



March 24, 2006

Mine Safety & Health Administration
Office of Standards, Variance & Regulations
1100 Wilson Boulevard
Room 2313
Arlington VA 22209-3939
UNITED STATES OF AMERICA

RE: RIN 1219-AB44

Dear Director

We thank the Mine Safety & Health Administration (MSHA) for the opportunity to comment on Underground Mine Rescue Equipment and Technology, particularly as some of our technologies have been specifically referenced in a number of official hearings and discussions.

Our submission will include the following sections:

- A. General introduction to Mine Site Technologies (MST) communication systems, submitting what our technologies actually achieve, and the limitations of what is possible and to clarify the misinformation about the reliability of properly installed and maintained MST systems.
- B. Answer some of the specific points raised in the Request for Information in the "Communications" and "Developing New Mine Rescue Equipment" sections.
- C. Also make some comments in other sections, based on our involvement in implementing some of these other initiatives (such as SCSR caches and rescue chambers) at mine operations in Australia.

It is important to note that the responses in this document are directed at achieving improvements in safety systems now, and discussing on-going developments to upgrade these systems over time as further functionality becomes available.

We have been somewhat surprised by the attitude and misinformation being stated as fact about our technologies, particularly PED. We appreciate that no one likes being told what to do, but the fact is legislation is being enacted, as seen in West Virginia, and needs to be addressed.

Therefore, the following submission is aimed at clearly stating what our technologies actually deliver and how they can, and do, contribute to higher levels of emergency preparedness at mining operations. These technologies have been installed voluntarily in a number of countries, over a number of years (such as Australia and China) as they were identified as proven technologies that offered a positive contribution to safety.

A. Introduction

Mine Site Technologies (MST) has been thrust into the center of this debate about mine safety equipment through no action of our own, but simply because we appear to be one of the few companies in the world that has taken the development of a range of underground communication technologies through to operationally and commercially viable products.

One thing that is apparent in all the comments we have received, and meetings we have participated in, is that most people's knowledge about underground communications is extremely limited. Considering the specific requirements and technologies involved in underground mining communications, maybe this should not have been surprising. Given the attention that has been focused on our company and technologies we feel we have the right to detail what those technologies, which we have been supplying to mines around the world since the early 1990's, actually do.

MST has a suite of underground communication technologies that offer particular benefits when used individually or complement each other when used together in a total communication solution. Since 1985 Mine Site Technologies has grown to be the largest specialized underground mining communication company in the world, with offices in Australia (Sydney, Kalgoorlie, Mt Isa & Mackay), Canada (Sudbury) and the United States (St Louis). We also have distributors established in China, USA, Chile, Peru, South Africa, Brazil, Sweden, Norway, Finland, and India.

Our technologies have been installed in over 300 mines in Australia, China, USA, Canada, Chile, Sweden, Mexico and Tanzania, and include:

PED Communication and Emergency Warning System; PED is an ultra-low frequency communication system that allows for direct signal propagation through thousands of feet of rock strata. This "through-the-earth" capability means, depending on aerial layouts, that PED is capable of providing signals to all areas in an underground mine. PED is operating at mines 24 hour a day, seven days a week, in Australia, China, USA, Sweden and Canada.

PED is used as the primary emergency warning system at many mines, with text messages being sent to an individual pager receiver attached to a miner's cap lamp battery or mounted on a vehicle (AutoPED). This broad signal coverage also means PED is a very effective day to day management tool. PED is also used for remote switching of equipment and remote blast initiation (see BlastPED below).

PED is installed with the aim to ensure signal coverage to 95% to 100% of a mine, dependent on specific site layouts. Please refer to the PED Brochure in Appendix 5 for more details.

Integrated Communications Cap Lamp (ICCL); is a cap lamp using lithium ion battery cell technology to reduce its size and weight by one third compared to traditional lead-acid batteries. What makes ICCL unique is that it can incorporate the PED pager electronics and TRACKER Tag into the same small package, so you can ensure two critical safety devices are always with a miner underground. Please refer to the ICCL Brochure in Appendix 5.

VDV Leaky Feeder Radio & Telemetry System; VDV is a two-way, multi-channel VHF radio system for use in underground mines and tunnels. VDV is one of the most technologically advanced leaky feeder systems available, which provides opportunity for expanded functionality e.g. into applications

such as telemetry control. Like any leaky feeder type radio system VDV only operates within line-of-site to the underground leaky coax antenna, thus cannot provide mine wide signal coverage in any practical installation (practical meaning a system that is realistic to install and maintain to a reasonable level of reliability).

In reality this means communication is only achieved in the roadway where the antenna is installed and part of any adjacent cross cut, perhaps covering 20% of the mine with signal in a typical aerial layout. The signal is two-way, and is certainly better than the 5% signal coverage a typical, fixed location telephone system may offer.

These comments are based MST's experience on installing over 100 leaky feeder systems around the world. Please refer to the VDV Brochure in Appendix 5 for more details.

TRACKER Tagging System; TRACKER is a tagging system that allows the location of personnel and vehicles to be known within zones, and in real time, throughout the mine. This provides significant management benefits (e.g. through diesel fleet management) and safety (knowing where people are at all times). The size of the zones is determined by the spacing between Reader Beacons that are set up underground. Please refer to the TRACKER Brochure in Appendix 5 for more details.

BlastPED Remote Blast Initiation; BlastPED is used in hard rock mines and is based on using the PED transmission system to communicate with remote receiver/exploders to initiate a number of blasts from the surface. The critical application of blasting (from both safety and productivity points of view) demonstrates the inherent reliability of the PED Transmission System, as mines would not contemplate using such a system unless it delivered very high reliability.

Please refer to the PED Brochure in Appendix 5 for more details.

ImPact Digital WLAN for Underground; ImPact is a system designed specifically for underground mines to allow the WLAN 802.11 protocol to be taken underground using proprietary WAP interfaces (Wireless Access Points). These WAPs enable wireless interface/access to all types of IP devices such as VoIP phones, lap tops, PDA's, video cameras, etc. ImPact also provides diagnostic interfaces to major underground equipment, such as trucks, loaders/scoop trams, transports, shearers, etc.

ImPact is dependent on underground data links (optic fibre cable) between the Wireless Access Points, and hence is intended for day to day operational use, rather than providing post-disaster communications. Due to the signal coverage around each access point a typical ImPact System can provide very high quality, high bandwidth communications to 30% of the roadways in an underground coal mine.

Higher levels of signal coverage are theoretically possible with the installation of additional WAP's. But the complexity of the subsequent fibre network and power network to support such an expansion means it is not practical to actually do or try to maintain over time. Please refer to the ImPact Brochure in Appendix 5 for more details.

The above technologies have been developed through over twenty years of operational experience with a significant understanding of the complexities of the underground environment and the reliability demanded by our industry.

We certainly respect that other companies have developed concepts and are able to trial those concepts. It takes many years of on-site experience to turn those concepts into products, plus it is imperative that the mining companies are prepared to install and maintain them under the OEM's standards and specifications.

B. Specific Responses to MST Relevant RFI Topics

As a means of introduction to this section it appears that the main aim of the RFI is gathering information on mines rescue related technologies after a major incident (i.e. explosion). After the tragedy of Sago this emphasis is understandable, but our comments will also highlight the importance of technologies on prevention of potentially hazardous incidents.

It is important to note that the systems installed in the US to date have been done so without any specification to MST to meet a post-disaster prerequisite. The approach to the installation by MST and the client would have been significantly different had that been the case.

It is for these reasons that current installations cannot be specifically targeted, based on this perceived shortcoming, if the design brief and specification was not directed at a post-explosion incident. MST stands ready and willing to work with MSHA to meet such standards and specifications, within the context of correct maintenance and practicalities.

Their role in immediate incident management of other less dramatic, but more numerous hazards, will also be discussed. This will include:

- Technologies relevant to the more common but still life threatening, as Aracoma tragically showed, hazard of fire.
- The relationship between signal coverage underground, the type of event, and survivability of the communication infrastructure.

Communications – RFI Topic E

Before answering the specific points raised in this section we would, again, use one of the countries we work in, Australia, as an example of a proactive approach to overall mine safety. Australian coal operators have learnt a lot from the US industry over the years that has contributed enormously to the productivity and safety of the industry in Australia. However in the last ten years the Australian industry has taken the lead in a number of safety and operational initiatives, and that experience should be tapped into by the US operators as a way of Australia “returning the favor”.

No Australian mine operator would take the risk of not doing anything while waiting for the “perfect” communication system to be available. The liability exposure and lack of demonstrating “duty-of-care” to their workforce would not be acceptable. The mine owners would (and do) install equipment now, then review over time to see what new developments become available and would then consider installation of any new technologies identified as offering additional benefits.

Basically, they **don't** consider their position to be; *“If we spend the money now and something new comes out in 18 months, I've wasted my money”*.

They **do** take the approach of; *“This equipment is available now and reduces the risk associated with my operation, so I need to install it to meet my obligations under the ‘duty-of-care’ principle. If*

something better appears in 18 months or two years I will investigate it, and implement it if I determine it adds a further level of safety to my operation.”

Better still the safety benefits have been paid for by the productivity and efficiency improvements achieved from using communication technologies – two major advantages from one investment.

Basically, this is why the Australian industry has voluntarily adopted systems, such as PED, and has avoided government authorities imposing laws saying they must install it. The US industry now has to do something to meet the new laws, but perhaps a more proactive approach in the future would make more laws unnecessary with the operators taking on risk management strategies to gain control of safety.

However the industry in the US is faced with a need to implement systems and equipment now based on what we have been advised, and waiting for a better “mouse trap” appears a risky strategy and would seem to confirm the need for continued legislation as the safety driver, rather than a higher degree of self regulation.

Finally, we would comment that some US operators we have met with are being proactive in areas of safety and lead the world in some of their initiatives. However, many are not being proactive and these are creating the conditions for the continuing burden of proscriptive legislation on the whole industry.

In response to the specific points raised in this section of the RFI, please note the following:

1. Emergency Communication Systems:

Depending on the type of incident, and subsequent rescue requirements, a number of communication devices may provide benefits.

The PED System does provide by far the greatest signal coverage to an underground mine, depending on the mine layout and on-going commitment to maintenance this signal coverage can be close to 100%. But even at less than full coverage, say 90%, then surely this is better than 5% offered by telephones at fixed points underground or maybe 20% offered by a leaky feeder radio system.

