested using gas with sufficient challenge concentrations to observe in the display that the sensors are reading gas and the alarms are functioning. If a monitor does not pass a bump test the monitor should be calibrated /serviced by a service technician on site or through an arrangement with the distributor or manufacturer.

7. Some mine rescue teams are using breathing apparatus which, according to the equipment manufacturer, will soon become obsolete. How can existing mine rescue teams be encouraged to update the equipment and technology they use?

- **Government grants are available for homeland security and should be made available for mine rescue equipment purchases. Some equipment is over 35 years old.**

8. Should any new technology be used assist mine rescue teams at mine emergencies?

New resuscitator devices designed for respiratory assistance to patients (mine accident victims. i.e. Draeger Safety/O-TWO MEDICIAL TECHNOLOGIES INC CAREvent (DRA).

See CAREvent (DRA) attachment

J. Government Role

1. What equipment and technology should be promoted to improve mine rescue?

- **Tracking technology currently developed by military should be developed for civilian underground operations.**

2. How should a mine's status (small, remote or operating under special circumstances) be taken into account in developing new or different equipment requirements?

- **The economics of small operations are the most concerning. Pre-deployment of rescue equipment for mines that have no rescue teams would support outside teams rescue operations. Example: Rebreather consumables, communications gear, and SCBA support**
- **Inaccessible locations could be supported by state and federal resources, helicopters, generators, etc.**

2. How could our standards and implementation regarding mine equipment and technology be improved?

Specific standards for mine rescue breathing apparatus should be developed. Currently 42 CFR 84 subpart H deals with all types of self contained breathing apparatus. A separate subpart should be developed for SCSR's and for long term breathing apparatus. This could also update the standard to utilize new technology for testing, for example an automatic breathing metabolic simulator (ABMS). This way testing by the manufacturer and agency could be more repeatable instead of using human subject tests.

3. What training, instruction and procedures should be provided to miners to better enable them to survive an underground emergency?

- **Coordinated training and responder training scenarios should be funded by combined government and mine operations.**

6. What further steps should we take to improve the capability, availability and effective use of mine rescue equipment and technology?

- **State and Federal grants for equipment**
- **Incentives for training personnel on the use and service of equipment i.e. tax credits**

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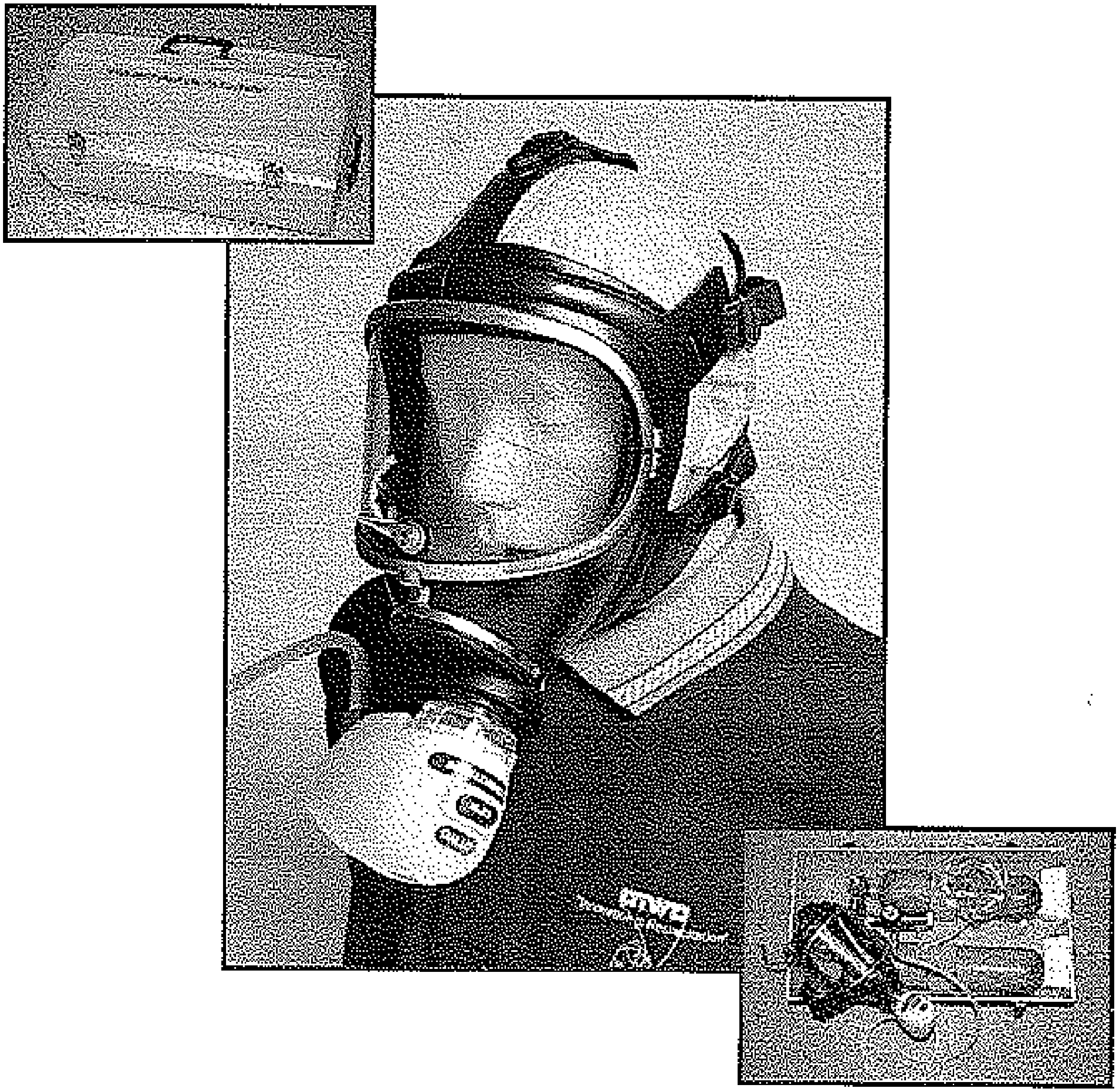
O-Two
MEDICAL TECHNOLOGIES INC
"INNOVATION IN RESUSCITATION"

CAREvent® (DRA)

Consistent Automatic Resuscitation Equipment ventilator



O-TWO MEDICAL TECHNOLOGIES INC.

CAREvent® (DRA)

Consistent Automatic Resuscitation Equipment Ventilator

The rescue of a trapped miner underground has presented new challenges over the last few years. The **CAREvent® (DRA) Automatic Rescue Ventilator** has been developed to meet these challenges.

The **CAREvent®** (DRA) has **"only one external control"**. The underground mining environment is considered to be so hazardous that the less the rescuer has to do to ventilate and transport the patient, the quicker the patent can be resuscitated and the greater the chance for the patient's survival.

All the rescuer has to do is secure the airway, turn on the oxygen or air supply and apply the mask to the patient's face.

The **CAREvent® (DRA)** will provide automatic ventilation to the non-breathing patient at a rate and volume designed to reduce the risk of gastric insufflation. Should the patient start spontaneous breathing, the **"Demand Breathing"** feature of the **CAREvent® (DRA)** allows the patient to breathe on their own.

During CPR a **Manual Override Button** is provided to allow for the provision of 2 breaths followed by 15 compressions.

The patient's inspiratory effort (if adequate) will also cause the **"automatic circuit shut off"** to stop the automatic cycling of the ventilator allowing the patient to breathe at their own rate and volume. If the patient stops breathing again, the automatic cycling will restart with no action required on the part of the rescuer.

By combining **"simplicity of operation"** with **technological sophistication**, the **CAREvent® (DRA)** provides trained individuals with a safe and effective means of maintaining artificial ventilation during respiratory arrest that may occur during mining operations.

NOTE: This device is intended for use by persons trained in CPR and in the use of this device.

WARRANTY: This product has a two year warranty against manufacturers defects.

SPECIFICATIONS

Tidal Volume:	0.8 litres	Relief Valve Pressure:	60 cm H_2O
Breaths per Minute:	12	Operating / Storage Temperature:	-35° to +60°C
I:E Ratio:	1 : 2	Input Connection:	9/16" DISS
Automatic Flow Rate:	28.8 LPM	Patient Connection:	15 / 22 mm
Demand Breathing Flowrate:	Min 120 LPM	Patient Valve Dead Space:	8 ml.
Demand Breathing Triggering Pressure:	>- 5 cm H_2O @ 100 LPM	Dimensions (inches):	5.5 x 2.5 x 2.9 (approx)
Minimum Input Pressure:	45 PSI	(millimeters):	140 x 63 x 73 (approx)
Maximum Input Pressure:	70 PSI	Weight:	14.6 oz / 0.45 kg (approx)

Ordering information:

01CV3000-DRA ***CAREvent®*** **(DRA)** Automatic Rescue Ventilator Kit
c/w Supply Hose, 2 Cylinder Manifold Block with 2, Self-Sealing DISS outlets and 0 - 25 L/min Therapy Flow Control, Medium Concentration Oxygen Therapy Mask with Tubing and Universal Resuscitation Facemask

O-Two MEDICAL TECHNOLOGIES INC

O-TWO MEDICAL TECHNOLOGIES INC.

"INNOVATION IN RESUSCITATION"

7575 Kimbel Street, Mississauga, Ontario, Canada L5S 1C8
Toll Free: (800) 387-3405 **Tel:** (905) 677-9410 **Fax:** (905) 677-2035
E-mail: resuscitation@otwo.com **Website:** www.otwo.com

ISO 13485

CE

Received 3/27/06
MSHA/OSRV

DIEHL
BGT Defence

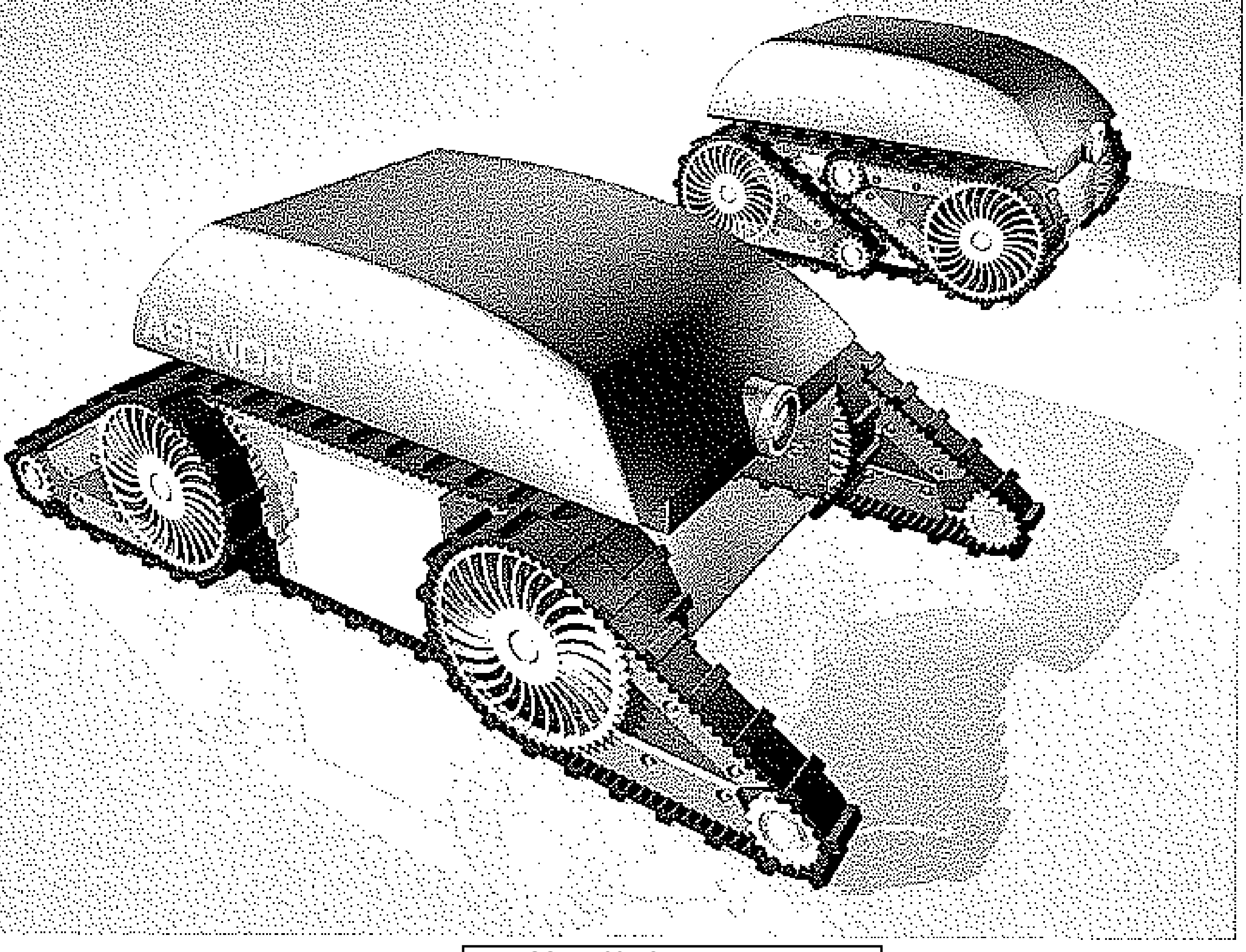
ROBOWATCH

DEFENCE

ASENDRO

MODULAR RECONNAISSANCE AND DEFUSING

An explosion in an industrial plant, people fainting in the middle of a major event, an abandoned suitcase in the airport or a military operation in a conflict area – hazardous situations may occur suddenly. But how grave is the situation and what exactly is happening? Now everything depends on acquiring information – in the shortest possible time – about the conditions in the affected area, if and to which extent action forces and relief units must be protected and whether the area is accessible at all. Intelligent robotics provides the critical information – faster, more precise and completely unemotional.



DIEHL
BGT Defence

ROBOWATCH

DEFENCE

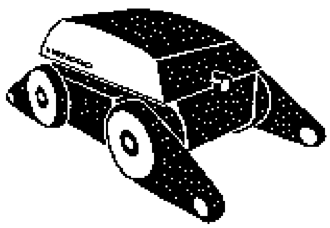
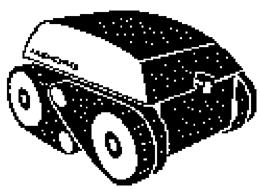
ASENDRO
SPECIFICATION AND PROPERTIES

The modular robot ASENDRO assumes reconnaissance and defusing tasks and protects relief units and action forces in hazardous situations. ASENDRO navigates autonomously or alternatively, is controlled by radio remote control. The flexible chain drive guarantees the robot's operational readiness on virtually any indoor and outdoor surface. Climbing stairs and negotiating obstacles is also rendered possible. The robot's small dimensions allow employment of the device in narrow spaces such as buses, trains or planes.

Applications: Military operations, Homeland Security tasks in buildings and outdoor areas (airports, train stations, harbour facilities, stadiums), civil protection (fire brigade, NBC reconnaissance units, police), complex and unclear accident sites.

