



**Mine Health and Safety Council
Research project name SIM 14-07-01**

Project Title:	<i>Develop Feasible Methodologies to Aid Escape in Poor Visibility in Underground Mining Environments</i>
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Report Date:		Related Projects:	N/A
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Category:		Applied Research	
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Summary



Background of the Study

This research project aimed to redefine and review the “user” requirements in providing underground mine workers with a safe escape in poor visibility conditions. With those requirements at the forefront, the project will evaluate the shortcomings of current solutions in the industry and recommend incremental improvements and conceptual solutions for development.

Objectives of the Study

The following questions were addressed in order to determine the root causes of the problem:

- What are the existing systems and methods available to mines to assist workers with escape in poor visibility underground environments?
- What are the shortcomings of the existing systems?
- How can these shortcomings be addressed?
- How can alternative solutions be prioritised?
- How well does the highest priority proposed solution address the problem?

In order to address the questions above, the following objectives were achieved:

- Identification of all available systems that assist miners with escape in poor visibility underground environments;
- Determination of the shortcomings of the existing systems;
- Development of alternative solutions;
- Selection of better alternatives; and
- Evaluation of alternative solutions.

Methodology

1. Gaining a proper understanding of the current technologies in use together with an understanding of their shortcomings. These shortcomings were analysed and understood from the perspective of the mining companies, government and employees.
2. Understanding what technologies are currently being developed, if any, that could possibly address the shortcomings identified.
3. Reviewing and redefining the detailed user requirements for an ideal solution.
4. Doing a gap analysis between the ideal solution and existing systems.
5. Providing solutions that would address the gaps identified.
6. Identifying appropriate manufacturers to work with in manufacturing the proposed solution.
7. Developing solutions in co-operation with identified manufacturer/s.
8. Testing solutions.
9. Reporting.
10. Conducting workshops.

Results of the study

The results of the study are contained within the conclusions and recommendations sections.

Conclusions

It was concluded by the project team that, although the integrated innovative solutions (IPPE and umbilical lifeline) could work, too many risks exist in terms of pursuing these solutions at this stage. The water spray assisted lifeline concept was also developed. The hypothesis was that, in a zero visibility and audibility environment, a water spray, when coming into contact with a person, would be able to guide the person to the origin of the spray. The hypothesis was tested and verified, and a conceptual methodology and system was proposed.

It is envisioned that the water spray assisted lifeline concept, if developed further, would be able to meet all the requirements of an effective escape system when used in conjunction with a proper early warning system, a traditional lifeline and self-breathing apparatus. A critical success factor lies with diligence in terms of detail design, installation and maintaining the system, as well as training workers on how the system works.

Recommendations

The project recommends the following:

- **Further investigation of the self-breathing technologies**

It is recommended that the broad umbilical lifeline value proposition be further investigated. The primary drive of the investigation should be to investigate the feasibility of alternative self-breathing technologies, as opposed to the chemical SCSR.

- **Further investigation of the water-assisted escape concept**

It is recommended that the water-assisted escape concept be further investigated. It is further recommended that this investigation should be in the form of a research and development project, where the main aim is to develop, test and implement a water-assisted escape system.

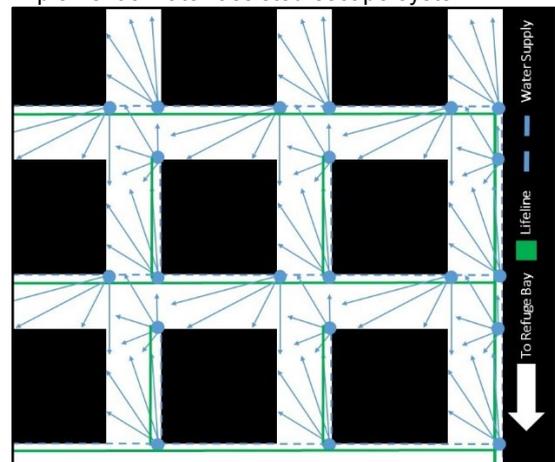


Figure 1: Water-Assisted Escape System: Conceptual Coal Bord & Pillar Layout

- **Consideration of IPPE concept in other MHSC research projects**

It is recommended that the IPPE concept should be taken into consideration in other digital technology-based projects. The IPPE system could potentially be the solution in the “mine of the future”, and should thus be considered in projects that are shaping the mine of the future.

- **Testing of traditional lifeline at hard-rock mines**

Generally, no clear reason exists as to why the traditional lifeline is not used in hard-rock mines in South Africa. It is recommended that in-field, trial testing should be conducted on the effectiveness and practicability of lifelines in hard-rock mines. Ideally, the lifeline should be tested for the full spectrum of U/G mining layouts found in the SAMI (not currently using lifelines). Realistically, the test sample size should test as many layouts as practically possible.

- **Issuance of air-tight goggles as part of PPE**

It is recommended that air-tight goggles should form part of standard PPE requirements, in environments where low visibility conditions could be experienced.

- **Use of lighting-based systems**

Where practical and affordable, mines could consider implementing a lighting-based system. The lighting system should be able to deliver three-fold value: Act as an early warning system; act as static lighting under normal operating conditions; and provide visual guidance to refuge bays.