Circumstances where no alternative exists and an underground antenna need to be used, than appropriate burial or other type of protection would be recommended by the OEM. There have been reports about signal coverage from underground antennas not being adequate, but it is apparent that a number of antenna systems have not been extended as the mine develops. Extensions, though not as numerous as required by leaky feeder systems, do need to be undertaken on PED systems that use underground antennas.

In relation to reports of phone noise and lack of signal coverage we would point out that some underground antennas have been installed incorrectly by running adjacent to phone and data lines, against the recommendation of the OEM. Additionally on many installations it is apparent the phone and data lines have not been installed in accordance with their respective OEM recommendations, for example exposing them to interference through incorrect grounding procedures.

There have also been comments about the BeltPED Personal Pagers losing signal whilst travelling in vehicles. This is clearly known and understood, and is the reason a vehicle mounted receiver known as the AutoPED was developed.

It must be pointed out that PED is one-way, so text messages can only be sent to the miners underground, they cannot reply. A “through-the-earth” two-way system allowing a response would be ideal, but currently this technology is still in the experimental stage with no proven, reliable system in the market today. Even with recent tests and discussions of “possible systems” they will just not be commercially available, nor proven in daily operation at mine sites, in the near future.

However, what the one-way capability of PED does provide is:

- A very high level of signal coverage.
- In many cases this signal coverage can be achieved without any transmission antenna infrastructure underground. No other communication system currently available and operating in mines can do this.
- Where surface access precludes the use of an antenna system on the surface, then an underground antenna can be used. Importantly, the through-the-earth transmission characteristics of the PED signal means that the underground antenna doesn't have to be run into the active working areas (as all other communication systems require). This is important as it does reduce the risk of damage in day to day use, as well as after an incident, such as a fire or even a methane explosion within a face area (e.g. an underground PED antenna survived a series of explosions at Willow Creek Mine in 2000). Additionally parts of the antenna could be buried to increase its protection.
- A track record of success of over 140 installations over the last 15 years.
- Continuing acceptance and expansion. For example as this document is being written we have technicians installing new PED Systems in China, Canada and Australia. This would not be occurring if the system reliability was poor, as some uninformed people are claiming.

Please refer to the letter from the Chief Operating Officer of Centennial Coal in Appendix 1 discussing the use of PED at their eleven (11) underground coal mines.

2. Current Communication Technologies:

MST has a range of existing communication technologies, as listed out in the introduction. One newer communication technology being utilized in underground mines is based on the 802.11b Wi-Fi standard. Again, somewhat limited to line-of-sight, but the potential for 802.11 to offer high quality, high data communications is what led to the development of our ImPact System as outlined in the Introduction (also see brochure in Appendix) over the last 3 years.

We now have ImPact operating in nine hard rock and salt mines in Canada, US and Australia, providing two-way voice via VoIP phones, wireless data links to PDA's etc, remote monitoring & control of equipment, and vehicle diagnostics. In fact, we see ImPact and 802.11 technology as the future of underground communications as a day to day operational tool, but not for post-disaster capability.

Depending on the type of incident 802.11 systems may assist but really cannot be relied on due to their dependence on hard wired (optic fibre) data links between the Wireless Access Points and the power supply requirements to each WAP. Systems like PED will still form an indispensable part of an emergency communication system and operate in conjunction with ImPact and other high data systems.

Another product briefly outlined in the Introduction, that's relevance to safety should be expanded upon, is the TRACKER Tagging System. Basically TRACKER relies on Reader/Beacons set up at strategic points underground to detect active Tags carried by miners or attached to vehicles underground. TRACKER is specifically designed for underground use and allows the location of people to be known in real time within zones underground. There are a number of safety and productivity benefits that result from this ability to track people and equipment, including:

- The location of the Responsible Person for that shift is known.
- The location of the mines rescue, fire fighting people, or electricians, etc is known should the nearest person to an incident need to be directed there quickly.
- Depending on the incident, the evacuation of personnel can be monitored to ensure everyone is escaping.
- TRACKER is currently operating underground in mines; it is not just a concept or early prototype.

As the TRACKER Beacons are hard wired (i.e. rely on data connections between Beacons and back to the surface), major incidents may render part of the system inoperable. But, again, incidents such as fire or limited methane ignitions in the face area could leave much, if not all, of the system functional, and it would be of great assistance in an evacuation and/or in the planning & undertaking of a rescue operation.

MST, MSHA and mine operators could clearly devise installation techniques to raise post-disaster availability.

Like any communication/information technology in place, there are obvious productivity benefits of using such a system in the day to day running of a mine. These would provide direct cost benefits and assist in any system expenditure justification.

3. Preference of One System over Another:

What the above comments are attempting to highlight is that this search for the "holy grail" or "silver bullet" where a mine's communication requirements are achieved with one product is just not realistic. A number of complementary technologies should be installed in any mine to achieve a safe and productive operation. Some mines do this now, but many don't.

This is not an approach that is unfamiliar, just look at the number of communication technologies we use in our offices; phones, faxes, emails, cell phones, text messages, internet, VOIP to name just a few everyday communication tools. We should also remember that these are used in a relatively stable surface environment, not the underground environment which is subject to geological effects and other arduous environmental conditions.

4. New Technologies for Day-to-Day Use and Emergency Use:

As discussed above and in many other submissions there are a number of technologies emerging, such as 802.11, which will contribute enormously to the day-to-day running of a mine. However, all these systems do depend on very large antennas or data networks underground, which are likely to be damaged during any major event. Though the damage will vary depending on the incident, and parts of a system may still be operational, there is a high probability that damage would be extensive close to the active mining areas.

Therefore, similarly to the comments in sections 2 & 3 above, a combination of systems should ensure a better chance of some communications still being available. In the worst case it may only be the one-way communication of PED remaining for any form of communications, but in other circumstances it could include other types of systems as well.

5 & 6. General surface communications:

These general surface communications from the mine site back to MSHA offices, mine company head offices, etc, are achievable by a number of readily available communication technologies. Depending on a mine's location this could involve standard land lines, cell phones, satellite phones, micro wave and radio links, etc. A combination, with an acceptable level of redundancy, should be chosen that would suit the individual requirements and location of each mine.

The management of such systems, and their use and access in an emergency, needs to be part of an "Emergency Preparedness Plan" which would include all the issues from notification of the incident, first response, management of the incident and rescue, handling media, etc. An assessment of the Trigger Action Response Plans ("TARPS") system used in Australian coal mines' overall Emergency Preparedness Plans, may be worthwhile.

TARPS are legislated requirements, but the actual implementation and equipment to support such plans are entirely up to the individual mine operator to determine through a risk assessment based analysis.

7. Communication When Wearing a Breathing Mask:

Again PED providing text messages assists here. Full face masks may allow access to voice devices but, with all these voice systems depending on underground infrastructure, they may not be operational after an incident.

Push button messaging systems that do transmit through-the-earth would be advantageous but currently do not exist. However, please refer to the comments in Point 9 below on MST's current R&D initiatives to achieve such as system.

8. Should PED's be Used:

We feel the safety and productivity benefits offered by PED should justify their use. The Australian underground coal industry has committed to PED at virtually every coal mine, and China is starting the process to do similar.

Additionally we would comment that:

- PED maybe one-way, but it provides the greatest signal coverage underground compared to any other system (95 to 100% as opposed to less than 30% for the next best signal coverage technology).
- A one-way alert is orders of magnitude more beneficial than the alternative – nothing. **To see what a one-way device can contribute to safety**, just read through the report on the Willow Creek Mine Fire in 1998 where the swift alert to evacuate credited with saving lives. See relevant extract of this report in Appendix 4.

- Also the report on the Willow Creek Explosions of 2000 indicated that the alert to withdraw may have helped prevent further casualties of people rushing in and getting caught by the second explosion – as has happened at other mine tragedies in recent years. See relevant extracts from this report in Appendix 5.
- Bear in mind the majority of serious, life threatening incidents are fires where early warning can be the difference between life and death (again refer to Willow Creek reports). Both MSHA and NIOSH highlight the importance of a simple one-way early warning (“Time is Never Your Friend”) in their Best Practices – Fire Protection Tip Sheet on the importance of Communications (Tip Sheet BPFP8 - see copy in Appendix 3).
- Normally we would not want to make any comment about the Sago Explosion due to the personal tragedies involved and lack of any official investigation reports. However the importance of what needs to be said, and the fact that others have been talking so publicly about Sago, we feel that a brief comment about the role PED may have been able to play in this tragedy is worthwhile.

Talking with a number of people involved in the rescue and the comments from other submissions, it appears:

- The other miners underground at the time that did eventually survive were aware of the extent of damage and where fresh air was available. It appears fresh air was available within about 1,000 feet of where the miners in the affected section walked to before retreating back into the section and barricading themselves in.
- The miners in fresh air may have been able to advise this information to the surface by any phones that were still operational or advise officials when they got out of the mine.
- On receipt of this information a PED message could have been sent to the miners underground advising them that fresh air was available past a particular point and they should keep evacuating; or, say a borehole was going to be drilled they could be advised where it was going to be putdown; or whatever other information people determine may assist any miners underground.

There are some “if’s” and “maybe’s” in the scenario above. Such as; were the reports about fresh air availability true? A PED antenna on the surface would have certainly been operational, but would a PED antenna underground still be operational (quite possibly if installed correctly)?

Whether or not PED could have made a difference we may never actually know. But the point is, if some of these assumptions are correct the PED System may have made a real difference in this tragedy. Hence, despite some perceived shortcomings in PED, we stress it **does provide a much higher level of communications ability than is currently available** with just phones and radios; and is available now where other “new” improved systems may take years to fully commercialize into products ready for mining.

9. Research & Development on Two-Way PED:

MST is involved in the development of a return through-the-earth signalling system to complement PED. The project involves the expertise of Australia’s key research body, the Commonwealth Scientific & Industrial Research Organization (CSIRO), who have undertaken a number of mining related R&D projects over many years.

The basic principle is the use of underground base stations to relay messages from mobile transceivers through-the-earth to surface, either directly or via other underground base stations. The R&D efforts to date have allowed successful field trials of a laboratory prototype at a coal mine. These tests proved the concept and the signalling techniques as being robust and practical to use.