DIMENSIONS

Chassis:	Aluminium, Injection-moulded chains with polymer wheels
Height:	200 mm (Without superstructure)
Width:	400 mm
Length:	600 mm (Rockers in resting position)
Length:	920 mm (Rockers in stretched position)

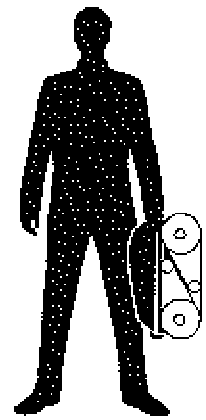



15 km/h
max. Speed

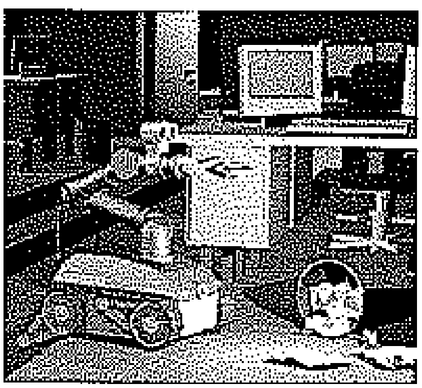
38 kg
including Explorer Head-Module and two batteries

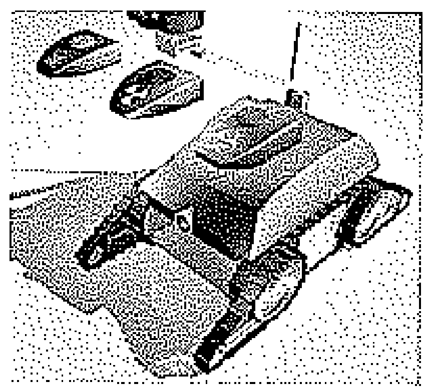
43 °
max. Gradeability on characteristical stair arrangements

2 km
max. Radio coverage



THE MODULAR ROBOT PLATFORM ASENDRO





ASENDRO EOD
Helps special units to defuse suspicious objects. The integrated Tele-Presence Technology enables the user to obtain a realistic view of the location of the robot and to optically estimate distances to given objects. The manipulator arm navigates synchronously to movements of the operators hands and head thus being able to precisely and easily reach for objects.

ASENDRO SCOUT
The reconnaissance robot enables police action forces, e.g. in unclear circumstances, to evaluate a situation from a safe distance. Revolving and pivoting propulsion ensures movements of the camera head of up to 350°. By means of the integrated wide-angle colour and thermal image camera the control room is optimally informed about events on location – at any time and in any weather conditions.

ASENDRO SCOUT + A/B/C
Assists civil defence and emergency aid forces by measuring the degree and type of contamination caused by nuclear, biological or chemical substances on site. If the reliable and highly sensitive sensors detect even the smallest amount of hazardous substances, the robot will transmit type and concentration to one or several control rooms.

CONTACT

ROBOWATCH TECHNOLOGIES GMBH, BUSINESS UNIT DEFENCE
Pankstraße 8 - 10, Haus C, D-13127 Berlin, Germany
Phone +49 30 47 49 88 60, Fax +49 30 47 49 88 66
info@robowatch.de, www.robowatch.de

DIEHL BGT DEFENCE GMBH & CO. KG, BUSINESS UNIT HOMELAND SECURITY
Fischbachstraße 16, 90552 Röthenbach a.d. Pegnitz, Germany
Phone: +49 911 957 2595, Fax: +49 911 957 2590
elisabeth.hausch@diehl-bgt-defence.de, www.diehl-bgt-defence.de

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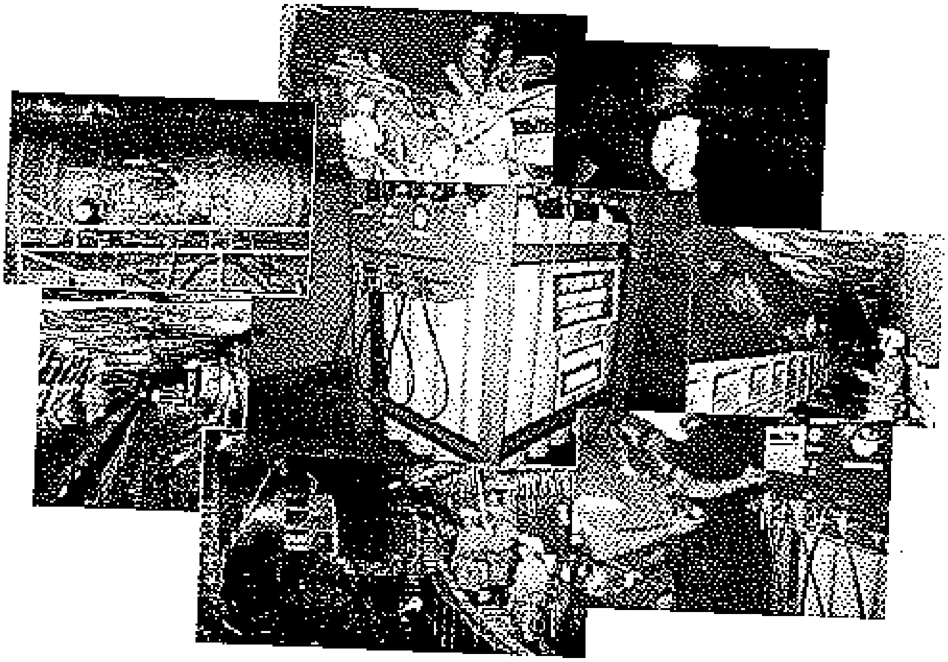
International Sales Package



Draeger Quick-fill Station

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- 3.1 Why we need it !
- 3.2 How it works !
- 3.3 Draeger Quick-fill Station
- 3.4 Test Report
- 3.5 FREEK (First Response Emergency Evacuation Kit)
- 3.6 Brochures
- 3.7 Prices

4.0 Quick-fill Operation

5.0 Report on the Simulated Emergency Exercise conducted at Newlands Colliery - Queensland Aust. (Part A only)

6.0 Reports on rapid filling cylinders

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1.0 Introduction

A new direction in Mine Self Escape philosophy have led to the development of the latest Drager Quick Fill Station for BHP Billitons South Coast Collieries. The Quick Fill system is a further development of the Escape system currently being supplied to PowerCoal in NSW and the successful First Response System implemented by Newlands Coal in Queensland. The report on the exersize conducted at Newlands and released in November 2000 described CABA as a powerful weapon in the self escape philosophy.

"Additionally, this years exercise provided the opportunity to evaluate the use of compressed air breathing apparatus (CABA) as a component in emergency response. The outcomes of the exercise clearly demonstrated that CABA adds a powerful weapon to the armory of the self-escape philosophy. Its flexibility, ease of use and ability to facilitate communication makes it well suited to the cause of emergency response, particularly as it provides a rapid, in-seam first response capability."

Greg Rowan **Chairman Emergency Exercise Management Committee**

The system combines the Drager PA94 Plus Breathing Apparatus fitted with ChargeAir™ the Drager Futura F2 Face Mask, Drager's own 9.0litre 300 bar Carbon Fibre cylinder and the Quickfill Station developed locally by Drager's Engineering Department.

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2.0 Application and Reference List

The Draeger Quick-fill System(QFS) is a respiratory protection system independent of ambient air ind is used to rapid fill compressed air breathing apparatus cylinders while still being worn. The application is originally directed at the mining market but the Draeger Quick-fill system can be used in fire fighting or rescue services, where cylinder charging times are crucial.

Newlands Colliery	Tarmoor Colliery
Newstan Colliery	Metropolitan Colliery
Myuna Colliery	Elouera Colliery
Cooranbong Colliery	West Cliff Colliery
Munmorah Colliery	Appin Colliery
Wyee Colliery	Mandalong Colliery
Angus Place Colliery	

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3.0 Product Folder

3.1 Why do we need it !

Old Escaping Strategies

☞ Self Rescuer Escape System (Filter Self Rescuer)

Legislative Changes
Moura 1994 (Queensland)
Warden Report

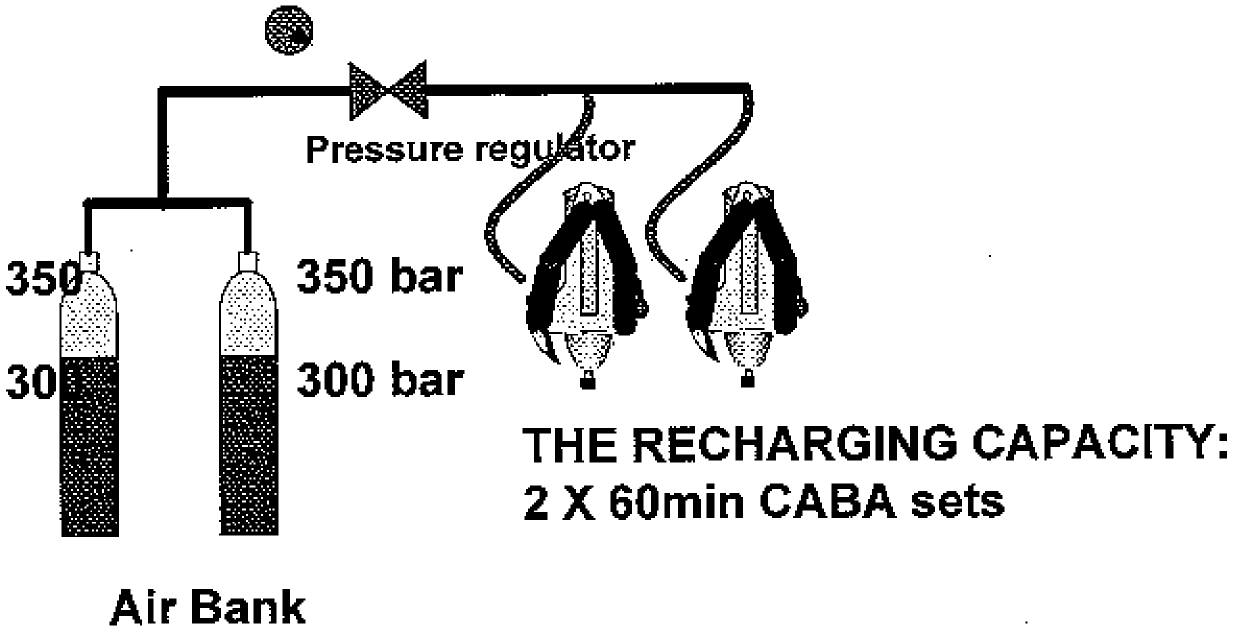
New Escaping Strategies

☞ SCSR Escape System (KO_2 Based Unit)
☞ CABA Escape System (Compressed Air Based Unit)
☞ Fully Integrated System (CABA-SCSR Escape Units)

3.0 Product Folder

3.2 How it works !

Fig. 1. Direct decanting system



A lot has been said about direct fill (Quick-fill) and about the use of charge air. The idea is not new, but it has not had any practical application until now. Decanting systems in the past have been limited in size and generally used only in workshop type situations.

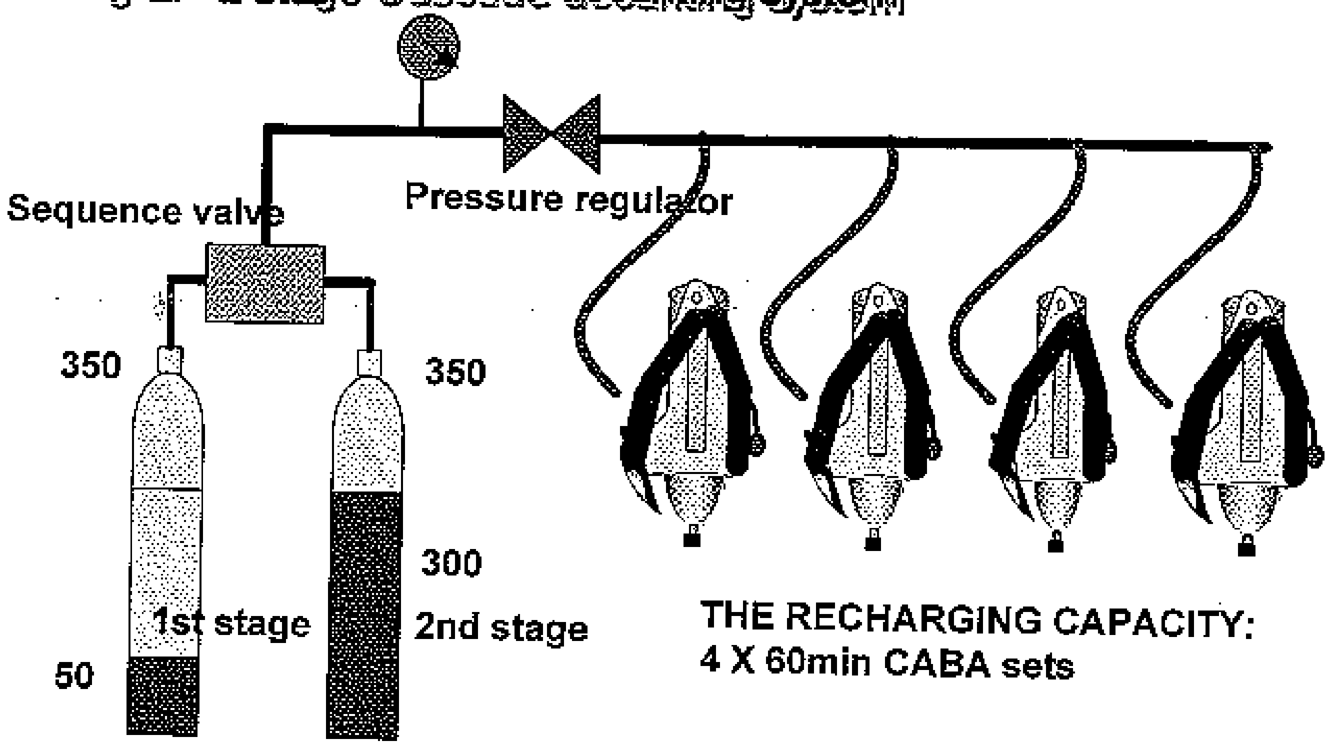
The ChargeAir™connection (Fig.1) allows refilling cylinders from an independent high pressure secondary air source ***while the user in wearing and breathing from the breathing apparatus set.***

Pressure equalisation depends on the amount of air remaining in the breathing apparatus cylinder before refill, but typically occurs after approximately 45-60 seconds. The final equalised pressure is governed by available pressure and volume of air in a secondary air supply.

