POWER SAFETY – A GLOBAL STANDARD

Tim Thornett, Ephraim Tozowonah

tim.thornett@globalmarinesystems.com , ephraim.tozowonah@globalmarinesystems.com

Global Marine Systems Limited, UK, New Saxon House, 1 Winsford Way, Boreham Interchange, Chelmsford, Essex CM2 5PD

Abstract: This paper focuses on Global Marine Systems Limited's (Global Marine) commitment to power safety and highlights the importance of a global understanding and agreement on power safety procedures. Initially Global Marine's fully revised and updated procedures are discussed in the context of ensuring powering operations are carried out as efficiently as possible, with safety to personnel of prime importance. Global Marine has recognised that safety requires the cooperation of all parties, so our power safety procedures have been written around not only our safety needs but equal consideration has been given to the needs of our customers. When, for example, testing between a terminal station and cable ship during a repair operation it is vital for global standards. They may be many hundreds of kilometres apart and working for different organisations, but in this situation they need to work efficiently and safely as a team. Global Marine has discussed the issue with many companies to ensure that the procedures meet a global requirement. Here an argument is put forward for a global standard and not just a Global Marine standard. The paper finally discusses how Global Marine is being proactive in its approach, we insist all of our engineers are fully trained in power safety procedures and offer training to our customers. It concludes with identification that procedures put in place to ensure safety to all personnel can only be achieved if there is the adoption of a Global Standard.

1 INTRODUCTION

Where Power Safety for submarine cable operations is concerned, different parties, whilst having the same objectives have differing methods. It is proposed that a unified approach should be adopted to enable a standard communication protocol regardless of in which region or on which system a cable repair (or installation) operation is conducted. The benefits are that safety hazards would be minimised, personnel at all sites would have greater confidence in the system being operated, and repair operations would be more often conducted with fewer of the delays that can be associated with Power Safety Communications. This would be by virtue of a simplified approach, common terminology and a reduction in the frequency of repeat requests or requests for clarification on such things as cable head condition. Global Marine has reviewed their company Power Safety Procedures with the result of rationalising the instructions for use both onboard Global Marine vessels and by the Cable Terminal Stations with which Global Marine vessels may interact.

During a marine cable repair, of which there can be many scenarios, the cable ship is generally between two cable ends each of which could potentially be electrically or optically 'live', that is, carrying electrical or laser based energy. The hazard appears when the cable end is onboard, as this is when there is the potential for personnel to come into contact with the cable and the energy it may be carrying. The greatest hazard is that power is on the cable when it is actually being handled, for example during onboard cable cutting, cable preparation, and cable jointing operations. Similarly there is a reciprocal risk to the Cable Terminal Station where the cable ship may be applying power (electrical or optical) in the course of performing tests on the cable or fibres. The aim of Power Safety procedures is to ensure that power is never applied to the system without the risks being assessed by the Engineer applying the power, to ensure that it is confirmed that it is safe to do so. A similar consideration must be made by the Engineer resuming work on the cable after power has been removed, that it has been confirmed safe to do so. Such risks can be eliminated by a strict adherence to an agreed set of procedures.

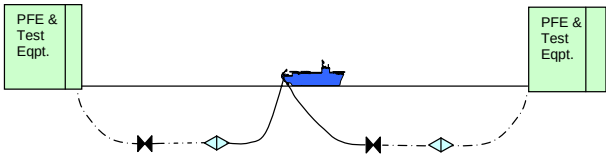


Figure 1 Typical cable repair scenario with both cable ends onboard the repair ship, between two terminal stations

Global Marine, over a period of time, has monitored wider power safety performance towards continuous improvement. Analysis showed that there would be a great benefit in introducing revised and globally accepted procedures, as there can be a variation in levels of staff expertise from region to region. One plausible reason in the variation is the reduction in the number of experienced staff at regional Cable Stations. The frequency of staff turnover, coupled with differing working arrangements in some regions are other contributing factors.

A number of discussions with some prominent customers, one of whom is also a keen proponent of the development of Power Safety from a terminal point of view, were used to provide external input to Global Marine's review process. The key elements of Global Marine's procedures are presented here, with the intention that these be considered as some of the aspects

of Power Safety Procedures that would benefit from having a common understanding in the wider industry.

2 POWER SAFETY TERMINOLOGY

Some terms already exist within the field of cable system Power Safety. These may not always convey the same meaning to all operators and terminal stations. For example the concept of Power Control although synonymous with the condition where one party has safety status authority over the system has, to some organisations, signified that this is the location which is presently in control of a currently operating Power Feed system. This can lead to ambiguity unless clarified. Another example is in the definition of *Power* when referring to Power Safety which, to some parties, may only mean electrical power or power used to energise the submarine repeaters. Clearly, electrical power can be potentially lethal and therefore represents the greatest hazard. However, *optical power* and in fact any energy applied to the cable for monitoring or fault location, such as a low frequency tone signal for trailed electrode operations should be viewed within the same category, although the extent of the hazard to personnel may vary dependent on the precise circumstances.