The Commercialisation of the project is planned in two stages:

Stage 1: Will deliver fixed Base Stations that will be located at strategic points underground (e.g. oxygen cache locations or rescue chambers). These units will be robust with small, buried antennas and designed to maximise survivability in the event of an explosion. Communication directly through-the-earth to the surface can be done from these Base Stations. For example, a miner can receive a text message on his existing PED unit, then when he is at an oxygen cache he can advise that he is changing breathing apparatus and intending to proceed to the next Base station via the Escape Way, or similar.

Stage 2: The main results from this stage are incorporating Mobile Transceivers into the PED unit (as a reverse compatible unit to our existing products). These units will allow two-way communication, hence giving a system that can:

- Receive messages either directly through-the-earth from the surface, and/or via a Base Station.
- Send return messages from the Mobile Transceivers through-the-earth or through the air to the Base Stations, which then transmit directly back through-the-earth and/or via other Base Stations to the surface.

MST is confident of Stage 1 being commercially available in 18 months to two years and would be seen as a simple add-on to the existing PED System. This confidence is based on our experience in mining communications; and CSIRO's work to date, technical expertise and a number of key US patents that CSIRO hold.

Developing New Mine Rescue Equipment - RFI Topic H

1. Technology and Economic Problems for New Developments:

The development of communication technologies has been restricted due to lack of R&D support from the industry. Also, the size of the industry may make it not as relevant as consumer markets to major communication companies. So it has been up to individual private companies to put in the R&D effort, working with mine operators wherever possible for testing, etc. It is perhaps a major reason that a company like MST has ended up being a global leader in mining communications, as MST is one of the only companies to identify the importance of communications to underground mining and has been prepared to commit significant funds to R&D over many years.

2 & 3. Permissible Equipment:

The requirements for permissible use does add cost to R&D and manufacture, and importantly the fact that any changes requires re-approving, does slow or even stop on-going development. But permissible equipment must be used, it is a potentially explosive atmosphere in a coal mine, so the equipment must take that into account and maintain strict standards to ensure approved equipment is delivered as approved.

4. Streamlining of the Approval Process:

The approval process for electronic equipment does subject that equipment to careful analysis and testing. Streamlining may be assisted by providing additional resources, such as additional personnel in approval centers; or the use of approved third party approval centers or acceptance of equipment approved in other countries. This last point is being progressed, but it is a slow and complicated process to ensure other countries' standards and processes achieve the same level of safety that MSHA testing provides.

The pace of change in some technologies may mean re-approval ("snap approvals) become more numerous, and a process to streamline this based on the design changes and their relevance to intrinsic safety should be reviewed and see if some flexibility or self assessment could be introduced.

5. Encouraging Investment in New Technologies:

Support from industry is vital for on-going development. Rather than wait for a mining disaster to force authorities to develop new laws and than encourage new developments, perhaps a system of proactive and on-going support from mine operators should be encouraged throughout the industry. Mines that are willing to test beta-systems, or be the first to fully commit to a new technology are essential for these technologies to progress. Perhaps some form of R&D funding scheme, or tax credit scheme, specific to mine research could be established with industry and government funds which would more widely promote R&D initiatives.

With limited R&D funding available worldwide, the industry should look to co-ordinate research funding and provide joint international funding to projects. This is along the lines of what the International Committee on Coal Research is attempting to do, but the mining industry may need to get more actively supportive.

C. General Comments on other RFI Topics

As mentioned in the introduction, MST has been involved over many years in emergency preparedness plans and safety related activities in a number of countries. Therefore we would like to make some general comments that may add some value to MSHA's RFI.

Again, in Australia the use of oxygen caches, emergency notification procedures, etc are long established practices and warrant investigation by US operators to take advantage of this accumulated knowledge and experience. We are not suggesting that Australia is better, but it has gone down this path over the last ten years, so why not take advantage of this fact.

Self Contained Self Rescuers (SCSR) and Rescue Chambers

One aspect of Rescue Chamber use that MST has been directly involved in at hard rock mines has been initiating sirens and lights to mark the location of a chamber. A number of rescue chambers have been fitted with sirens and lights that are turned on in an emergency. At one of Australia's largest copper mines, the PED System is used to turn on the sirens and lights whenever an emergency message is sent out.

The mine has all personnel underground (over 600) equipped with PED receivers as their primary evacuation warning system. Each rescue chamber has a special AutoPED Receiver (see PED brochure in Appendix) that provides two functions:

- When an emergency message is sent, the AutoPED initiates the turning on of lights and sirens at the chambers.
- The display unit of the AutoPED is inside the chamber to display text messages (e.g. when rescue teams should arrive, etc). There is a phone and radio system access in the chamber as well, but the PED forms redundancy should these systems become inoperable if there data connections are damaged. The chambers have battery power back up as well as oxygen supplies, CO₂ scrubbers, etc.

A similar type of indication system should be considered for SCSR caches, as West Virginia is already looking to implement.

D. Conclusion

We trust the above comments and attached information assist in MSHA's assessment of safety related technologies. In particular, MST's experience in communications in a number of countries over the last 20 years will hopefully add credibility to our submission and help clear up some of the misinformation about our, and other's, communication technologies that seems to be occurring.

We are hopeful that the US will take this opportunity to not only improve levels of safety by installing additional communication and rescue systems, but they will use this as a catalyst to review their overall safety strategies. In this last point we would encourage them to look outward, as well as inward, in finding world's best practice.

Thank you again for the opportunity to present these comments.

Yours faithfully

MINE SITE TECHNOLOGIES PTY LIMITED

GARY I. ZAMEL

Managing Director

APPENDICES

Appendix 1	Letter from Centennial Coal Company on PED
Appendix 2	MSHA Best Practices – Fire Protection Tip Sheet
Appendix 3	Extract from MSHA web site on Willow Creek Mine Fire in 1998
Appendix 4	Extract from MSHA Investigation Report into Willow Creek Explosions in 2000
Appendix 5	PED Brochure ICCL Brochure TRACKER Brochure VDV Leaky Feeder Brochure ImPact WLAN Brochure

APPENDIX 1

Letter from Centennial Coal Company on PED Implementation and Use



Friday, 17 March 2006

Minesite Technologies – PED System

Centennial Coal is an Australian owned thermal and coking coal producer, which owns and operates 13 underground and opencut coal mines located in NSW Australia.

Centennial was established in 1989 as a single mine operator producing 150,000 tonnes of coal per annum. Following a series of acquisitions Centennial now has a market capitalisation of about \$1,000 million, producing more than 20 million tonnes per year with over 1800 employees.

The PED system is installed and operating at all Centennial mines. It is an integral part of both the mines emergency management system and the communications systems. The latest system being installed at Tahmoor mine following its acquisition last year.

It is essential when consideration is first given to the procurement of a PED system that the OEM is brought to the mine, shown the mine plan (complete with all proposed workings), and taken on an inspection of all surface and underground operations. This is a critical first step to ensure the system will be correctly specified, and appropriately budgeted and resourced. This will ensure the system is customised to the requirements of the operation and will provide the services the mine expects to receive.

Once the PED system is installed, regular testing and maintenance must be undertaken to ensure that signal strength is adequate to the needs of the mine. If the system is maintained correctly the reliability is extremely higher.

Once installed the mines will rely upon the system for much of their communications. This has not only had a positive impacted upon the safety of the mine but also the overall mine efficiency.

Yours sincerely

David Moult
Chief Operating Officer
Centennial Coal Company

APPENDIX 2

MSHA Best Practices – Fire protection Tip Sheet

It Happened...

On November 25, 1998, a fire rekindled following a roof fall in the gob. The longwall area and eventually the mine was sealed. All miners were successfully evacuated through the use of Personal Emergency Device (PED) System.



Example of a communication station for dispatcher



Example of a mine wide monitoring control room

Best Practices Fire Protection

Card No. BPPF-8



COMMUNICATIONS during a mine emergency are a critical part of fire fighting and evacuation activities. A successful evacuation or fire fighting operation is dependent on the quality of the information that is communicated. The sooner miners are notified of a problem, the greater the chance of escape and/or fire fighting activities can begin. TIME IS NEVER YOUR FRIEND during a mine fire.

LOCATIONS

Working sections Strategic locations Belt drives

- **ALWAYS** provide accurate information to the surface regarding emergency situations.
- **ALWAYS** consider the use of personal communication devices that could provide key mine personnel early warning in the event of a fire or emergency situation.
- **ALWAYS** consider optional forms of remote communication such as; interlocking mine power or main belt operation with the main mine fans.
- **NEVER** disregard or take lightly reports of a mine fire.
- **NEVER** assume anything has been completed during an emergency, ASK FIRST!
- **REMEMBER:**

TIME IS NEVER YOUR FRIEND!

U.S. Department of Labor
Mine Safety and Health Administration

APPENDIX 3

Extract from MSHA Web Site on Willow Creek Coal Mine Fire in 1998

Willow Creek Mine Fire A Chronology of Events

Week of November 22, 1998

On Wednesday, November 25, 1998 at approximately 6:20 pm, a mine fire occurred at the Cyprus Plateau Mining Corporation's Willow Creek Mine, which is located near Price, Utah. The accident occurred near the longwall tailgate area during normal coal production. No injuries resulted from the incident, however, several longwall crew members were knocked down by the ensuing rush of air. An orange colored flame was observed in the gob that appeared to move toward the face area and then back into the gob.



</MINEFIRE/WCREEK/CHRONO/C0LG.HTM/MINEFIRE/WCREEK/CHRONO/C0LG.HTM>

Click Picture for Enlargement

The shift foreman ordered an evacuation using a unique system which operates like a pager that was worn by some miners. This "PED" system (Personal Emergency Device), allowed for constant contact with the miners, even those working in remote areas. After the accident, a message was sent to the miners -- "mine fire-evacuate". The 45 miners were safely evacuated in about 45 minutes.