3.0 Product Folder

3.2 How it works !

Fig 2. - 2 stage Cascade decanting system



Due to the rapid compression of the air in a cylinder during refill, temperature will increase by more than 10°C than the ambient temperature of the cylinder. Indicated pressure after refill will also decrease as the cylinder cools to ambient temperature.***Remaining working time will also decrease acccordingly.***

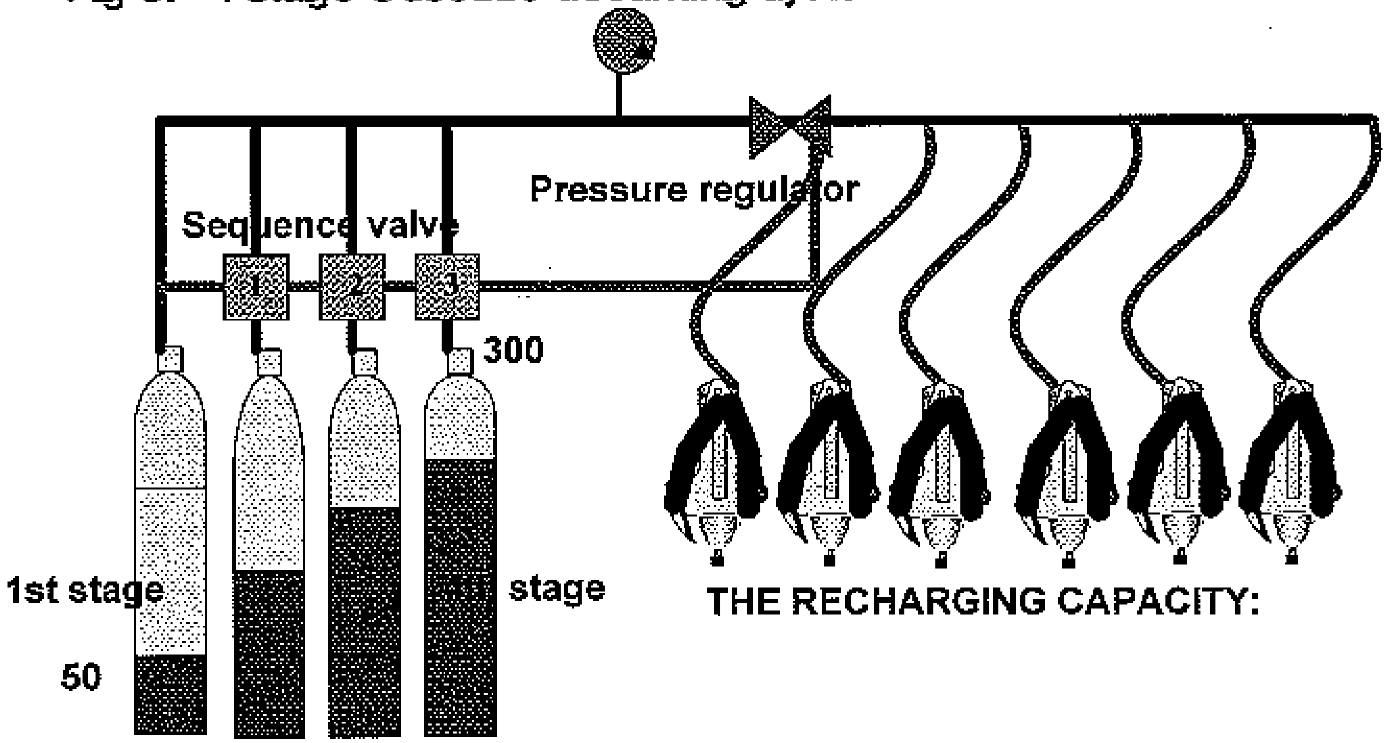
The high pressure secondary air supply source can be any system where compressed breathing air is stored. Examples include

- High pressure battery of cylinders
- High pressure breathing air compressor with air receiver

3.0 Product Folder

3.2 How it works !

Fig. 3. - 4 stage Cascade decanting system



There is a significant difference between the filling capacities if direct fill (Fig.1) and cascade systems (Fig.2 and 3), in a cascade system the air storage bank are divided into two or more air banks which are connected via sequence or priority valves, this system uses the available air more efficiently.

The primary function of the priority valve is to control the air bank sequence without the need for the operator to open and shut valves therefore providing a fully automatic system. The operator of this system only needs to open the main control valve to his individual filling line.

The benefits of cascade systems are a reduced number of high pressure cylinders, lower weight and smaller in size.

3.0 Product Folder

3.3 Draeger Quickfill Station

Fig. 1

•Fork lift access from 3 sides (lifting lugs optional)

•Fully enclosed

•High visibility fluoro- green

•Robust cradle

3.0 Product Folder

3.3 Draeger Quickfill Station

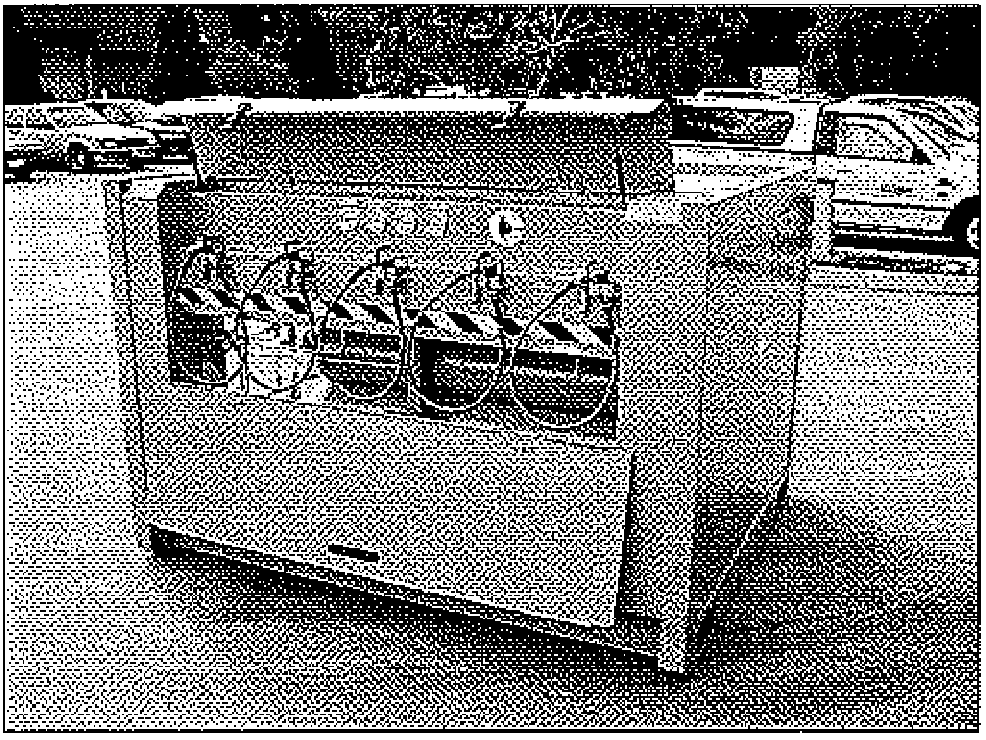


Fig. 2

- Maximum operating pressure ...350 bar
- Filling pressure ...200 or 300 bar
- Filling times 9litrex300 bar ...45 - 70 seconds
- Cradle size ...L2000 x W1670 x H1350mm
- Gross weight C20 ...1870kg
- Gross weight C40 ...2960 kg

3.0 Product Folder

3.3 Draeger Quickfill Station

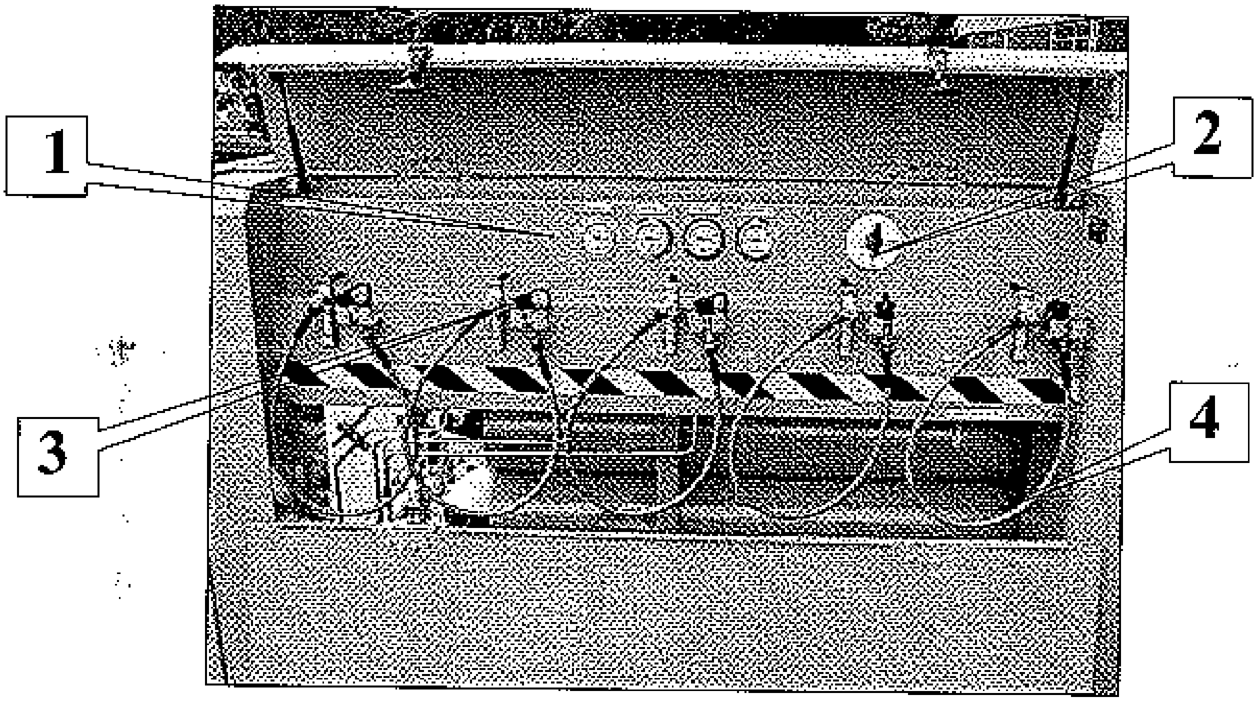


Fig. 3

- •1 Separate stage pressure indicators
- •2 Single main isolating valve
- •3 Independent "beer tap" valves
- •4 High pressure hoses - 1.0 metre long

3.0 Product Folder

3.3 Draeger Quickfill Station

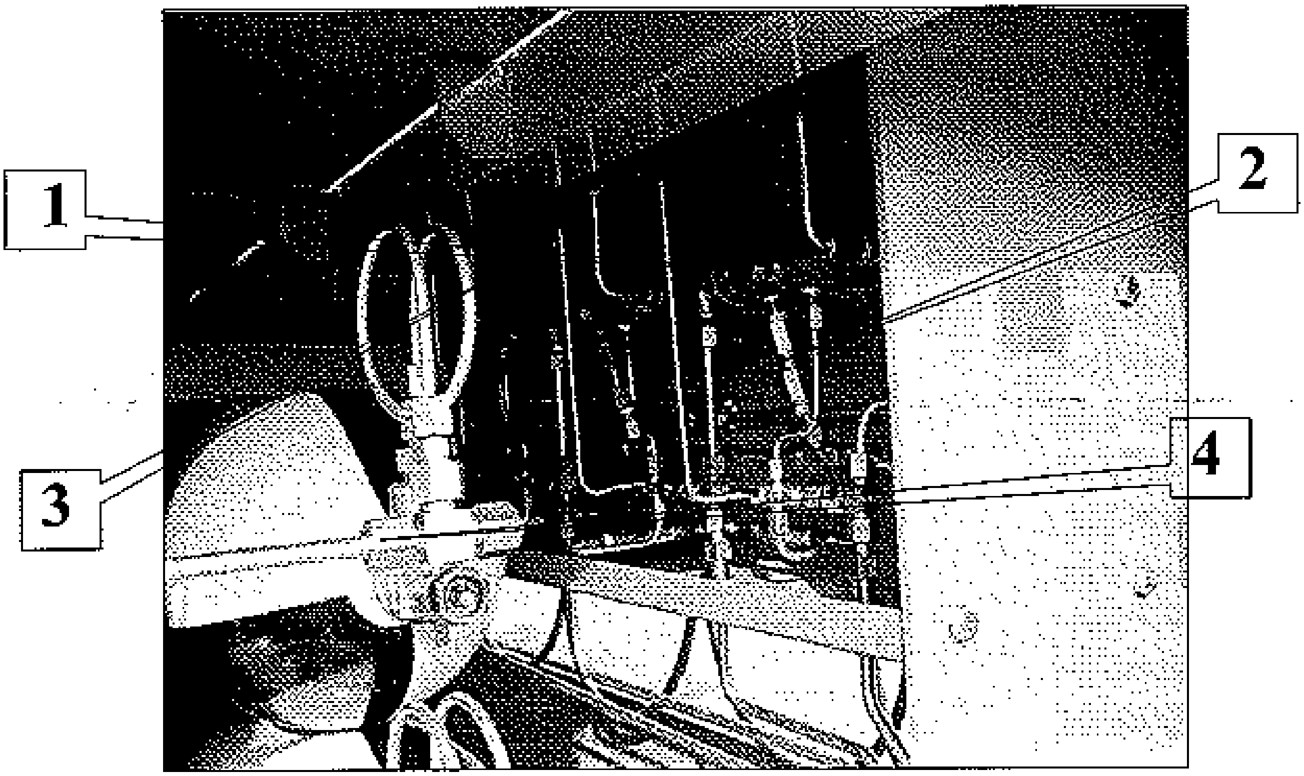


Fig. 4

- 1 Sequence Valves
- 2 Non Return Valves
- 3 Pressure Gauges
- 4 Cylinder Manifold

3.0 Product Folder

3.3 Draeger Quickfill Station

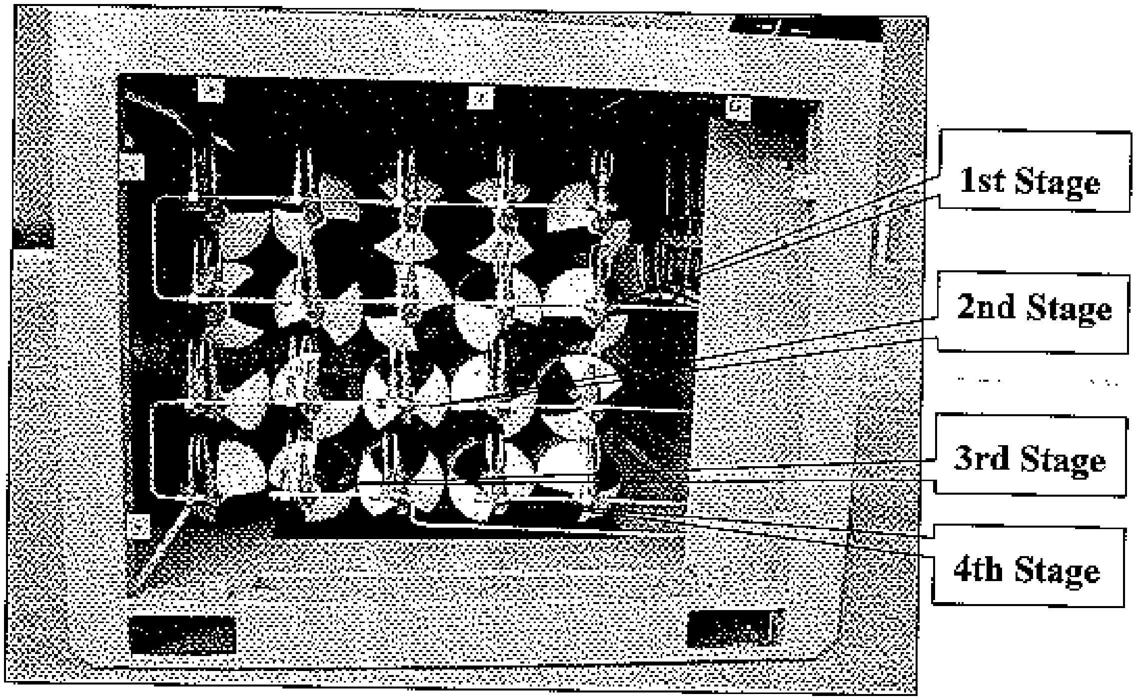


Fig.5 Air cylinder battery of C40 unit

•2 version available

•Draeger C20

•Draeger C40

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3.0 Product Folder

3.3 Draeger Quickfill Station

Draeger C20 Quick-fill Station

Unit refilling capacity is minimum 20 x 9.0 litre 300 bar cylinders from 50 bar residual

C20 consists of 10 x 350 bar 50 litre cylinders

1st stage 5 cylinders

2nd stage 3 cylinders

3rd stage 1 cylinder

4th stage 1 cylinder

Draeger C40 Quick-fill Station

Unit refilling capacity is minimum 40 x 9.0 litre 300 bar cylinders from 50 bar residual

C20 consists of 10 x 350 bar 50 litre cylinders

1st stage 10 cylinders

2nd stage 6 cylinders

3rd stage 2 cylinder

4th stage 2 cylinder

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3.0 Product Folder

3.4 Test report

<u>10 cylinders / 4 stage system</u>

1st stage 5 cylinders, 2nd stage 3 cylinders, 3rd stage 1 cylinder, 4th stage 1 cylinder.