APPENDIX 4

**Extract from MSHA Investigation Report
into the Willow Creek Coal Mine Explosions in 2000**

**UNITED STATES
DEPARTMENT OF LABOR
MINE SAFETY AND HEALTH ADMINISTRATION
COAL MINE SAFETY AND HEALTH**

CAI-2000-18/19

**REPORT OF INVESTIGATION
UNDERGROUND COAL MINE EXPLOSIONS
JULY 31 - AUGUST 1, 2000**

**WILLOW CREEK MINE - MSHA ID. NO. 42-02113
PLATEAU MINING CORPORATION
HELPER, CARBON COUNTY, UTAH**

by

Ray McKinney
District Manager, District 5, Norton, VA

William Crocco
Mining Engineer, Division of Safety, Arlington, VA

Joseph S. Tortorea
Supervisory Mining Engineer, District 2, New Stanton, PA

Gary J. Wirth
Supervisory Mining Engineer, District 11, Birmingham, AL

Chris A. Weaver
Mining Engineer, District 3, Morgantown, WV

John E. Urosek
Chief, Ventilation Division, Technical Support, Pittsburgh, PA

Dennis A. Beiter
Supervisory Mining Engineer, Technical Support, Triadelphia, WV

Clete R. Stephan
Principal Mining Engineer, Technical Support, Pittsburgh, PA

Originating Office
Mine Safety and Health Administration
Office of the Administrator
Coal Mine Safety and Health
4015 Wilson Boulevard
Arlington, Virginia, 22203
Marvin W. Nichols, Jr., Administrator

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apparently knocked unconscious. Gonzales, Whitten and Berdan received burns and abrasions from the explosion. McKinnon, in Crosscut 49, experienced difficulty breathing and passed out. Medley, on the face near Shield 6, felt debris pelting him. Burton was located in the No. 1 entry near the stageloader, still unconscious. Marvidikis, near Crosscut 24, was knocked down and rolled outby in the No. 1 entry about 10 to 15 feet, losing his hard hat. He traveled through a mandoor where he found a pager and called outside. LaCotta advised him that there was a fire on the face and that everyone was to evacuate. Jas Mills was between Crosscuts 15 and 20 when the explosion force blew his hard hat off. He observed that the air became dusty and seemed to reverse. He donned his respirator and waited until he felt the air begin to flow inby.

Ellner exited the mantrip and traveled outby a few crosscuts on foot until he came upon Burton's truck. Because Burton's truck was facing inby, Ellner backed it outby for several crosscuts until he found a location where he could turn the truck around. He traveled alone toward the mouth of the section. Although Gonzales had problems breathing and seeing, due to the dusty conditions, he struggled to his feet and started walking outby. Gonzales located the six-inch water line in the No. 2 entry and used it as a guide for traveling out of the section. He heard a back-up alarm from a vehicle and followed the sound outby for some distance. Whitten found himself along the rib line. His hard hat, cap lamp, and SCSR were missing. Whitten felt his way until he saw a faint light, which turned out to be the longwall transformer. He continued walking out of the section.

Ellner came upon Marvidikis near Crosscut 25, as Marvidikis was completing his phone call to the surface. Ellner shouted to Marvidikis that there had been an explosion and that he should get in the truck. Ellner continued driving outby with Marvidikis. Ellner collided with the scoop operated by Jas Mills as he attempted to pass. Ellner maneuvered around the scoop and told Jas Mills to get in the truck. Jas Mills decided to move the scoop so others coming out of the D-3 section would have clearance to pass the scoop. Ellner and Marvidikis changed positions in the truck and Marvidikis drove. As they got near the mouth of the section, they passed Willson and another miner, who were transporting fire extinguishers to the section. Ellner and Marvidikis continued to the surface where they arrived at approximately 12:12 a.m.

As Willson traveled inby, he passed Jas Mills and Gonzales. He came upon Whitten at Crosscut 39 and decided to turn around, pick up these three injured miners, and transport them to the surface. As they traveled outby, they met Henry Mills, Boyd Moosman, midnight shift maintenance foreman, and four other miners heading inby. Willson informed Henry Mills of their decision to exit the mine. Henry Mills and the others continued to travel inby. At Crosscut 46 or 47, it became apparent to Henry Mills and Moosman that there had been an explosion. At that moment, Henry Mills received a signal from his personal emergency device (PED), indicating that all miners should evacuate. They drove out, reaching the surface around 12:45 a.m.

The miners that were left on the section began to move from their locations and interact with each other. Medley, who had donned a 10-minute SCSR, crawled himself from the

Moosman, and Wood remained at the location of the telephone until the other three returned. Robinson and Powell prepared Stansfield for transport while Haigler, Montoya, Wood, and Moosman went to retrieve Nielsen from the face. While under oxygen, the team returned to the face to retrieve Nielsen. The four members removed Nielsen from the face and carried him to the vehicle. Team members called the command center to inform them that the recovery was complete and that the entire team was returning to the surface. All remaining miners arrived on the surface at approximately 4:00 a.m.

Upon reaching the surface, the team assisted placing Nielsen and Stansfield into ambulances. The ambulances left the mine site at approximately 4:05 a.m. A debriefing meeting was conducted in the mine office. Present were the six mine rescue team members, Burggraf, Ramey, Ray, and Frey. Haigler provided an account of the underground activities of the team. The meeting was concluded at approximately 5:05 a.m.

INVESTIGATION OF THE ACCIDENT

MSHA was notified of the accident at approximately 12:30 a.m. on August 1, 2000, and MSHA personnel began arriving at the site by 1:15 a.m. Preliminary information was obtained by MSHA District 9 personnel during the rescue and recovery operation. On August 1, the Administrator for Coal Mine Safety and Health directed that an investigation be conducted by a team consisting of personnel from MSHA Coal Districts 2, 3, 5, and 11, personnel from Coal Mine Safety and Health Headquarters, personnel from MSHA's Technical Support Division, and personnel from the Department of Labor's Office of the Solicitor. MSHA's District Manager from District 5 in Norton, Virginia, was assigned as the accident investigation team leader.

The investigation team members arrived onsite and began the investigation on August 2, 2000. Preliminary information, including records, were obtained from MSHA and the operator. Mine personnel were identified for interviews. Witness interviews began on August 7, 2000, at the Price, Utah, MSHA field office. Subsequently, 37 interviews were conducted with personnel working at the mine who had relevant knowledge. Other contacts were made and information was obtained from contractors and state and local authorities. All pertinent records were obtained and reviewed during the course of the investigation. Appendix C is a list of persons interviewed and Appendix D shows persons participating in the investigation.

DISCUSSION

Personal Emergency Device

A Personal Emergency Device (PED) system was in use at the mine. The system permitted text messages to be transmitted to key personnel underground. Miners

provided with the receiving units included management officials as well as miners working in remote areas such as beltmen, examiners, and pumpers.

The use of the PED system was instrumental in alerting miners underground of the need to evacuate. Miners working in active and remote areas of the mine at the time of the explosion were notified through the use of the PED. These miners all safely exited the mine.

Self-Contained Self-Rescuers

The mine was operated under an approved SCSR storage plan. For the longwall section, 60-minute SCSR storage caches of 10 units each were maintained at both the headgate and tailgate areas. Mantrip vehicles were equipped with SCSR caches. Also, all miners carried 10-minute personal SCSR units on their belts. The 10-minute units carried by miners were Ocenco Model M-20. The 60-minute units stored in caches on the section and in the mantrip vehicles were Ocenco Model EBA 6.5. Although injured by the second explosion, Medley used a 10-minute unit in traveling from the longwall face to the No. 2 entry. It is possible that the atmosphere on the longwall face was irrespirable at this time. Some other miners, including McKinnon and Burton who were in Crosscut 49 after the third explosion, donned SCSR units.

Geology

Geology in the area surrounding and including the Willow Creek Mine includes formations prone to substantial methane liberation, as well as heavy bumps, bounces, outbursts, and liberation of hydrocarbons. Increased methane liberation sometimes accompanies bumps, bounces, and outbursts. Underground coal mines in close proximity to the Willow Creek Mine have operated with varying degrees of success over the past century. Mines have operated in the Sub 3, D, K, and A seams. The nearby Castle Gate No. 3 and No. 5 Mines, now closed, were characterized by violent bumps, and outbursts, as well as methane liberations, which frequently interrupted operations and resulted in accidents.

The Willow Creek Mine was developed in the D seam, which is one of nine seams in the 1000-foot thick Blackhawk formation. From the bottom to the top of the formation, seams are identified as Sub 3, 2, and 1, then A, B, C, K, D, and E seams. The D seam lies above the K-D interburden which consists mainly of sandstones and silty mudstones. The roof material above D seam consists of thin lenticular layers of mudstone, sandstone, and thin coal layers. A sandstone layer approximately seven feet thick is located 30 to 35 feet above the seam. The operator's geologist believed that this sandstone would break after approximately 400 feet of longwall retreat. The geologist had observed the D-3 gob caved approximately 20 to 40 feet high. The massive Castlegate Sandstone, approximately 500 feet thick, is located approximately 700 feet above the D seam. Overlying the Castlegate Sandstone are the Price River Formation, sandstones and mudstones, and the North Horn/Flagstaff Formation of interbedded mudstones, sandstones, thin limestones, conglomerates, and coal seams.

APPENDIX 5

Mine Site Technologies Product Brochures:

- **PED Communication and Emergency Warning System**
- **Integrated Communications Cap Lamp**
- **TRACKER Tagging System**
- **VDV Leaky Feeder Radio System**
- **ImPact WLAN Digital System**

PED Communication and Emergency Warning System



MINE SITE
TECHNOLOGIES

PED[®]
SAVES LIVES SAVES COSTS

- Personal Communication
- Emergency Evacuation Warnings
- Remote Blast Initiation

Reliable Mine Wide
Communication

PED®

SAVES LIVES SAVES COSTS

The PED® Communication System is based on ultra-low frequency transmission that propagates through rock strata (see operation schematic below). The PED® System has been in use at mines for over ten years. Refinements to the system over this time has further improved its reliability and functionality. It is used in over one hundred coal and metalliferous mines in Australia, USA, Canada and China.

Investment in a PED® System is justified on significant cost savings, and safety benefits.

- **Paging**, PED® can send a 32 character text message to an individual wherever they are underground.
- **Emergency Evacuation**, in an emergency an evacuation instruction can be sent simultaneously to all personnel in only 15 seconds. PED® has been installed in many mines as their primary evacuation system, and has been proven reliable and effective in emergency situations.
- **Overall Communications**, PED® complements your existing phone and radio systems to maximize benefits to the mine operator.

- **Safer Blasting**, the BlastPED System uses the proven PED® Transmission system to provide a safe and reliable remote blast initiation system.
- **Remote Control**, ventilation fans, etc can be remotely switched to reduce energy usage and manage pre- & post-blast fan use.

What PED® Does

Provides mine wide signal coverage

The ability of PED® to transmit through rock strata means it can truly deliver complete signal coverage to an underground mine. This is achieved without the need of installing antenna cable in every part of the mine (something more traditional 'line-of-sight' radio systems would require). A relatively small antenna on the surface, or underground, provides complete signal coverage – refer to the operation schematic below). This signal coverage is achieved at a fraction of the cost that any other type of radio system.

Where other systems are vulnerable to rockfall, fire and general wear and tear, PED® eliminates these typical problems of unreliability and maintenance.

Contact key people, wherever they are

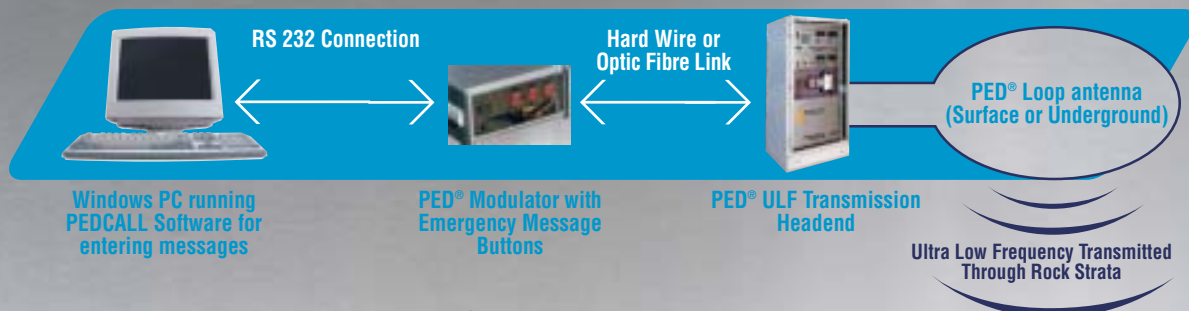
- PED® can send a private message to any individual, wherever they are underground.
- Groups of miners can receive information such as conveyor belt status.
- A beltman can be quickly advised of a problem to check (e.g. belt slip re-set).
- A transport driver can be advised of an urgently needed part.

Contact all your people in an emergency

PED® is installed in many mines as the main emergency warning system.

- In an emergency, messages can be sent to all personnel simultaneously.
- **Importantly** not only does PED® provide rapid warning, it also provides specific instructions – such as the nature of the emergency or evacuation routes to use.

PED® Communication System Operation Schematic



The PED® System is an **emergency warning system** - PED® stands for Personal Emergency Device. The use of ultra low frequency (ULF) signals enables PED® to transmit directly through rock strata, so wherever you are in a mine a message can be sent to you.

The mine wide signal coverage of PED® also means it is very useful **day to day communication system**. By using it every day, should it be required in an emergency, you know it is in working order.

BeltPED Receiver:

- **Beeps and flashes light on receipt of a message.**
- **Message can be read from the 32 character display on the top of the unit**
- **Messages can be sent to individual receivers or to All Receivers at once.**

Other types of receivers are also available that operate off the PED® transmission system. AutoPEDs (in vehicles), ControlPEDs (for equipment switching), and BlastPEDs (for remote blast initiation).





BlastPED receiver unit

How PED® Operates

PED® uses ultra low frequency (ULF) signals to send signals directly through rock, so called “through-the-earth” transmissions. The main difference between PED® and other so called through-the-earth systems is that PED® works. PED® has been installed in over 100 mines since 1990.

The system has been refined and enhanced over this time, but the basic working principles remain the same. The basic operation schematic is shown in the Figure opposite.

The ULF transmission system transmits to a number of receiver types to allow a range of applications. The receivers are:

- **BeltPED**, personal receiver is integrated with your existing cap lamp batteries (such as Wheat, Oldham, Northern Lights and MSA). On receipt of a message, the cap lamp flashes, a buzzer sounds, and the 32 character text message is illuminated on a liquid crystal display. The PED® receivers always indicate that they and the transmission system are operating.

- **BlastPED**, is a receiver/exploser unit that allows for the remote initiation of blasts. Specially coded signals are sent through via the PED® system that ensure the BlastPED receivers only operate when required. This coding, and several other levels of physical and software security, ensure the total safety of the system. BlastPED is approved for use in Australia, USA and Canada and is the only “radio” remote blasting system in general use in underground mines.



AutoPED receiver

- **AutoPED**, is a vehicle mounted receiver to ensure people traveling in a vehicle receive messages. The large display on the AutoPED is clearly visible to all occupants.



ControlPED receiver

- **ControlPED**, is simply a receiver that allows the remote switching of equipment, such as fans, pumps, etc. The ControlPED receiver is typically interfaced to the Stop-Start contacts in a fan's control panel.

The PED® System has been proven to give significant productivity and safety benefits to a mining operation, large or small.

For further information visit our website www.minesite.com.au



BeltPED versions fit a variety of Cap Lamps.

PED® COMMUNICATION, BLASTING AND CONTROL SYSTEM

TRANSMISSION SYSTEM

Transmission Headend

Frequency ULF
Output Power 1.2kVA
Operating temperature range 10°C - 40°C (50° F - 104°F)

Power requirements 110/240V AC
Includes earth leakage/ground fault detection and lockout
Dimensions Housed in 19 inch rack cabinet (H=1200mm/48in; W=600mm/24in; D=600mm/24in)

Software PEDCALL®

Windows based main system software
Individual, groups and general broadcast
Name search
Custom text messages
Priority Access
Message log
15 second Emergency Message Facility
Preprogrammed messages generated at specific times

PEDLAN® MINE MONITORING

Remote PCs can send messages via LAN
Interface to monitoring system for
Automatic message generation
Monitors an unlimited number of inputs
Programmable messages to predefined personnel and devices

Smart External Modulator

Power 110/240 VAC
Input RS-232 9 Pin to 9 Pin from PC
Output 0-20mA to PED Headend
Features Emergency message buttons (3)

RECEIVING DEVICES

BeltPED® Personal Receiver

Alert Cap lamp 10 second flash, buzzer
Display 32 character liquid crystal dot matrix
LED back light
Time display

Message
Power
Power Drain
Weight
Operating temperature
Rating
Storage (2), scroll facility
Cap lamp battery nominal four volts
50 mA
450 grams (11lb)
-20°C - 50°C (-4°F - 120°F)
IP65, Intrinsically Safe

AutoPED® Vehicle Mounted Receiver Alert

Flashing light – 10 second
Horn optional
32 character liquid crystal dot matrix
LED back light
2 messages
Scroll and delete functions
10/28 VDC vehicle supply
Automatic power shut down facility
IP65

Display
Message storage
Power
Rating
Dimensions
Display
Antenna

H=70mm W=220mm D=80mm
H=3in W=9in H=3in
L=170mm W=30mm D=30mm

ControlPED® For Fixed Equipment

Power
Indicator LEDs
Switching relays
Dimensions
Receiver
Antenna

110V AC 50 / 60Hz
24V AC 50 / 60Hz
Power ON / OFF
Transmission Status
110V AC / 5amp

Receiver
Antenna

H=70mm W=220mm D=80mm
H=3in W=9in D=3in
L=170mm W=30mm D=30mm

BlastPED® Remote Blasting System

Capacity
Security
Indicator LEDs
Rating
Dimensions

Capable of firing 160 ohm series circuit
Individually coded receivers
System access only via floppy drive disk
Key/Switch to Receiver
Independent supervisory circuit
Sequenced command string
Battery Status, Receiver ready,
Arm, BlastPED®
IP66
H=480mm Diam=140mm
H=19in Diam=5.5in

Mine Site Technologies Pty Limited ABN 93 002 961 953 Website www.minesite.com.au



Sydney
25-27 Whiting Street
Artarmon NSW 2064
Australia
PO Box 156, Artarmon 1570
Tel: +61 2 9437 4399
Fax: +61 2 9437 5866
mst@minesite.com.au

Kalgoorlie
17 Darcy Lane
West Kalgoorlie WA 6430
Australia
PO Box 4200, Kalgoorlie 6430
Tel: +61 8 9022 2300
Fax: +61 8 9022 2311
mstwa@minesite.com.au

Mount Isa
15 Duke Street
Mt Isa QLD 4825
Australia
PO Box 2436, Mt Isa 4825
Tel: +61 7 4749 4922
Fax: +61 7 4749 4933
mstisa@minesite.com.au

DISTRIBUTED BY:

Integrated Communications Cap Lamp

NEW

**MINE SITE
TECHNOLOGIES**

ICCL

INTEGRATED COMMUNICATIONS CAP LAMP

A Breakthrough in Personal Safety & Productivity.

- Light
- Communication
- Location
- Safety
- Productivity



**Not just a cap lamp,
but much, much more
in every way - except size!**

www.minesite.com.au

What ICCL is

ICCL is the Integrated Communications Cap Lamp, which means it is a new type of cap lamp that can also include a range of communication and Personal Protective Equipment (PPE) options. ICCL uses the latest Lithium-Ion battery technology to provide long duration battery for a fraction of the weight of older lead acid or NiMH powered cap lamps.



Why it is Better

Not only is the ICCL smaller and lighter than other cap lamps, but within its sealed casing various options can be seamlessly included. Such as the PED® personal pager, an electronic tag, or radio. Having these communication devices contribute to personal safety and productivity. Having them integrated into a sealed housing ensures their protection and long term reliability.

Easy to Install - Easier to Wear

ICCL is easy to use, as it does not require an entire new charging system, but simply fits onto your existing charging racks. It even uses your existing headpieces to minimize the cost to change over to ICCL. However a miner will notice the difference in weight and bulk of the battery pack. With more and more PPE (such as large SCSR's) to carry, reducing the weight and bulk of a miner's cap lamp and communication equipment offers significant OH&S advantages.



Take all this.....

and turn it into this...
the ICCL

1/3 the weight & size of existing units.



Only 0.7 to 1kg (1.7lb) in total!

ICCL is a **breakthrough** in cap lamp technology.

ICCL provides a **solution** on how to ensure an underground miner can carry all the necessary personal equipment without being weighed down.