1st refill 36secs
2nd refill 45secs
3rd refill 48secs — 5 x 9.0 Litre 300 bar cylinders connected 1 at a time
4th refill 49secs
5th refill 51 secs

<u>Filled to 300 bar</u>

6th refill
7th refill
8th refill — 5 x 9.0 Litre 300 bar cylinders connected all at once
9th refill
10th refill

<u>Filled to 300 bar 3 mins 40 secs</u>

11th refill
12th refill — 2 x 9.0 Litre 300 bar cylinders connected all at once

<u>Filled to 300 bar 1 mins 38 secs</u>

13th refill
14th refill — 3 x 9.0 Litre 300 bar cylinders connected all at once
15th refill

<u>Filled to 300 bar 2 mins 43 secs</u>

16th refill
17th refill
18th refill — 5 x 9.0 Litre 300 bar cylinders connected all at once
19th refill
20th refill

<u>Filled to 300 bar 5 mins 40 secs</u>

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3.0 Product Folder

3.4 Test report

Residual pressure left in quick fill station

1st stage - 200 bar
2nd stage - 270 bar
3rd stage - 290 bar
4th stage - 290 bar

Total volume of air remaining inQuickfill station - 11,500 litres or 49.8 man hours (calculated at 40 lpm consumption

21st refill	1min 10 secs to 285 bar
22nd refill	1min 12 secs to 275 bar
23rd refill	1min 12 secs to 270 bar
24th refill	1 min 15 secs to 262 bar
25th refill	1 min 15 secs to 252 bar

Filled to 300 bar 3 mins 40 secs

5 x 9.0 Litre 300 bar cylinders connected all at one time

Note all tests conducted with 9.0 litre 300 bar Carbon Fibre Cylinders

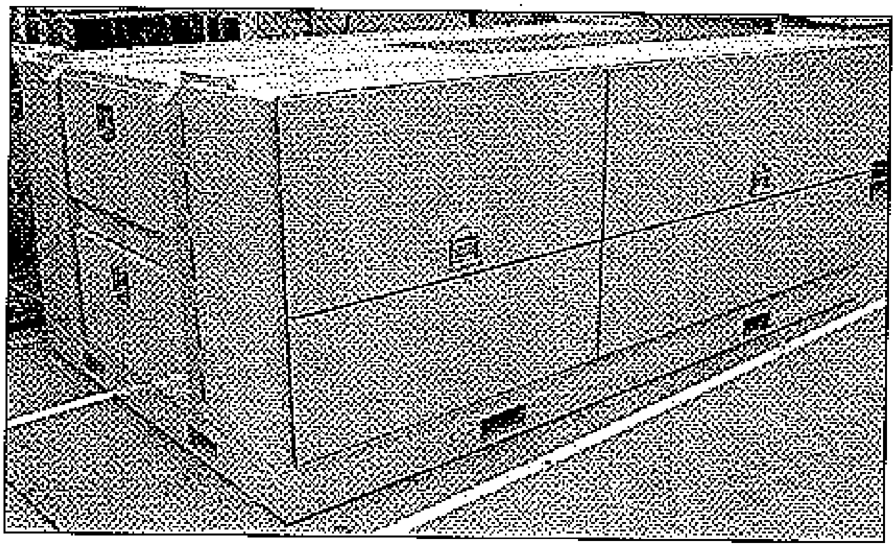
3.0 Product Folder

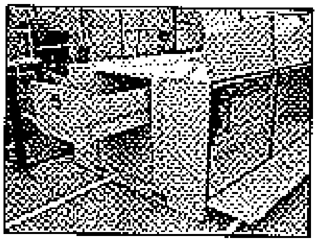
3.5 FREEK (First Response Emergency Evacuation Kit)

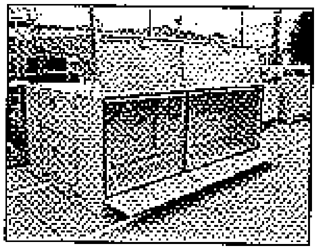
The FREEK is a sturdy dust tight locker for storing up to 20 Breathing Appartus sets and other safety equipment in an underground mining environment.

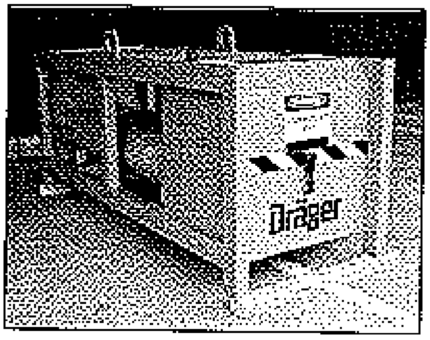
The unit is equipped with four compartments for stoing breathing apparatus as well as three pull out drawers for storing self recuers, first aid supplies etc.

For topping up breathing apparatus cylinders a 2x 350 bar recharging unit is also fitted within the FREEK.









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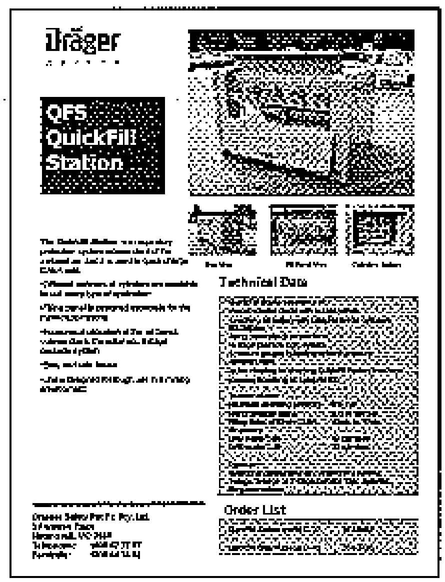
3.0 Product Folder

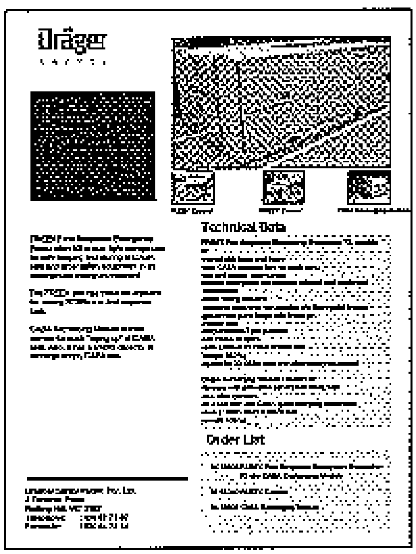
3.6 Brochures.

The following pages contain the

•Draeger Quick-fill Brochure

•FREEK Brochure





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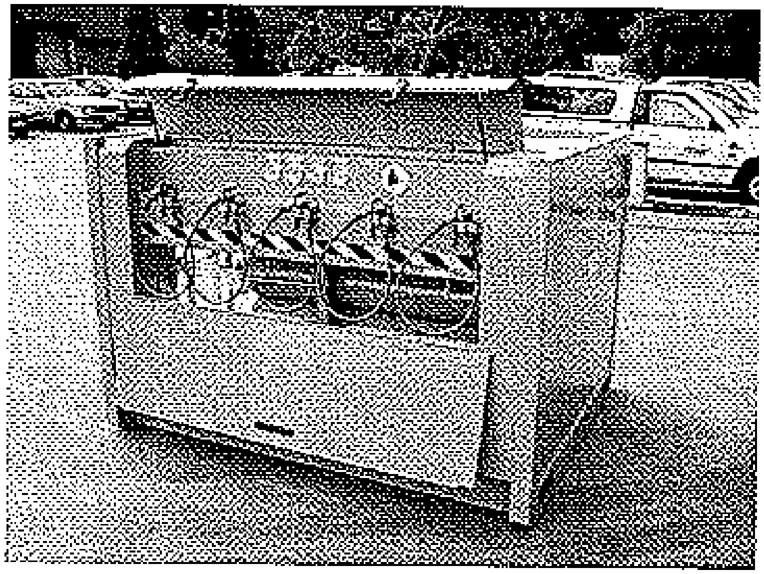
QFS QuickFill Station



Side View

Fill Panel View

Cylinders Battery

The Quickfill Station is a respiratory protection system independent of the ambient air, and it is used to quick charge CABA sets.

•Different batteries of cylinders are available to suit every type of application.

•Filling panel is designed especially for the mining applications.

•Economical utilisation of the air banks volume due to the automatic 4-stage cascade system.

•Easy and safe to use.

•Unit is designed for tough use in a mining environment.

Technical Data

QuickFill Station consists of:
-robust cylinder cradle with access panels
-breathing air battery with compressed air cylinders 50L/350 bar
-filling panel with 5 connections
-4-stage cascade logic system
-pressure gauges indicating air bank pressure
-isolation valve
-quick coupling for charging QuickFill Station from high pressure breathing air compressor

Technical data:

Maximum operating pressure	350 bar
Filling pressure rating	200 or 300 bar
Filling times of 60min CABA	45sec to 70sec
Air battery:	
QFS model C-20	10 cylinders
QFS model C-40	20 cylinders

Options:
quantity of compressed air cylinders in a battery,
1-stage, 2-stage or 3-stage cascade logic systems,
filling connections

Order List

QuickFill Station model C-20	35 53852
QuickFill Station model C-40	35 53735

Draeger Safety Pacific Pty. Ltd.
3 Ferntree Place
Notting Hill, VIC 3168
Telephone: 1800 67 77 87
Facsimile: 1800 64 74 84

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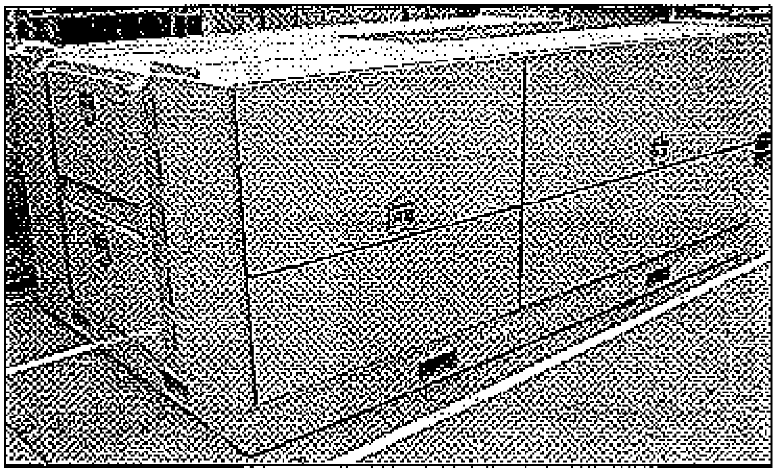
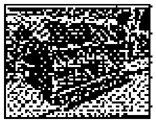
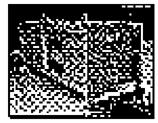
FREEK





FREEK Cabinet

FREEK Cabinet



CABA Recharging Module

FREEK First Response Emergency Evacuation Kit is dust tight storage unit for safe keeping and storing of CABA sets and other safety equipment in an underground mining environment.

The FREEK unit has three out drawers for storing SCSRs and first response tools.

CABA Recharging Module is used namely for quick "toping up" of CABA sets. Also, it has a limited capacity to recharge empty CABA sets.

Technical Data

FREEK First Response Emergency Evacuation Kit consists of:
-robust skid base and frame
-four CABA cabinets (two on each side)
-top and bottom door panels
-bottom door panel are doubled skinned and reinforced mechanism
-three sliding drawers
-stainless steel drop tee handles c/w three point locking
-galvanised piano hinge with brass pin
-rubber seal
-fully enclosed Tyne pockets
-ten CABA hangers
-size L3000 x H1150 x W1800 mm
-weight 980 kg
-space for 20 CABA sets and other safety equipment

CABA Recharging Module consists of:
-farming with protection panels and lifting lugs
-two 50ltr cylinders
-fill panel with one CABA quick charging connection
-size L1800 x H675 x W670 mm
-weight 450 kg

Order List

35 53908 FREEK First Response Emergency Evacuation Kit c/w CABA Recharging Module

35 58240 FREEK Cabinet

35 53909 CABA Recharging Module

Draeger Safety Pacific Pty. Ltd.
3 Ferntree Place
Notting Hill, VIC 3168
Telephone: 1800 67 77 87
Facsimile: 1800 64 74 84

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SAFETY

3.0 Product Folder

3.3 Prices

Draeger C20 Quick-fill Station

Unit refilling capacity is minimum 20 x 9.0 litre 300 bar cylinders from 50 bar residual

Part No 35 53852

Draeger C40 Quick-fill Station

Unit refilling capacity is minimum 40 x 9.0 litre 300 bar cylinders from 50 bar residual

Part No. 35 53735

Draeger FREEK - First Response Emergency Evacuation Kit

complete with recharging module

Part No. 35 53908

FREEK Locker only

Part No. 35 58240

Recharging module only

Part No. 35 53909

Note: All prices are FOB Melbourne Australia

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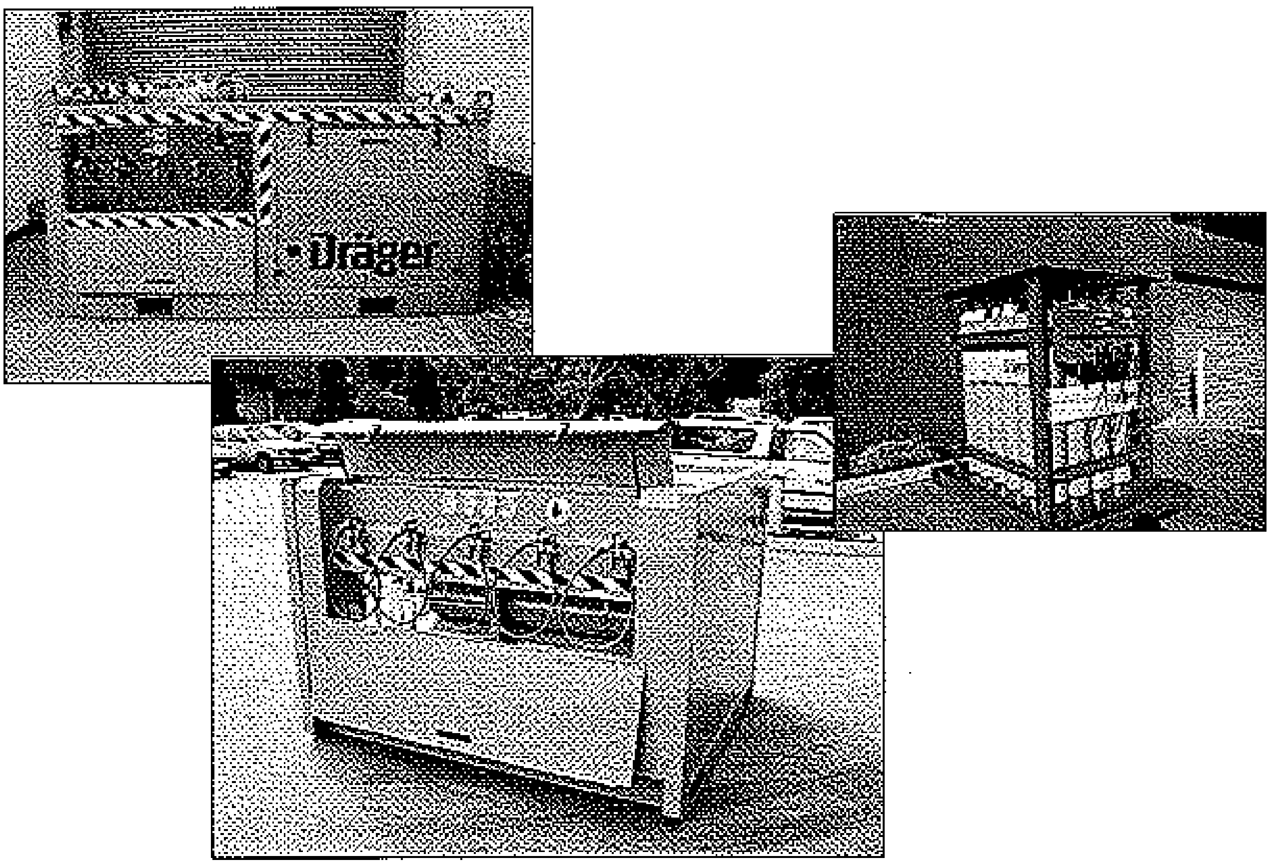
4.0 Operation