Duration: Suitable for 12 hour shifts
 Weight: 750 g (1.6 lb) Lamp only
 950 G (2 lb) with PED & Tag
 Size: 140 mm (5 1/2") wide x 120 mm (4 1/2") high
 Ergonomics: Hip hugging curved design
 User selectable lamp cord exit point
 Use on left or right hip
 Options: With PED, PED & Tag, Radio.
 PTO: 7.4v/0.3A
 Temp Range: -20°C to +60°C (LCD -5°C to +60°C)

Watertight: IP67
 Soft Start: Increases bulb life
 Diagnostics: Full battery management system interfaced to LCD display.
 Battery fuel gauge with battery low warning and indication.
 Battery Cells: Advanced Lithium-Ion
 Compatibility: With most existing cap lamp systems (minor modifications may be necessary)
 Approvals: Coal mine approvals pending



Mine Site Technologies Pty Limited ABN 93 002 961 953 Website www.minesite.com.au

Sydney:
 25-27 Whiting St
 Artarmon NSW 2064
 Tel: +61-2-9437 4399
 mst@minesite.com.au

Sudbury:
 1085 Kelly Lake Road
 Sudbury ON P3E 5P5
 +1-705-675 7468
 mst-canada@minesite.com.au

Kalgoorlie:
 17 Darcy Lane
 West Kalgoorlie WA 6430
 +61-8-9022 2300
 mstw@minesite.com.au

Mt Isa:
 15 Duke St
 Mt Isa QLD 4825
 +61-7-4749 4922
 mstisa@minesite.com.au

NOTICE: Mine Site Technologies reserves the right to make changes to the specifications and information contained in this brochure without notice.

TRACKER Tagging System



**MINE SITE
TECHNOLOGIES**

TRACKER TAGGING SYSTEM

- Control
- Management
- Safety
- Productivity

A tagging system
designed and
manufactured specifically
for underground mines

TRACKER

TAGGING SYSTEM

The TRACKER Tagging System has been developed by Mine Site Technologies (MST) specifically for underground use in coal and metalliferous mines, as well as tunnelling operations. The system tracks tags – carried by personnel or attached to vehicles – as they move through underground areas of a mine or tunnel.

WHAT TRACKER DOES

The TRACKER System relies on active Tags that transmit to Beacons that are strategically placed throughout the mine (and on the surface). As the Tag or Tags go past a Beacon they are read and the information transmitted back to the main database PC. This allows the current location of all Tags to be known, as well as the history of their movements.

There are obvious safety and management benefits that this information provides, for example:

- Know, at all times, where the Responsible Person appointed for that shift is.
- Know which supply vehicle is nearest to the store.
- Know the nearest electrician to a section where a breakdown has occurred.
- TRACKER can replace a physical tag board for monitoring the "All Clear" status at blast time in hard rock mines.
- Monitor haul trucks, LHD's, Scoops etc to confirm whether they have picked up muck or ore, where they have taken and dumped it, etc.
- In an emergency, know the whereabouts of personnel to better co-ordinate evacuation strategies and/or rescue efforts.



Tag-Self Contained Version

Additionally, TRACKER can be interfaced to large LED displays (Zone Display Units) to better manage access to certain areas, such as:

- Maintain a count of personnel past (inbye) a certain point. This can initiate an alarm when a pre-set number is reached (e.g. the limit imposed by the availability of SCSR's in that district or section).
- Maintain a count of vehicles (and vehicle type) past a certain point. This can be setup to alarm if a pre-set number is reached (e.g. when the amount of diesel horsepower exceeds the limit for the ventilation present in that section or zone).



Zone Display Unit

HOW TRACKER OPERATES

Relatively simple in concept, the final TRACKER product is the result of an extensive engineering development to ensure it delivers the three key requirements of mine operators:

- Accuracy
- Reliability
- Flexibility

Existing, general use, tagging systems are plentiful, but none could be found to operate consistently in the mine environment and meet the mine operator's requirements. Hence all aspects of TRACKER have been designed from 'scratch', specifically for underground applications.

TRACKER is based on strategically placed Beacons receiving and reading coded transmissions from active Tags. This information is then transmitted back to the main data base PC where it is processed by a proprietary software package. More detail on these three main elements is summarized as:

KNOW



Zone Display Unit

Beacons

Beacons receive the Tags' transmitted ID's and battery status. This is stored in static RAM. When polled, the Beacons transmit their data back to a PC, typically located in the main mine office or control room, via RS485 serial protocol. The Beacon to PC link can consist of an integration of conventional wiring, fiber optic and radio modems to carry both up-stream and down-stream data.

The Beacons are designed so they can be easily configured to operate as a number of devices (such as Beacon only, branch, repeater, converter, etc) in a total system by the simple addition of modules or jumpers.

The Beacons are capable of reading 10 tags in a vehicle traveling past at 35 – 40 km/hr (22 – 25 mph).

Two main types of Tag are available:

- Self Contained, with 12 month replaceable battery pack.
- Integrated with BeltPED Receiver.



Tags can also be integrated with the latest BeltPED Receiver

Software

The TRACKER software provides users with powerful sorting, filtering, and searching tools to allow for the presentation of data, comprehensive logging, as well as extensive report generating facilities.

TRACKER is a tagging system that actually works. The safety and cost benefits of a TRACKER installation should provide rapid pay back on your investment in the system.

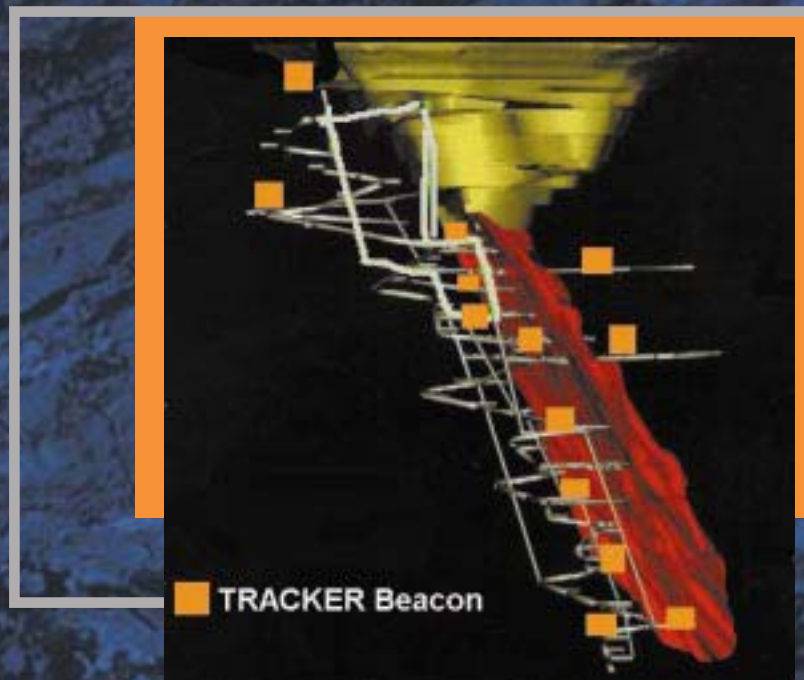
For further information visit our web site www.minesite.com.au



Beacon - receives and processes signal from tags

Tags

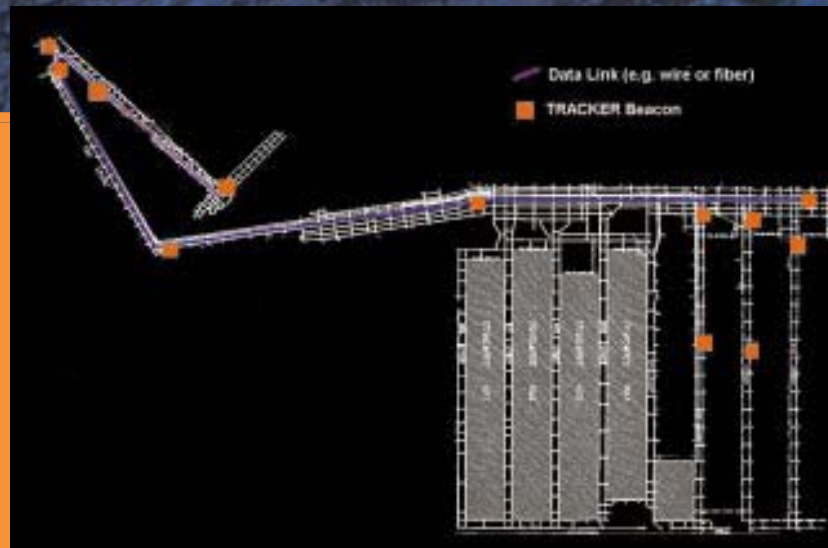
Basically Tags are a miniature UHF transmitter. They transmit data to Beacons (unique ID, Battery Status and Checksum). The Tag is approved as intrinsically safe, allowing its use in coal mines in Australia, USA and China.



Typical Beacon Layout in Hard Rock Mine

WHO, KNOW WHAT, KNOW WHERE

TRACKER TAGGING SYSTEM



Example Beacon Layout in Coal Mine

TECHNICAL SPECIFICATIONS

Beacons

Receiving Frequency	UHF
Antenna	Quarter Wave monopole with TNC connector
Supply	Nominally 24 VDC (12 to 30 VDC)
Power Consumption	1 Watt per Beacon Module
Comms	Proprietary Protocol over Master/Slave 485.
LED Indicators	Heartbeat (Red) = crystal oscillator functional. Tag Read (Yellow) = Tag read verification. Communicating (Green) = stored data has been transmitted to PC
Read rate	Min 10 Tags in vehicle at 35-40m km/hr (22-25 mph)

Tags

Transmitting Frequency	UHF
Transmitting Power	9 mW
Power Consumption	0.4 mA (av)
Battery	Replaceable NiMH, 12 month life nom.
Data Transmitted	Unique ID, Battery Status and Checksum
Transmission Range	50m – 60 m (165 ft – 200 ft) typical
LED Indicator	Off = OK Blinking = approx. one month life left Solid = Replace battery pack
Dimensions	Self Contained version - 97mm x 60mm x 32mm (3.8in x 2.4in x 1.2 in) and 165g (5.8oz)
Rating	IP66, Intrinsically Safe

Software

Client	128 Mb RAM, 800 MHz, 10 Mb HDD, 800x600 Screen Res, NT/2000/XP TC/IP
Database	+MS SQL7/2000 + MySQL 3.21 Can use other databases on application Stores up to 1 Mb/day Depending on how critical the information is to your operation, an extremely robust server is recommended



Mine Site Technologies Pty Limited ABN 93 002 961 953 Website www.minesite.com.au

Sudbury, Ontario

Mine Site Technologies (Canada) Inc.
1085 Kelly Lake Road
Sudbury ON P3E 5P5
Canada
Tel: 705 675 7468
Fax: 705 675 7815
mst-canada@minesite.com.au

Rolla, Missouri

Mine Site Technologies (USA) Inc.
10250 CR 3050
Rolla Missouri 65401
United States of America
Tel: 573 364 1356
Fax: 573 364 0059
mst-usa@minesite.com.au

Sydney

25-27 Whiting Street
Artarmon NSW 2064
Australia
PO Box 156, Artarmon 1570
Tel: +61 2 9437 4399
Fax: +61 2 9437 5866
mst@minesite.com.au

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VDV Leaky Feeder Radio System



**MINE SITE
TECHNOLOGIES**

LEAKY FEEDER RADIO SYSTEM

- Voice
- Data
- Video
- Telemetry

INFINITY SERIES

Quality underground,
line amplified
communication
systems

VDV

LEAKY FEEDER RADIO

The VDV System delivers a reliable, easy to maintain two-way radio system to your mine. The productivity and safety benefits associated with a VDV installation make VDV a cost effective solution to your underground communication and telemetry requirements.