The following pages contain a generic training program for the operation of the Draeger Quick-fill



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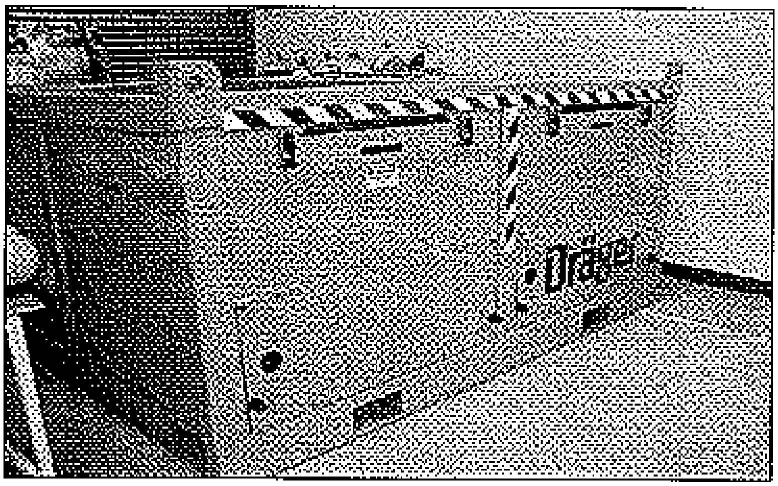
QUICK FILL STATION OPERATING MANUAL



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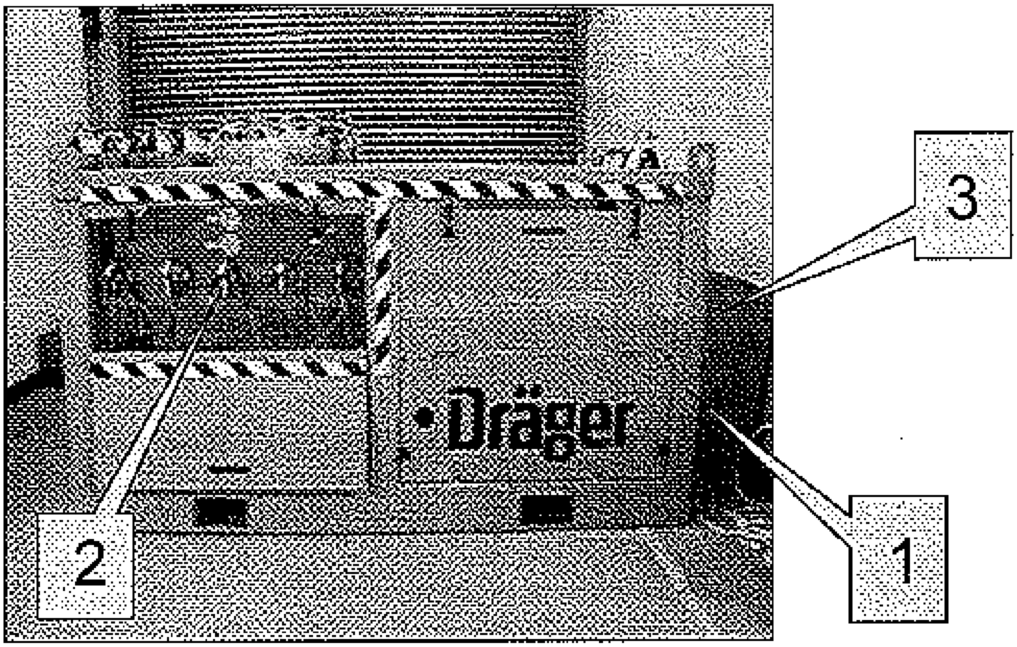
The System Components



1. Cradle
2. Fill Panel
3. Air Storage Bank 1, 2 (not shown)

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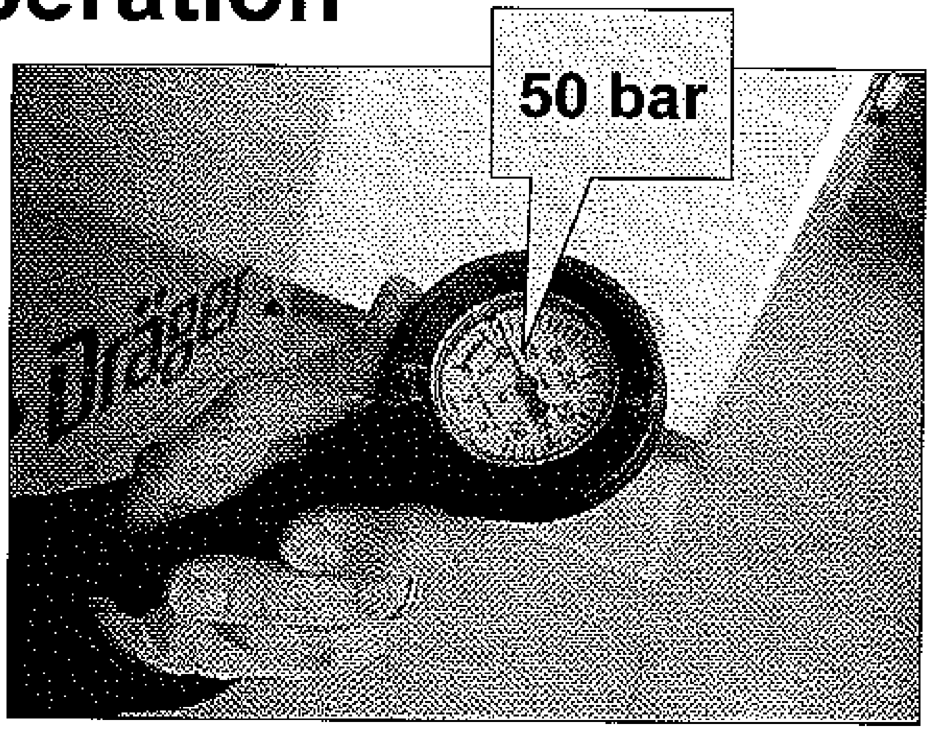
Quick Fill Operation



- **Observe the CABA pressure gauge**
- **When the pressure gauge indicates 50 bar, recharge your CABA.**

Quick Fill Operation

- Open the front cover of the quick fill station to access fill panel

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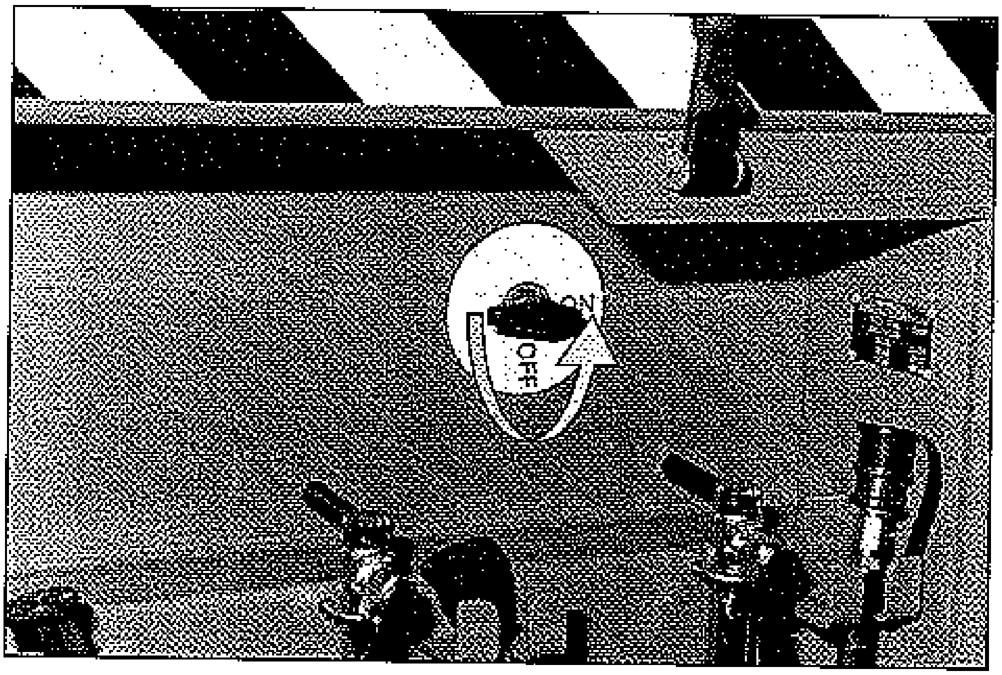
Quick Fill Operation



- **Activate the system by turning the isolation valve anticlockwise to the "on" position**

Note:
The valve should remain open during the entire operation of the system

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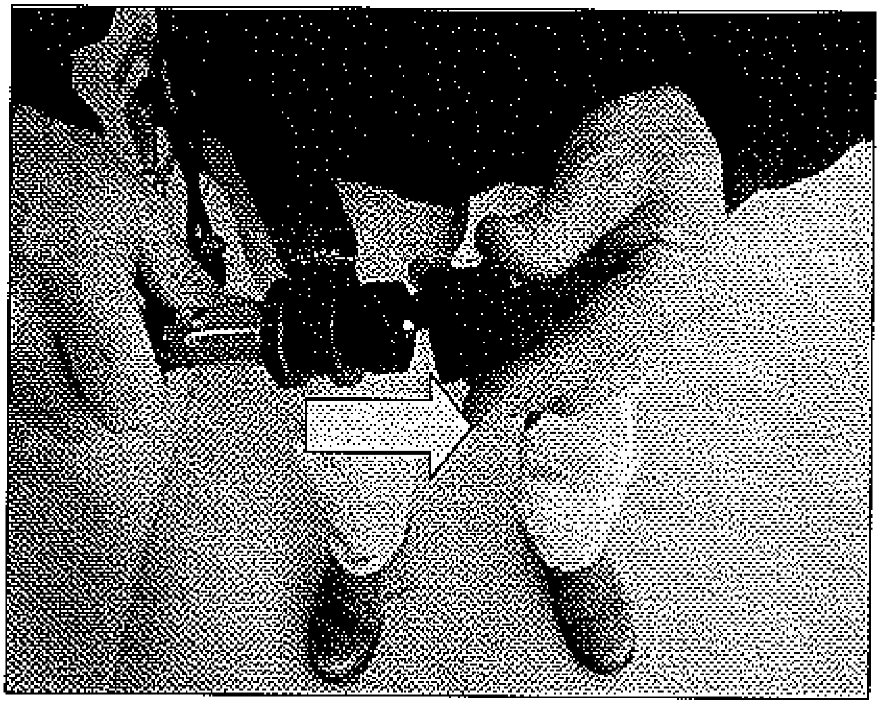
Quick Fill Operation

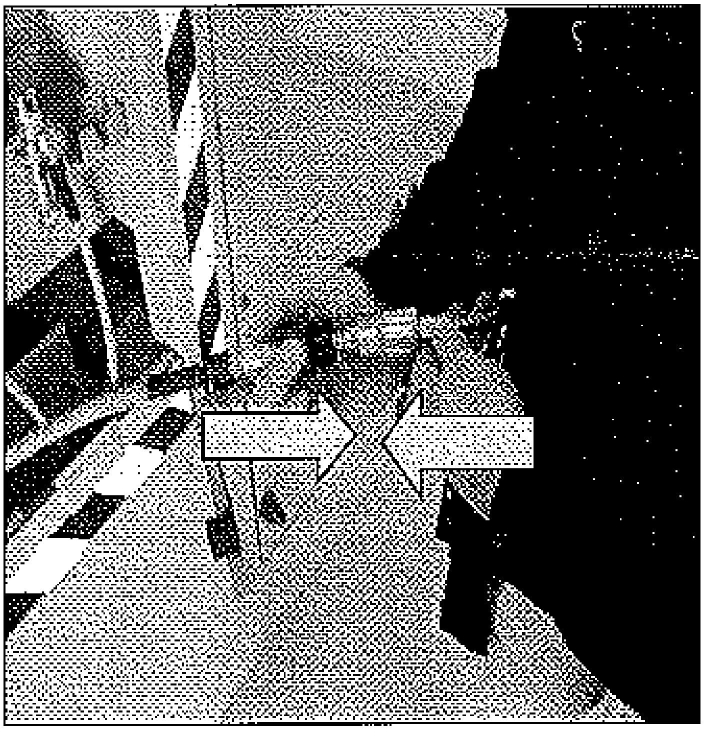
- **Remove the filling hose from the bracket**

Quick Fill Operation



- **Remove the dust cap from the charging air couplings**

Quick Fill Operation



Note:
Do not use any tools

- **Push charging air male to female couplings together until a ‘click’ is heard.**

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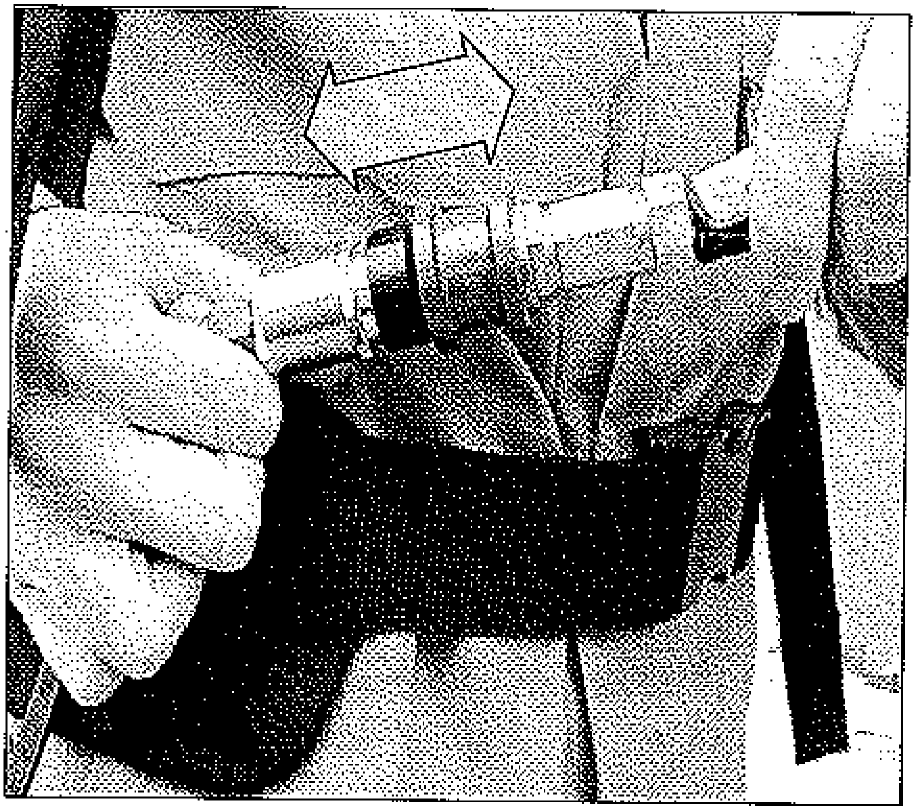
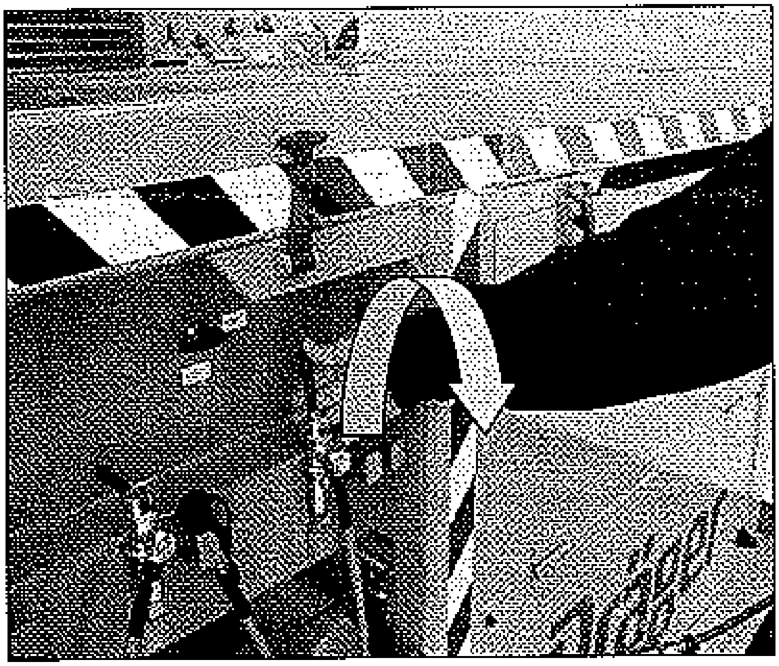
Quick Fill Operation



- **Ensure the connection is firm by pulling ends of coupling and a lime green ring is visible.**

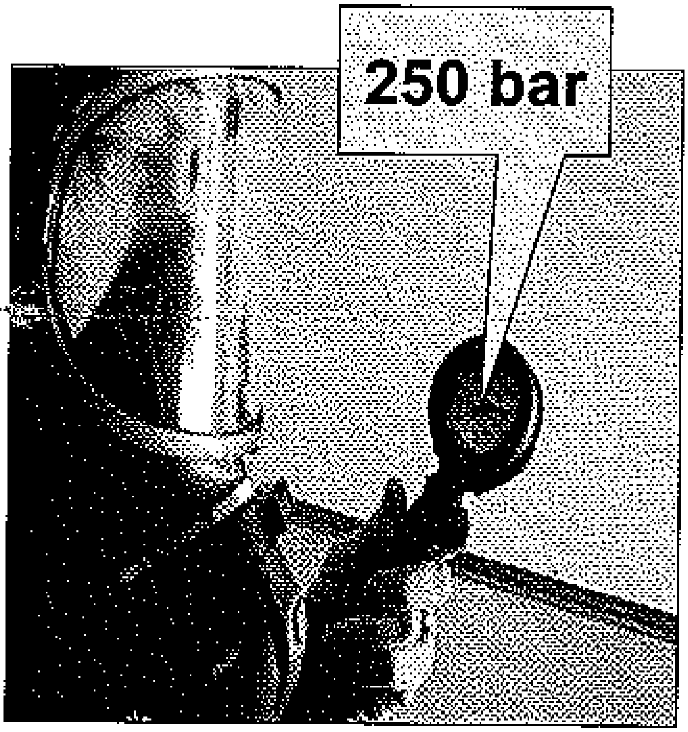
Quick Fill Operation



Note:
Beer tap valves should be opened and closed with one fast motion.

- Open the 'beer tap' valve on the fill panel

Quick Fill Operation



Note:
When switching from the 1st to 2nd air bank, may occur a short delay.

- Observe the CABA pressure gauge
- When pressure gauge indicates 250 bar, the system switches from 1st to 2nd air bank.

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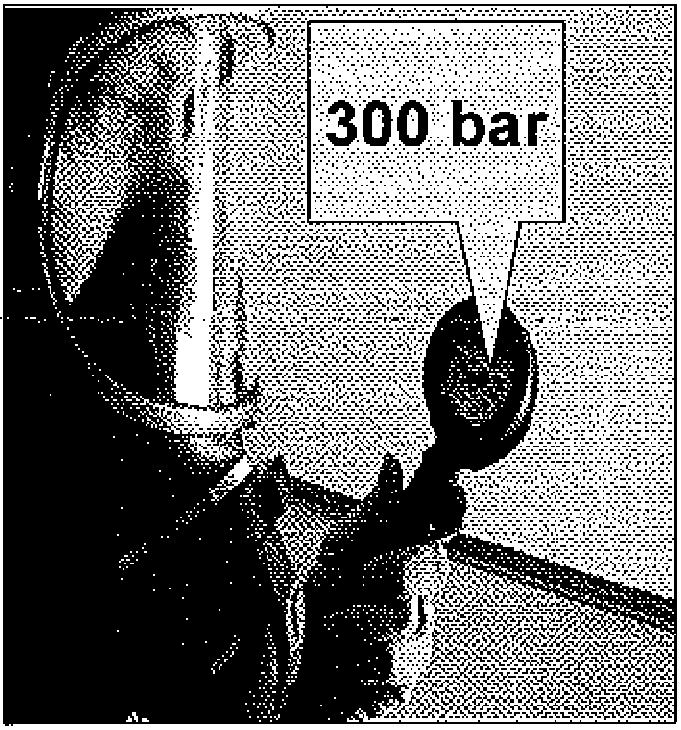
Quick Fill Operation



Note:
Approximate fill times of
1 x CABA -1min 40sec
5 x CABA - 4min 35sec

CABA cylinders pressure may drop due to cooling effects.

- **Observe the CABA pressure gauge**
- **When pressure gauge indicates 300 bar, your CABA is recharged.**

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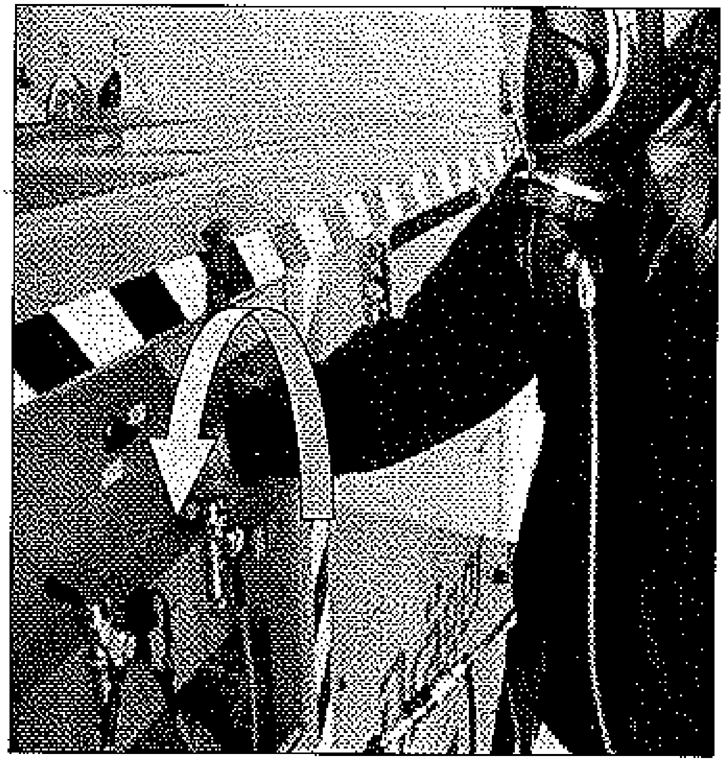
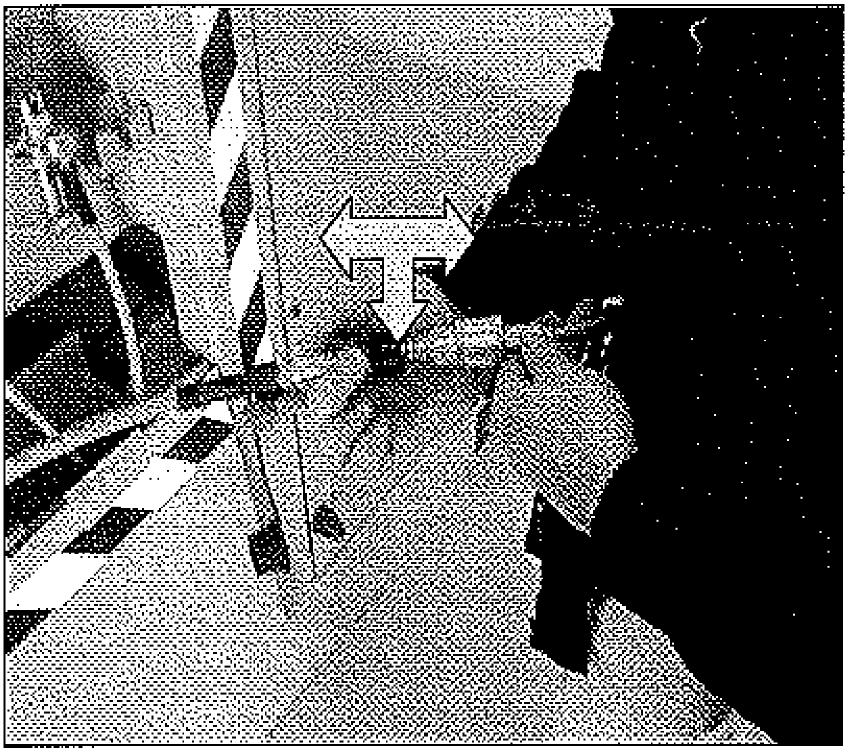
Quick Fill Operation



Note:
When 'beer tap' valve is closed, it vents a small amount of air from fill hose

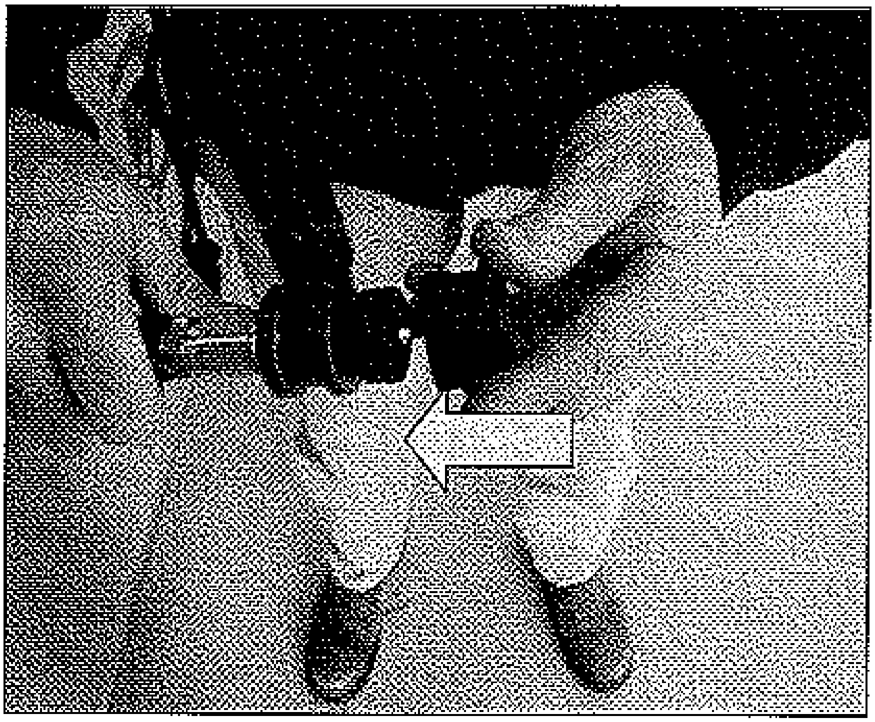
- Close the 'beer tap' valve

Quick Fill Operation



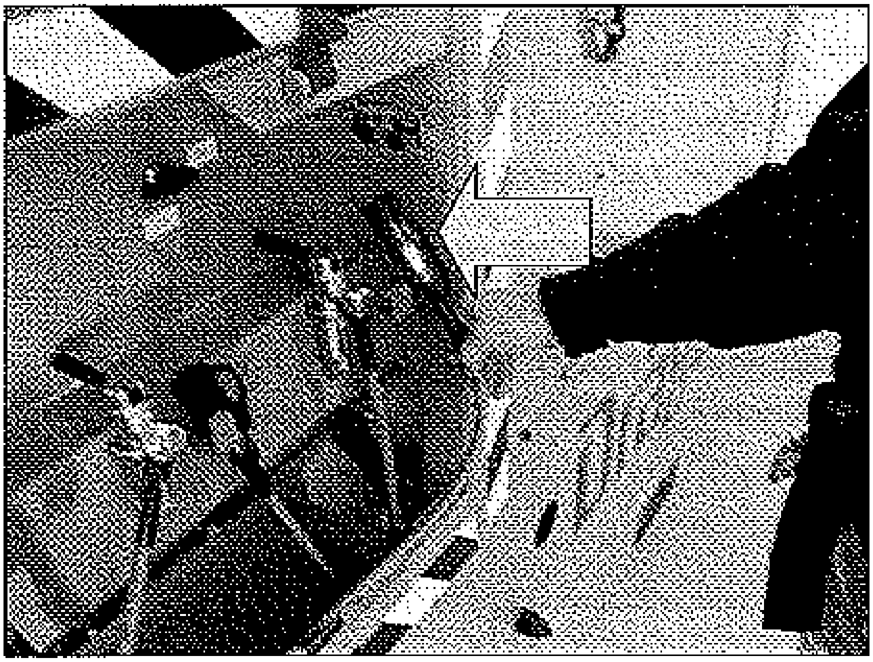
- **Disconnect charge air couplings by pulling away the sleeve of the female coupling**

Quick Fill Operation



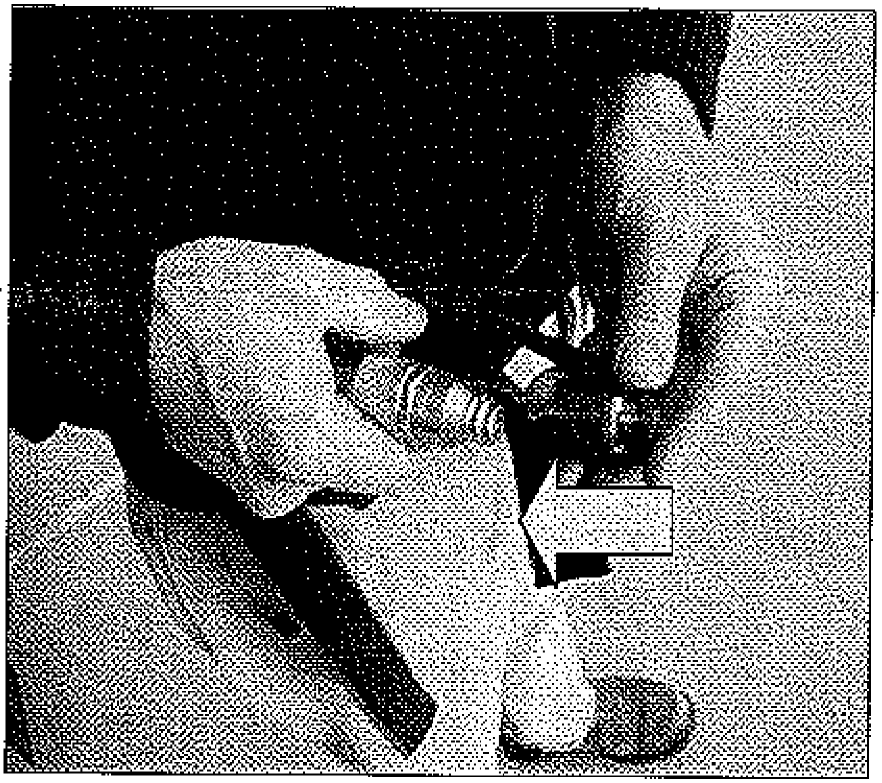
- **Fit the dust cap on the charging air coupling**

Quick Fill Operation



- **Place fill hose into the bracket**

Quick Fill Operation



- **Fit the dust cap to your CABA male coupling**

Quick Fill Operation

CABA is fully recharged and ready for use.