8 AND 16 CHANNELS EXPANDABLE

This allows for system expansion in blocks of 8 channels as your needs grow.

NOISE FREE

The MST VDV system is virtually noise free and is impervious to HV power or other electrical interference.

TELEMETRY - DUPLEX VOICE AND DATA CAPABLE

System is capable of both voice and data communication on all channels, simultaneously, allowing Telemetry control of remote equipment. Unlike other systems, VDV can be used for full telemetry control of underground equipment. MST's experience in designing and installing telemetry systems, at a range of mines, ensures the system will operate as specified.

ON BOARD REMOTE DIAGNOSTICS

Should remote interrogation of system performance be required, the on board diagnostic module will relay the amplifiers condition.

VIDEO

Depending on the system configuration VDV is capable of transmitting video.

Every active device in the distribution system is fitted with a DC voltage regulator and filter. This enables the amplifier chain to compensate for voltage irregularities throughout the system.



VDV Headend

DESIGNED & MANUFACTURED BY MST

Being designed and manufactured by MST allows for excellent levels of support and commitment to on-going Research and Development.

The Headend distribution panel is fitted with 4 output feeders, each of which is capable of driving a minimum of 9 km of feeder without the need for additional supply units.

“Quality underground, line amplified communication systems”

FROM THE MI



Miner on Jumbo using radio communication

COMPATIBLE WITH MOST EXISTING SYSTEMS

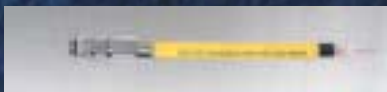
The amplifiers have been designed to perform equally as well with other suppliers' systems. This allows customers to source VDV equipment to suit an existing system.

AUTOMATIC LEVEL CONTROL

ALC allows the system to be unbalanced and still operate to maximum specification, even when the cable attenuation is inconsistent.

MODULAR AMPLIFIER CONSTRUCTION

As the amplifiers are modular in construction, installation and service time is greatly reduced.



Leaky Feeder Antenna Cable and Connectors

COMPATIBLE WITH BOTH 75 & 50 OHM CABLES

This allows Headend and Amplifier equipment to be terminated to either 75 or 50 ohm coaxial feeders.



Internal casing and electronics of VDV Line Amplifier

SUBMERSIBLE HOUSINGS & TERMINATIONS

The amplifiers have been designed for the harshest of environments, from high pH levels to extremely dusty and wet exposure.

The amplifiers and terminations are submersible up to 1m. The amplifiers are also RF shielded for protection in electrically noisy environments.

COAXIAL AMPLIFIER TERMINATIONS

Having bolt on submersible connectors eliminates exposed cable within the amplifier enclosure. Also negates the need to expose the amplifier during installation.



The latest VDV Infinity Series Line Amplifier

TOTAL COMMUNICATIONS

The high reliability and quality of the VDV Leaky Feeder ensures voice and data communication will enhance any operation.

MINES

VDV provides two way communication for your voice and data requirements. The true multi-channel performance ensures the optimum combination of voice & data signalling can be achieved to better manage your mine.

TUNNELS

The simplicity of installation will mean VDV can provide a powerful project management tool. Two way voice communication between tunneling crews, loco drivers, etc., and data logging from TBM's, etc., throughout the tunnel length will assist in the tunnel development and be available for use by the tunnel operator, if required.

BLASTING

BlastPED allows for remote blasting commands to be sent through the VDV Leaky Feeder System. The same proven safety protocols as used in the PED version are utilized in the VDV version.

TAGGING

Our customized Tagging system, TRACKER, operates through the leaky feeder system, allowing for remote tag board activities to be processed and monitored by mine personnel. Personal safety and fleet management can benefit from the TRACKER system.

For further information visit our website www.minesite.com.au

TECHNICAL SPECIFICATIONS

VDV HEADEND UNIT SPECIFICATION

Channel Capacity (Voice/Data)

Combiner 8 channel increments
Combiner Splitter 16 channel

Insertion Loss

Tx. Junction to Leaky Feeder 38dB max.
Leaky Feeder to Rx. Junction 23dB max.

RF Driver Levels

RF Driver Level @ Tx. Port +40dBm
RF Signal Level @ Leaky Feeder +2dBm

Connections

Rx. Junction Connection TNC Female
Tx. Junction Connection TNC Female
Leaky Feeder Connection "N" Female

Impedances

Rx. Junction Connection 50 ohms
Tx. Junction Connection 50 ohms
Leaky Feeder Ports 75 ohms

Isolation

Between Rx. Ports 20dB min.
Between Tx. Ports 20dB min.

LINE AMPLIFIER UNIT SPECIFICATIONS

Frequency Band VHF Spectrum
Frequency Split 9.5 MHz
Pass Band 177 MHz \pm 9 MHz
(Uplink - return path)
152 MHz \pm 7 MHz
(Downlink - forwd. direction)
22dB nom (forwd. & retrn.)
Construction Surface Mount Tech.
Gain Adjustment Auto (ALC)
AGC Range 20dB
In/out Impedance 75 ohms
Suggested Amplifier separation 350 metres
Third order intercept Forward 16dBm
Return 20dBm
Operation Voltage 32 - 5 volt DC
Maximum Line Current 5 amperes
Power Consumption 1.2 watts
Nominal RF Input Level Forward -15dBm
Return -16dBm



Leaky Coax Cable and Connectors.

Nominal Current

Amplifier module (VCC = 5 VDC.) 100 mA typ.

RF Levels

Base Port O/P level Return 0dBm max.
Forward 1dBm max.

Enclosure

Construction Submersible Cast CATV
Size 130mm x 90mm x 60mm
(6in x 3.5in x 2.5in)
Termination CATV through-pin connector

PILOT TONE GENERATORS

Chain Pilot Generator (Agile)

Direction Optional as Uplink or Downlink
Operating Frequency PC Adjustable in 12.5 KHz steps

DIAGNOSTICS MODULE (AGILE)

Operating Frequency 168-186 MHz
PC Adjustable in 12.5 KHz steps

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Sydney
25-27 Whiting Street
Artarmon NSW 2064
Australia
PO Box 156, Artarmon 1570
Tel: +61 2 9437 4399
Fax: +61 2 9437 5688
mst@minesite.com.au

Kalgoorlie
17 Darcy Lane
West Kalgoorlie WA 6430
Australia
PO Box 4200, Kalgoorlie 6430
Tel: +61 8 9022 2300
Fax: +61 8 9022 2311
mstwa@minesite.com.au

Mount Isa
15 Duke Street
Mt Isa QLD 4825
Australia
PO Box 2436, Mt Isa 4825
Tel: +61 7 4749 4922
Fax: +61 7 4749 4933
mstisa@minesite.com.au

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ImPact WLAN Digital System

The **FUTURE** of mining
communications through the
convergence of technologies

**MINE SITE
TECHNOLOGIES**

IMPACT

TAKING YOUR 802.11 WLAN UNDERGROUND

- Enabling technology
- Enterprise Solutions
- Vehicle Intelligence
- VoIP
- Asset tracking
- Production monitoring



www.minesite.com.au

Productivity through the
management of information

IMPACT

TAKING YOUR 802.11 WLAN UNDERGROUND

Solutions by taking your LAN and IP Applications Underground

INTRODUCTION

The *ImPact* technology suite is designed to meet the communication infrastructure and application requirements of mines in the 21st century. ImPact is a purpose designed network communications platform that extends a site's Ethernet topology into the underground workings of a mine. The design architecture philosophy provides extended general TC/IP functionality with the added benefit of utilizing productivity enhancing tools available through proprietary and off-the-shelf wireless networking technologies (802.11b/g).

ImPact takes over where other technologies reach their limits. Leaky feeder technology just cannot meet the data and flexibility requirements demanded by modern mining. For basic voice and data leaky feeder is still a good option (we still supply a lot

of VDV Leaky Feeder), but for very high data applications (video, on-board vehicle diagnostics, remote control, etc) leaky feeder is limiting. Therefore, MST has decided to bring a truly advanced communication technology into the underground mining industry. *ImPact* provides an alternative to leaky feeder technology that offers a quantum leap in bandwidth, and hence data quality and capacity.

The *ImPact* LAN and Wireless LAN technologies utilize carrier quality wired and wireless components and include design criteria that ensure high reliability and maintainability through architectures such as redundant loop implementations and SNMP fault detection and network management tools.