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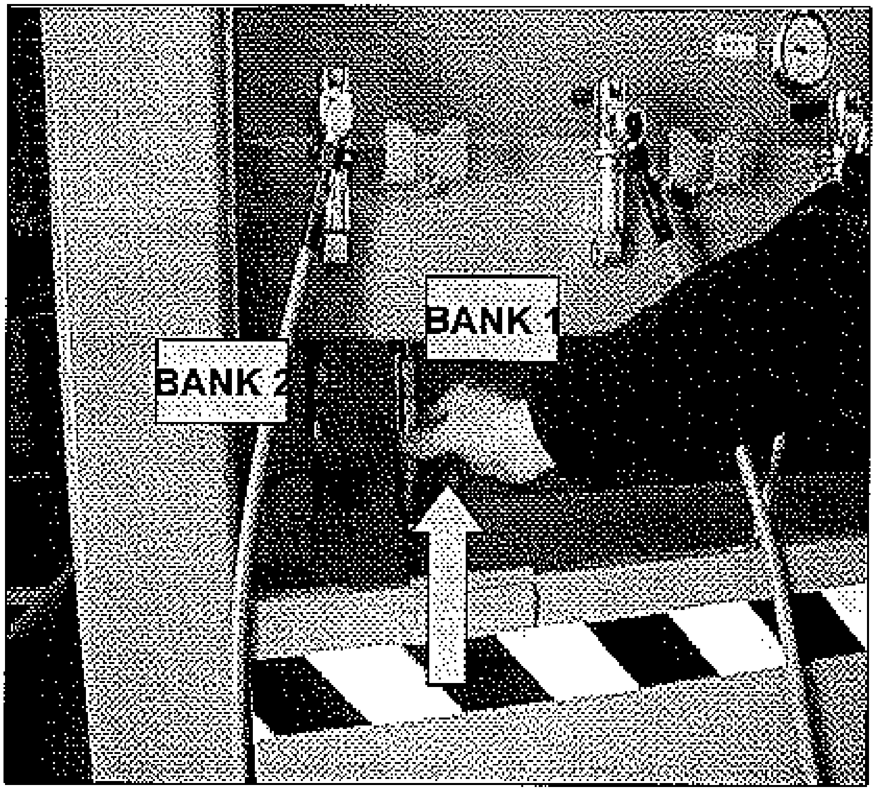
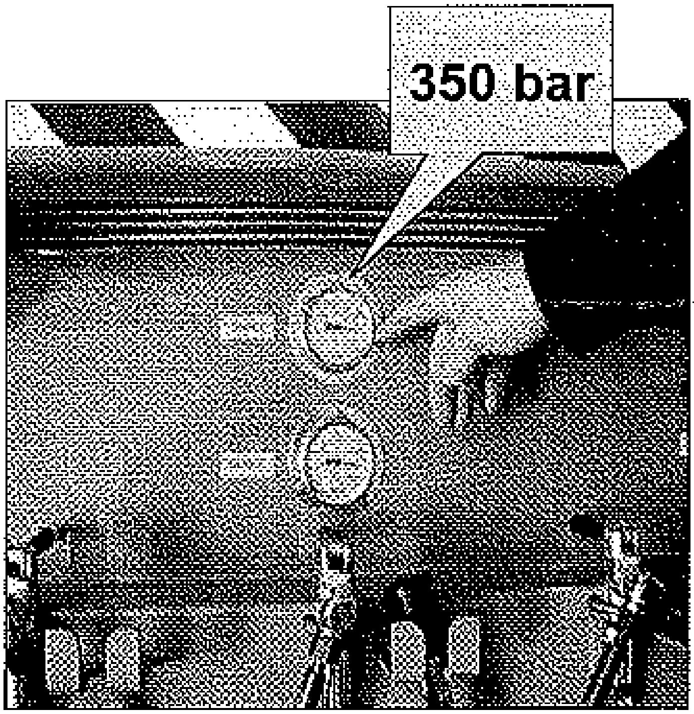
Quick Fill Operation



- Connect compressor hose to quick connector 'Bank 1'

Quick Fill Operation



Note:
The compressor will turn off automatically when the fill pressure of 350 bar is reached

- **When 'Bank 1' is fully charged, the pressure gauge will indicate pressure of 350 bar.**
- **Repeat the same procedure when filling 'Bank 2'.**

5.0 Report on the Simulated Emergency Exercise conducted at Newlands Colliery - Queensland Aust. (Part A only)

The following pages contain part of a report by the Queensland Government - Department of Natural Resources and Mines.
The report looks in part at the successful introduction of Compressed Air Breathing Apparatus as an option in a Mine Escape Strategy as both a first response tool and an escape apparatus to replace self recuers

Queensland Government
Natural Resources and Mines

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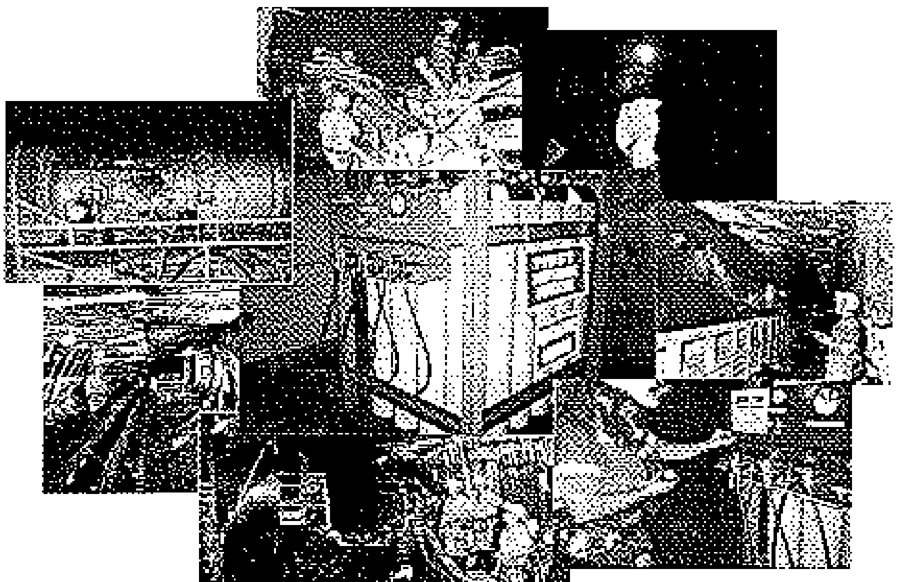
Report on the Simulated Emergency Exercise held at Newlands Colliery



Saturday, 25 November 2000

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EXECUTIVE SUMMARY

The third of Queensland's Level 1 emergency exercises introduced a number of different elements to an already rigorous test of a mine's emergency response capabilities.

This year's exercise was held at the Newlands mine with the exercise being initiated through two separate and unrelated events late on a Saturday evening. This strategy was designed to challenge the initial response protocols and the emergency declaration triggers in place at the mine, and to examine the call-out times of a mine approx. 2 hours driving time from the weekend domiciles of a number of key mine personnel.

Additionally, this years exercise provided the opportunity to evaluate the use of compressed air breathing apparatus (CABA) as a component in emergency response. The outcomes of the exercise clearly demonstrated that CABA adds a powerful weapon to the armory of the self-escape philosophy. Its flexibility, ease of use and ability to facilitate communication makes it well suited to the cause of emergency response, particularly as it provides a rapid, in-seam first response capability.

Finally, a small number of the underground workforce were intentionally prevented from evacuating to a place of safety in order to evaluate their survival strategies once it became apparent that their self-rescuer oxygen supply would not sustain them until assistance arrived. Their innovative and ingenious final solution was most successful and those persons are to be commended for their actions.

Throughout the exercise, it was apparent that the Newlands Emergency Preparedness and Response Plan was comprehensive, well conceived, well practiced and "owned" by the whole of the workforce. The standard of decision making exhibited by the deputies and workforce underground was admirable, and the technical expertise and control of circumstances demonstrated by the Incident Management Team was most creditable.

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Further, the report contains a number of recommendations specific to the exercise and several others for broader attention. The analysis covers the full scope of the audit, however specific detail is provided on the need for the appointment of key control personnel to surface and underground incident sites and the need for tighter integration of the self-escape CABA resources and first response protocols, with the aided-rescue resources and personnel provided by the Qld Mines Rescue Service

In conclusion, the assessment team found all the Newlands personnel (and contractors) to be most professional, willing and capable in the approach and prosecution of their emergency response. I would like to thank them, and the assessment team, for their contributions and trust that this report will further add to the energy and knowledge pool of our industry's emergency response capability.

Greg Rowan

Chairman Emergency Exercise Management Committee

Part A: The Exercise

PLANNING AND CONDUCT OF EXERCISE

SCOPE

OBJECTIVES

SCENARIO

Transformer Scenario

Emergency Scenario

Assessments Points at Issue

- N1 Crew
- Longwall N4 Crew
- Main Dip Crew
- QMRS
- Incident Management Team

EXERCISE EVENT LOG

KEY FINDINGS AND RECOMMENDATIONS

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Findings

1. A coordinated combination of Self-Escape and Aided Rescue strategies has again proven itself as a most effective vehicle in enhancing survival of underground personnel
2. Compressed Air Breathing Apparatus (CABA) provides a powerful addition to the armory of resources supporting these strategies. Its ability to provide a rapid in-seam response was clearly demonstrated in the event time-logs compiled during this exercise
3. The Emergency Response capability at the Newlands mine is comprehensive, well conceived and resourced, practiced and "owned" by the whole of the workforce
4. Emergency Response activities need to recognise the vital strategic importance of maintaining effective control of key locations, eg underground emergency site/s
5. All persons should be aware of facilities provided to allow emergency communication hardware to be installed such that inbye communications are not disrupted
6. Current Status white-boards detailing the deployment of personnel and resources should be commenced as soon as an emergency is declared. These boards assist greatly in scenario planning and provide vital information during review and hand-over activities
7. There is a need for the Assessment Teams at future exercises to solve the problem of maintaining a sense of urgency and realism at simulated emergency sites

Recommendations

1. It is recommended that a forum of stakeholders be urgently established to develop and implement a set of protocols covering the interactions between mine-site first-response teams and external aided-rescue organisations. Each of these parties provide specialist, but separate, skills and resources and it is vital that the issues involved in their interactions be identified and coordinated. There is little doubt that CABA teams will increasingly form part of emergency response capabilities in our industry and we must be prepared
2. It is recommended that the functions inherent in current gas monitoring software be explored, particularly the facility to store and retrieve documents detailing required Action Response Plans. Such software has much to offer Control Room Operators and IMT personnel
3. It is recommended that the ergonomics of the CABA main valves be reviewed and modified (if possible). The need to turn two valves in different directions using different hands will inevitable give rise to circumstances where both cylinders are not fully operated

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PART A: THE EXERCISE

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PLANNING AND CONDUCT OF EXERCISE

A number of planning meetings were conducted and a detailed risk assessment process was undertaken during the development of this exercise scenario. The scenario and subsequent events were based on the hazards and risk profile specific to Newlands mine.

The scenario itself was based on a fire initiated by a fault in the transformer at cut-thru 2. C D heading Main Dips. Through a series of events, detailed in *Transformer Scenario*, the transformer acted as the energy source to ignite a fire in the coal roof and ribs. The fire grew rapidly as it consumed fuel in the roof and ribs and spread throughout the cut-thu. Combusting coal in the roof eventually reached the far side rib of 2cut-thru D heading, where it burnt through the tube bundle monitoring lines.

The fire was seemingly brought under control following the application of low-expansion foam applied from both sides of the cut-thru. However, combustion was still occurring in the coal roof strata, eventually resulted in a fall of the weaken roof in the intersection at 2 cut-thru D heading. Following this fall, the combusting roof coal was exposed to the fanning effect of the full ventilation flows in D heading and again rapidly grew out of control. Further application of low-expansion foam from the out-bye side of the fall again brought the fire under control.

It should be pointed out that at no stage was the transformer itself on fire.

All mine atmospheric and ventilation monitoring data was provided through the mine control room, in real time and in a format compatible to computer assisted analysis and system interrogation. As in previous years, the software program developed by SIMTARS proved invaluable in the provision of this data. The data was presented in formats identical to those used at Newlands and with which the personnel at Newlands were familiar.

It was anticipated that the exercise would be attacked on four fronts:

1. In-seam evacuation of personnel using self-rescuers and compressed air breathing apparatus (CABA)
2. Fire fighting and control by in-seam and/or surface directed teams
3. Rescue and recovery of missing personnel by in-seam CABA teams and/or surface directed Mines Rescue Teams
4. Deployment of the GAG inertisation equipment

No constraints were to be placed on the extended deployment of the Queensland Mines Rescue Service teams other than those imposed by QMRS internal policies and procedures, or on the mine's internal emergency response teams.

The practice previously adopted by the Emergency Exercise Management Committee of providing advance notice of the "window" during which the exercise was to be conducted was continued, and advance notice provided to all stakeholders, including the police, community, media and emergency services.

In recognition of the international interest now being generated by these exercises, the Exercise Management Committee has been requested to detail the names, qualifications and experiences of its members. It is imperative that these exercises be conducted with the greatest regard for transparency and it is with pleasure that I include this information as an Appendix to this report

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SCOPE

To conduct an Emergency Exercise in accordance with the "Guidelines for the Conduct of Emergency Procedures Exercises" as established by the Moura Recommendations Implementation Task Group 2.

These guidelines proposed that exercises:

- Be systematic;
- Be consistent with the concept of mutual assistance from other mines;
- Require direct reference to the risks at the mine;
- Recognised that exercises should not necessarily be held on day shift;
- Be inclusive of external agencies such as QMRS, police, media and senior company officials;
- Have an audit and evaluation process;
- Be subject to risk assessment principles to ensure the exercises do not introduce new safety risks to persons at a mine;
- Require inertisation equipment to be put in place, as well as confirming airlocks and emergency stoppings on the surface are found to be safely accessible and operative.

In recognition of these guidelines:

- A strategy document was produced establishing the systematic initiation, control and assessment of the exercise;
- Mines signatory to mutual assistance agreements were required to supply mines rescue trainees and GAG operators sufficient to meet the exercise minimum needs i.e. 14 trainees and 3 GAG operators;
- A scenario was developed strictly in accordance with the hazards present at Newlands mine;
- The exercise was conducted on a weekend change over from day shift to night shift, commencing 25th November 2000;

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OBJECTIVES

The objectives of the exercise were to:

- Ensure no personnel injury, equipment damage or introduction of additional risks. Please note that the design of the emergency exercises was done using risk assessment methods
- Test the ability of the current Mine Emergency Procedures, to meet the desired outcomes of an emergency response
- Provide an opportunity to evaluate the use of CABA equipment in an emergency evacuation and response
- Demonstrate a coordinated response involving both Newlands permanent employees and external contractors
- Demonstrate a coordinated response involving Newlands, QMRS, DME, Check Inspectors, SIMTARS, Emergency Services and other stakeholders
- Enhance the confidence and ability of personnel to respond to an emergency
- Allow for a performance analysis and debrief to occur following the exercise, with the outcomes recorded and relevant information disseminated to industry

To meet these objectives, audit and assessment tools were developed to cover the following functions:

- Emergency Initiation
- Emergency Response Plan, including the Duty Card System
- Incident Management and Emergency Control
- Emergency Evacuation
- In-seam Emergency Response
- Location of Personnel and Debrief
- QMRS – Ability to Respond, Mutual Assistance, GAG, Mandatory Performance Criteria

External Agencies – ability to respond

SCENARIO

TRANSFORMER SCENARIO

Some days before the incident (a period less than the routine test period for 11kV protection tests), a maintenance electrician replaced a suspected faulty capacitative trip unit and gas pressure trip.

The electrician did not test functionally of capacitative trip unit due to being at an end of shift.

He also did not correctly connect the gas pressure trip gas lines.

The nitrogen gas leaked out, the low pressure gas trip sent a trip signal to 11kV breaker but was unable to trip as capacitative trip unit was incorrectly installed.

11kV feed to the transformer was temporarily de-energised due to tests on surface breaker.

On re-energising the 11kV feed to the transformer, the normal surge (inrush) caused a flashover across the main 11kV terminals of the transformer windings causing major arcing between phases resulting in catastrophic failure of the transformer tank.

The structural failure of the tank (the lid "blew" off) allowed extreme high temperature ionised gas, in the order of 14,000^{O}C, burning insulation and molten copper to impinge on the coal roof and ribs igniting the coal.

No one was present to combat the – if anybody had been present they would have received serious injuries or burns

EMERGENCY SCENARIO

EVENT	EFFECT
25 November 2000 **21:00 hours**	Start of afternoon shift.
22:13 hours	• Methane drainage water-trap at 27 cut-through, B → C Heading damaged. • Line ruptures – issues 600 l/sec into the $40m^3$/sec airflow in the Dips.
22:21 hours	Surface control room advised by Deputy in the Dips of the damage to the methane drainage line.
22:36 hours ***Time : T 0:00***	• **Electrical fault in the transformer at 2 cut-through, C → D Heading causes catastrophic failure of the transfer tank.** • **Underground power trips.** • **Super-heated ionised gas and molten copper impinge on roof and rib strata – fire develops.**
23:39 hours	First Alarm sounded on monitor in Control Room – 5ppm CO No2 D/head
22:46 hours	Choking fumes from electrical failure, burning insulation etc arrive in Main Dips
22:51 hours	Fire fully developed
22:57 hours	Choking fumes from electrical failure, burning insulation etc arrive in Longwall N4
01:03 hours	Fire in roof coal has extended across 2 cut-thru D heading and burns through the tube-bundle monitoring lines
02:30 hours	PROVIDED fire fighting activities have been ongoing for **more than 3 hours** – all visible flame is extinguished
03:30 hours	Roof fall at intersection of 2 cut-thru and D heading. Burning coal in roof strata re-flares when exposed to full ventilation flow
04:50 hours	PROVIDED fire fighting activities have re-commenced and are on-going – fire out
06:00 hours	Exercise terminated

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ASSESSMENTS POINTS AT ISSUE

Notes For Assessment Teams

N1 Crew

- Smoke and or fumes will not enter this panel until 23:40 hrs (T + 1:04)
- Crew members to be supplied with and use training model SSCRs
- If the crew searches appropriately, they will be advised that they have located the fire at 2 cut-through, C D Heading
- It is anticipated that the crew will locate and don CABA gear and attempt to fight the fire
- Fire fighting attempts will be unsuccessful until approx. 3 hours after coordinated attacks have commenced from both sides of fire using low expansion foam
- Assessors will video-tape their actions with the CABA and fire-fighting
- Communication with control is to be evaluated for frequency, effectiveness and accuracy

Longwall N4 Crew

- Deputy to be isolated from crew prior to notification of smoke
- Crew to self organise with visibility impaired
- Crew members to be supplied with and use training model SSCRs
- Monitor which of the crew takes the limited CABA equipment and how/why such allocations were made
- Evacuate on foot -- transport to be disabled
- Monitor communication to control room – note methods of communication with mouth-pieces
- Monitor advice provided/received from control room Re: missing Deputy
- Evaluate actions regarding the missing Deputy - do they conduct a search, if so, by who and for how long, does the crew split up with some evacuating and others searching
- Upon leaving the crib room to evacuate or search, or at 2302 hours, impose ZERO visibility
- Monitor / evaluate use of "blind man" sticks in evacuation
- Video tape the evacuation
- If appropriate, provide facility for Deputy to observe as co-assessor
- Once at FRS 15 cut-thru B C Heading, evaluate communication, use of additional CABA, return to search for the Deputy

Once at fire site, 2 cut-through, do they assist in fire-fighting or continue to evacuate

Main Dip Crew

- Crew members to be separated from each other
- At least one person to become disorientated and to remain in section
- Others to evacuate as they deem appropriate or as advised by control – transport may be used
- Assess effectiveness of communications with control room with mouth pieces in
- Crew members to be supplied with and use training model SSCRs
- Monitor / evaluate survival strategies of crew members remaining in section
- For evacuees, once at FRS 15 cut-thru B C Heading, evaluate communications, use of CABA, are there any CABA units left, do they return to search for missing crew or continue evacuation
- Once at fire site, 2 cut-through, do they assist in fire-fighting or continue to evacuate

QMRS

- Time taken between call-out and turn-out
- Efficiency of mutual assistance schemes
- Evaluate possible conflicts in Roles, Responsibilities and Authorities of Newlands personnel who are also QMRS trainees
- Evaluate communication flows
- Evaluate efficiencies of resource deployment and equipment use
- Monitor interactions / performance / preferences BG174s and CABA
- Monitor deployment strategies of QMRS - to fight fire and/or locate and recover missing persons
- GAG to be mobilised from Dysart station, assembled and test run

Incident Management Team

- Identify independent nature of the two pre-cursor events – damage to the gas drainage line and the loss of power triggered by transformer failure
- Ascertain nature of the true circumstances
- Mobilise personnel and resources
- Collect and correctly interpret data
- Establish objectives and priorities
- Establish and maintain effective communication channels
- Continuous monitoring of progress towards attaining objectives
- Interpret and respond to changing circumstances
- Monitoring of resource deployment and establishment of hand-over priorities
- Ongoing re-evaluation of objectives and priorities

Regular up-date meetings and checks on communication flows

EXERCISE EVENT LOG

In the course of the exercise, several different Event Logs were compiled by the assessment team and Newlands personnel. The following table is a simplified compilation of the major events and is provided to assist in understanding the interaction of the various activities and processes that necessarily unfold simultaneously during any emergency.

The in depth details regarding these activities are contained within the logs prepared by the assessors and included in the separate sections of this report.

START TIME	EVENTS	ELAPSED TIME
FIRST HOUR		
2221	Control Room Operator was advised by Main Dips Contractor that the methane drainage line ruptured	**- 0:15**
2231	CRO contacted Ventilation Officer and Mine Manager	**- 0:05**
2236	Mains, 2 cut-through transformer explodes and coal fire starts. All underground power tripped at surface breaker	**START**
2239	CO monitors start to alarm at 5ppm Number 2 drive head cut-through 39.	**0:03**
2245	▪ Multiple alarms in Control ▪ Thick choking smoke arrives at the faces main dips where four contractors are working	**0:09**
2247	CRO called Preparation Plant for assistance	**0:11**
2248	Two out of four contractors donned rescuers and left Main Dips	**0:12**
2253	CRO informed the Deputy at N1 that there was 50ppm on the trunk belt and has had no contact with contractors in the Dips	**0:17**
2257	▪ Deputy at N1 contacted Control to advise of his intended actions to search the Dips for the contractors ▪ During DAC message from CRO smoke entered longwall panel. Crew donned belt worn SCSR units and retreated outbye	**0:21**
2300	Open-cut assistance arrived (two persons): ▪ 1 x allocated as back-up response controller ▪ 1 x Control Point 1 was established	**0:24**
2302	N1 Take off Chute crew left the panel travelling inbye via transport	**0:26**
2303	▪ Longwall crew grouped at crib camp before progressing to FRS and attempted to phone CRO. CRO officer logged "funny voice on phone" and attempted to initiate non-verbal communications. ▪ CRO called open-cut for assistance	**0:27**

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2312	Manager arrived on surface	
2315	Longwall crew contacted CRO and reported missing Deputy and informed route of travel and were ready to depart	0:39
2318	▪ N1 Deputy established that fire was at the transformer at Mains, 2 cut-through and Deputy and crew elected to fight fire. ▪ Open-cut assistance arrived and were utilised as security	0:42
2320	▪ IMT established ▪ Ventilation Officer arrived	0:44
2324	Longwall crew depart FRS 19 cut-thru with impaired visibility masks	0:48
2325	CRO instructed by Mine Manager to contact mine site Mines Rescue Coordinator who was to put QMRS on standby	0:49
2326	Dips Contractors (2) called from 10 cut-through, B Heading. They were clear of smoke. Two men still missing in the Main Dips and heavy smoke was observed in the belt road. They removed their SCSR and continued outbye on foot	0:50
SECOND HOUR (commencing 23:26)		
2345	Four N1 crew commenced fighting fire with hoses whilst under CABA	1:09
2348	▪ N1 crew contacted CRO and reported that the fire was too hot and they were making no head way about to use low expansion foam. ▪ Two Dip Contractors arrive on surface and de-briefed by Mine Manager	1:12
2353	▪ First Longwall CABA unit sounded warning whistle (55 bar) – wearer donned 60 minute SCSR. ▪ Mine Site Mines Rescue Coordinator arrived on site	1:17
0015	Local Mines Rescue brigades start arriving (from Newlands)	1:39
0017	GAG unit called out.	1:41
0024	Four out the five Longwall crew on SCSR and one still on CABA	1:48
0027	N2 Panel – fighting fire – requested more men and foam	1:51
0032	Longwall crew arrived 2 cut-through, MG N4 cache and took additional units	1:56
THIRD HOUR (commencing 00:26)		
0040	Mines Rescue men to set up FAB at 8 cut-through – stay at phones	2:04
0042	Longwall crew arrived at B15 cut-through QFS	2:06
0057	▪ CRO was advised by the N1 crew that they were out of low expansion foam and cannot get within 20 meters of the fire. ▪ Longwall crew departed QFS with full CABA units	2:21

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0112	* QMRS Team 1 leaves the surface to assist with fire fighting. * Longwall crew contacted CRO from 7 cut-through, Main Dips and informed that all were okay	[illegible]36
0117	QMRS Team 1 arrived at 1 cut-through, B Heading, Main Dips	2:41
0127	Longwall crew arrived at B1 cut-through, informed they were in fresh air, removed CABA and directed to proceed to surface in a vehicle	2:51
0136	Longwall crew arrive on surface	3:00
FOURTH HOUR (commencing 01:26)		
0142	Longwall Deputy arrived at 2 cut-through, B Heading	3:06
0147	Second QMRS mines rescue team 2 arrived on surface (North Goonyella)	3:11
0223	Mines Inspectorate personnel arrived on site	3:47
0225	QMRS Team 1 contacted CRO and informed that fire was starting to be controlled but more men were needed	3:49
0230	QMRS Team 1 contacted CRO and reported that the fire was out	3:53
FIFTH HOUR (commencing 02:26)		
0300	QMRS Team 3 (mines rescue from Moranbah North) arrives	4:24
0315	QMRS Team 2 leaves the surface to go to the Dips in transport to search for missing contractors	4:39
SIXTH HOUR (commencing 03:26)		
0330	Roof fall intersection 2 cut-thru and D heading **Smoldering fire in fallen roof coal rapidly flares**	
0337	QMRS Team 2 encountered smoke at 10 cut-through, B Heading, contacted CRO and were instructed to retreat to FAB	5:01
0403	IMT decided to source high expansion foam generator from North Goonyella	5:27
0435	QMRS Team 3 leaves surface under instruction to prepare site for use of high expansion foam generator	5:59
SEVENTH HOUR (commencing 04:26)		
0450	Fire reported as out	6:14
0503	Underground exercise terminated	6:27

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SUBSEQUENT		
0700	GAG arrived on-site	8:24
1121	GAG ready to start	12:24
1125	GAG engines started	12:44
1138	GAG engine shut down – test successful	

DEFINITIONS

CRO	*Control Room Operator*
N1	*N1 Take Off Chute*
FRS	*First Response Station*
MG	*MainGate*
QFS	*Quick Fill Stations*
QMRS	*Queensland Mines Rescue Service*

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SAFETY

6.0 Reports on Rapid filling compressed air cylinders

Dräger

IMPORTANT FAX MESSAGE FROM EFIC

Utah Division
47 West 200 South, Suite 331
Salt Lake City, Utah 84101 USA
Phone: (801) 596-0357
Fax: (801) 596-1570

DATE:	January 10, 1995
COMPANY:	Draeger Ltd.
PERSON:	Mr. Kevin Harris
PAGES:	1 of
FAX NO.:	011 44 0670 361732
RE:	Our January 9, 1995 telephone conversation; Quick Fill of EFIC Cylinders

I am pleased to present information regarding the use of quick fill systems with EFIC cylinders. A copy of EFIC Technical Bulletin TB004, "Recommended Charging Procedures for EFIC Fiber Reinforced High Pressure Cylinders," is attached to this fax for your reference.

Fill rate has no significant effect on the safety or performance of EFIC composite cylinders. The cylinders are pressurized from zero to test pressure and back to zero in less than 15 seconds for thousands of repetitions during batch qualification testing. This pressurization rate is far faster than any expected in service.

The composite overwrap on EFIC cylinders is a very efficient insulator, resulting in a low heat dissipation rate through the cylinder walls. Consequently, the maximum temperature achieved after filling is not greatly affected by varying fill rates. Likewise, immersing a composite cylinder in a water bath during filling has little effect on maximum temperature.

The maximum allowable sustained temperature for EFIC composite cylinders is 100°C. One developer of a quick fill system reports that the maximum achieved temperature is approximately 50 to 55°C after filling. The thermodynamic laws for compressible gases can be utilized to calculate the maximum internal charging temperature by allowing the cylinder to stabilize at room temperature, and then comparing the room temperature equilibrium pressure to maximum fill pressure.

EFIC cylinders should be placed in protective fragmentation containers during filling under normal circumstances to prevent the possibility of personal injury in the event of component failure. A thorough pre-charging inspection procedure of the breathing apparatus is always mandatory, but is especially crucial when charging without the use of a fragmentation container.

Typical quick fill applications do not top off the cylinder after it settles to room temperature. Hence, there will be a decrease in stored air with such a system.

EFIC

Dräger

S A F E T Y

Luxfer USA Limited
Composite Cylinder Division
[illegible] Avenue
Riverside, California 92[illegible]

For Sales Information:
[illegible] Suite [illegible]
Riverside, California [illegible]

January 10, 1995

Kevin Harris
Draeger Limited
Kitty Brewster Industrial Estate
Blyth
Northumberland NE24 4RG
England

Subject: Quick Filling of Luxfer Composite Cylinders.

Dear Mr. Harris:

We have reviewed your request for quick filling our composite cylinders at a maximum fill rate of 6000 psi/min and do not know of any technical reason why our cylinders can not withstand these types of fill rates. During hydrostatic testing and cycle testing, Luxfer composite cylinders are hydraulically pressurized faster than 6000 psi/min.

The temperature rise during the quick pneumatic fill process is an issue. We know of quick fill gas charging experiments of similar cylinders where the maximum aluminum liner temperature was less than 160°F when the cylinder was charged with air within 30-60 seconds. Luxfer composite cylinders are satisfactorily being used by at least one SCBA manufacturer where the cylinders are quick filled, as a normal operating procedure. Therefore we do not foresee any problem with quick filling our composite cylinders. If you have any questions please contact me.

Sincerely,

Al Godil

Altaf Godil
Engineering Manager

cc: Ed Morris
Jerry Waite
Don Clervi
Mark Trudgeon

Dräger
SAFETY

For further information..........

Please contact..........

Draeger Safety Pacific Pty. Ltd.

3 Ferntree Place

Notting Hill

Victoria 3168

Australia

Telephone ...613 92655000

Fax ...613 92655095