ImPact 802.11b WIRELESS ACCESS POINT

Mine Site Technologies' *ImPact* 802.11b/g Wireless Access Point (WAP) provides the mining industry with a high throughput and robust communications infrastructure to support the deployment of general IP applications with a focus on mobile data

solutions that are implemented over the ImPact Wireless LAN. The *ImPact* WLAN is standards based and Wi-Fi compliant. Some of the advanced applications supported by the *ImPact* WLAN in an underground mining environment include:

1. Mobile Vehicle data Solutions;

- Production Monitoring
- Ore Flow Modeling
- Utilization Monitoring & Optimization
- Condition Monitoring
- Equipment Tracking
- Equipment Scheduling & Traffic Control

2. Voice over Internet Protocol (VoIP)

Wireless Phones

- Digital Functionality
- PTT (Press to Talk) Broadcast available
- SMS Text Messaging
- Voice Mail

3. Mobile Data Download (PDA and Pocket PC)

- Equipment Operators' Logs
- Shift Logs
- Surveying Input
- Geology Input
- Materials Management

4. Mobile & Fixed IP Video

- Real Time High Res Digital Video
- Remote Monitoring
- Security

5. Integrated Wired & Wireless LAN Connectivity Underground

- Mobile work groups
- Dispatch Applications
- Email
- Tracking via IP



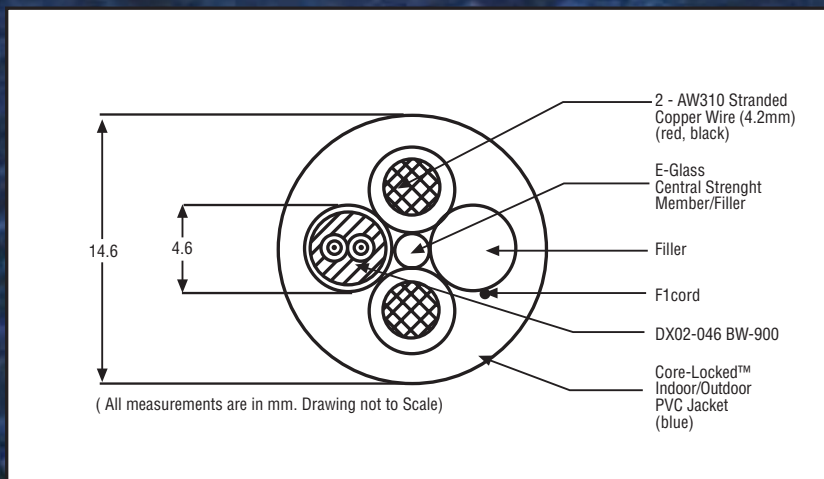


Key Design Criteria - For Underground Mining Applications

The ImPact 802.11b Wireless Access Point (WAP) is a purpose built wireless communications device, designed specifically for industrial applications in an underground mining environment. The design addresses the specific requirements and deployment considerations associated with the challenging environments that exist in underground mines.

Among the principal design criteria incorporated into the ImPact 802.11 Wireless Access Point are the following:

- Standards based and compliant with: IEEE 802.3, 802.11b; Spectralink SVP Protocol; Cisco Call Manager Protocol; Nortel G.729 speech coding protocol; IREDES Wireless Data Standard; XML Wireless standard; Wi-Fi compliant.
- Ruggedized platform, i.e. the WAP's are designed specifically for the arduous underground environment in terms of physical packaging, electronic design and connecting to fibre and power. ImPact WAP's achieve in one mine rugged housing, what 3 to 4 "off-the-shelf" plastic housed components would be required to achieve electronically. **Physically, and in the practicality of installation and maintenance, the ImPact WAP's are vastly superior.** (see pictured right)
- Integrates fast switch to facilitate hub/branch configuration or to switch between access cards based on data priority (e.g. VoIP packets assigned priority for QoS performance).
- The switch is capable of switching two wireless segments and four fiber segments at full wire line speed.
- Full wireless access functionality is implemented via Wireless Access Card (WAC) - consists of a wireless network processor and integrated Cardbus (PCMCIA) 802.11 adaptor.
- Operates on touch voltage (30 VDC) - no certifications or approvals required - do not need to use armoured high voltage cable
- Fiber Optic interface to maximize WAP spacing -targeting 600m separation [802.11b] based on minimum signal propagation of 300m in typical 4m x 5m openings.
- Hybrid fiber/copper connector as well as secondary copper connector for power only if deployed on mine's existing fiber optic network (see pictures below).
- Ruggedized WAP's (both in electronic design and packaging/connectorization) Pre-manufactured connectorized cable in 50m, 100m, 200m lengths c/w coupling joint - network can be easily expanded by operations personnel.



Wireless Signal Coverage Underground

ImPact WAP's can be set up to provide complete, continuous signal coverage (e.g. if required for VoIP applications to replace traditional radio systems). Or it can be setup to create "hot spots" in particular areas (e.g. for vehicle diagnostics on a production level). With 200 meters to 300 meters (1,000 feet) signal coverage from

a WAP in a typical mine profile, means WAP's can be spaced up to 600 meters (2,000 feet) apart and still achieve continuous signal coverage.

A typical mine layout showing ImPact WAP's and Fibre Network is seen below:



ImPact - Voice over Internet Protocol (VoIP)

ImPact WAP's allow the introduction of "Voice Over Internet Protocol" (VoIP) Networks. VoIP can offer a number of benefits, including:

- Build voice VPN (Virtual Private Network) services over existing wireless infrastructure
- Allows person to person calls from surface to underground, whilst PTT options still available for broadcast calls when required
- Integrates Digital phone signaling into VoIP functionality
- Transparent to clients' existing PABX-based dialing
- Supports additional and complimentary VoIP signaling options
- Unified messaging increasing productivity
- Supports desk top functionality as well as hand held peripherals



ImPact - VIP Suite (Vehicle Intelligence Platform)

ImPact VIP is an enabling technology that simplifies data transfer to and from equipment, and right through to remote control if required. Basically, VIP is a vehicle monitoring and control system that can allow on board diagnostics to be seamlessly transferred to the enterprise or corporate business network.

The various modules have been developed for easy integration into existing and new equipment, combined with the use industry standard wireless interfaces for Ethernet, enables:

- Network connection using standard 802.11b protocols.
- Storage of up to 2,000 data samples from any I/O point on the CANopen network. When to modules is in range of an access point, the data is transferred to the network.
- Data is transferred in standard XML format, with schema conforming to the IREDES standard for heavy equipment offboard communication.

The key modules are listed below.

VIP-CP10 Control Processor

The CP10 Control Processor Module is a vehicle hardened IEC1131 programmable controller. It provides an additional level of control for more sophisticated on-board control functions. A minimal I/O compliment is provided, included are 4 on/off outputs, 4 discrete inputs and 4 analogue inputs

VIP-CM10 Extended Control Module

The ECX10 Control Module provides 10 current controlled PWM outputs, 4 on/off outputs, 6 discrete inputs and 4 analogue inputs.

VIP-TSD Dash Mounted Touch Screen

The ECD10 Display Module includes a 1/4 VGA, 5.7" monochrome display with a CCFL backlight, and a fully integrated analogue touch panel.

VIP-RLC 802.11b Radio Link Controller/Interface

The Radio Link Control Module provides a maximum of 4, 12 bit proportional control points and 16 discrete on/off control points over an RF link to the CANopen network.

Communication is bidirectional, data from the vehicle can be sent back over the link to operator display on the pendant. In addition the 802.11b interface card provides a network connection to a standard 802.11b access point. This module allows machine data to be seamlessly transferred to the enterprise or corporate business network.

VIP-GVA Generic Vehicle Adaptor

The Wireless Vehicle Link Adaptor is a high performance, microprocessor based interface for local PC and PDA to vehicle communication, or as a 802.11b/g wireless bridge allowing remote access to engine management and statistical information. As the primary link between heavy duty and medium duty vehicles and Windows based OEM service applications, this adaptor is compatible with the latest vehicle standards - including SAE J1587/J1708 and J1939. This adaptor kit also includes two additional RS232/802.11b/g interface ports.



PURE LOCAL RADIO CONTROL

ImPact VIP can also provide complete remote equipment operation. The high data and integrity of the 802.11b ImPact communication, or 900 MHz line-of-sight links, plus stringent adherence to remote control standards, ensures safe and reliable operation.

VIP-MEP Radio Remote Control Pendant

The Mobile Equipment Pendant is available in several different factory configurations to support different vehicle controls. Custom configuration is also available. The Pendant communicates to the ERC20 module in order to place the control information on the CANopen bus. The Pendant is capable of transmitting 4 analogue signals, and 28 discrete signals to the ERC20, and will receive up to 64 status bits from the ERC20. Status information is displayed on a 2X20 LCD display.



VIP-MER Radio Control Link Module

The ERC10 Control Module provides 16 discrete on/off control points over an RF link to the CanOpen network. Communications is one direction only, from the control pendant to the network interface. Utilizes 802.11b standard or 900 MHz for 'line-of-site' applications.



TECHNICAL SPECIFICATIONS

ImPact Wireless Access Points (WAPs) and Composite Cable:

General:

Housing	Stainless Steel to IP 66
Antenna Mounting	External through IP66 Gland x 2
Mounting	Customized Wall Mount

RF Section:

Radio Data Rate	11, 5.5, 2 and 1 Mbps (AFB)
Range (radius open air)	Approx. 500 metres (1,600 ft)
Range (underground)	Approx. 200 m (650 ft) either side of WAP
Operating Voltage	5 VDC
Regulation Cert.	FCC 15/UL; ETSI 300/328/CE
Compatibility	IEEE802.11b
Drivers	Windows 95/98/ME/2000/NT/XP
Roaming	802.11b compliant
Security	64/128 Bit WEP Data Encryption
Frequency	2.400-2.484 GHz
Type	Spread Spectrum (DSSS)

Motherboard/Fibre Drivers:

Operating Voltage	5 - 30 VDC (nom 250mA)
Communication Ports	4 x 100base-FX Communication
Ethernet Port	Segments 1 x 10/100 Ethernet
Wireless Access Availability	Copper Port 2 x Wireless Access Radio Card Slots

Composite Fibre/Copper Cable:

Fibre Type	Multimode
Fibre Count & Size	2/62.5µm
Copper Count & Size	2/10 AWG
Outer Diameter	14.5 mm
Colour & Markings	Blue/IP - 10/62.5-PV Mine Site
MSHA Markings	P-7K-27105-MSHA



Mine Site Technologies Pty Limited ABN 93 002 961 953 **Website** www.minesite.com.au

Sudbury:

1085 Kelly Lake Road
Sudbury ON P3E 5P5
Tel: +1-705-675 7468
mst-canada@minesite.com.au

Sydney:

25-27 Whiting St
Sydney NSW 2064
+61-2-9437 4399
mst@minesite.com.au

Kalgoorlie:

17 Darcy Lane
West Kalgoorlie WA 6430
+61-8-9022 2300
mstwa@minesite.com.au

Mt Isa:

15 Duke St
Mt Isa QLD 4825
+61-7-4749 4922
mstisa@minesite.com.au

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