Global Marine's revised documentation includes a glossary of Power Safety terms as used within the procedures. *Power*, in the context of Power Safety is described as any energy that is periodically applied to the cable. Terms such as *Coordinating Terminal* Station and *Power Control* are described and clarified. These are examples of simple yet important concepts of which all parties would benefit from a shared understanding. It is feasible to consider that a finite set of terms could broadly cover the roles, equipment, conditions and statuses that are relevant during the course of a cable ship operation. Three such definitions used by Global Marine are given in full below:

2.1 Power

The term "Power" is often used to describe energising a cable system by way of applying a DC current from Power Feed Equipment. However for the purpose of Power Safety it must be understood that "Power" includes:

(a) Optical Power generated by test equipment, transmission equipment and cable system plant.

(b) Electrical Power from DC test equipment used to conduct Insulation Resistance, Conductor Resistance and Capacitance tests, and also from TDR based test equipment.

(c) Electrical Power associated with equipment generating an electroding signal.

(d) Electrical Power generated by Power Feed Equipment.

2.2 Power Control

A location (terminal or cable ship) has *Power Control* once it has been agreed that it will control *directing* the application of power, switching of power, and any changes in cable end terminations. It should be clear that in the context of Power Control, the word "Control" refers to a *commanding* role over other locations to control cable system status rather than actual physical operation of equipment applying power.

2.3 Coordinating Terminal

During most cable operations powering and / or testing between two or more land stations is required. It is recommended that the terminal which will lead coordination of any such powering or testing is nominated prior to operations commencing. This terminal is referred to as the *Coordinating Terminal*.

The Coordinating Terminal can only initiate powering and / or testing sequences once all relevant terminals have received a Power Safety Message (PSM) from the location having Power Control (normally the cable ship) giving permission for the powering and / or testing. Similarly, on completion of powering and / or testing the location having Power Control will need to receive a Power Safety Message from each terminal confirming their own equipment status before it will be deemed safe for the next stage of operations to commence.

The Coordinating Terminal may have a role in *distributing* Power Safety Messages. It is not responsible for *producing* Power Safety Messages containing instructions or information from any other terminal or from the cable ship. However, it is acceptable for all Power Safety Messages to be relayed to their intended recipients through the Coordinating Terminal. On completion of most operations the cable ship will hand Power Control to the Coordinating Terminal.

3 POWER SAFETY RESPONSIBILITIES

The power safety officer (PSO) or their deputy holds the key role in operational power safety coordination and must ensure that all actions carried out are done so safely. For cable ship operations, the Commander or Offshore Superintendent has ultimate responsibility for the safety of all onboard and has the authority to hold off or stop an operation where he feels that it is appropriate to do so. This may be due to weather conditions or any safety matter. Figure 1 shows the responsibility structure as viewed and operated by Global Marine.

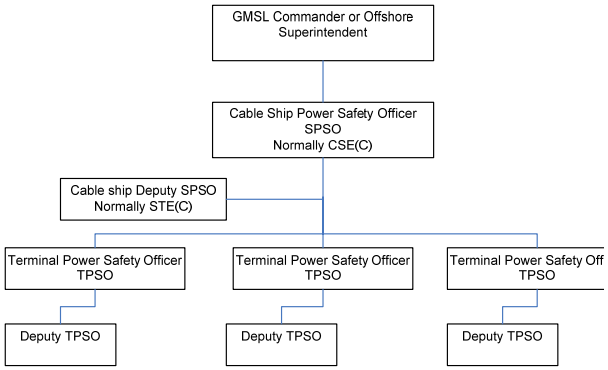


Figure 2 Power Safety Organisation for a cable ship. The CSE(C) and STE are Global Marine's in-house titles for the industry's equivalent of Chief Cable Engineer (CCE) and 2nd Cable Engineer

The clear statement and clarification of the responsibilities of the ship power safety officer (SPSO) and terminal power safety officer (TPSO) is essential so that each party involved during a cable ship operation is aware of the requirements of their role. This is for the reason that the safety of other personnel, both at their immediate location and at a remote location, could be compromised if there is a failure to comply with the requirements of their position. It must be accepted between Power Safety Officers that, apart from in exceptional circumstances, the Power Safety Control – that this, the authority to command the powering status of the system at any time rests with the cable ship Power Safety Officer (SPSO) during a cable repair operation.

Global Marine has elaborated the duties expected of both Shipboard Power Safety Officer and Terminal Power Safety Officer as follows:

3.1 Ship Power Safety Officer (SPSO) Responsibilities

- The SPSO shall be responsible to the Commander or Offshore Superintendent for the safety of all personnel on the cable ship in respect of electrical and optical power associated with the cable system during powering, terminating, jointing, testing, tracking of cable by a remotely operated vehicle (ROV) or divers, and locating cable and fault by trailed electrode detection. The SPSO is also responsible for ensuring that actions taken on the cable ship do not compromise the safety of terminal or other remote location personnel.
- The SPSO or their deputy will control access to the key for the cable ship Power Feed Equipment (PFE).
- The SPSO will be responsible for maintaining the local Power Safety Log and the exchange of Power Safety Messages (PSMs) between the cable ship and any other locations during the cable operation.
- The SPSO will ensure that the cable ship staff use safe procedures in respect of transmission and power-feed equipment, and that safe powering, wiring and earthing arrangements are employed.

3.2 Terminal Power Safety Officer (TPSO) Responsibilities

- The TPSO shall be responsible to the Maintenance Authority or Senior Project Coordinator for the safety of all personnel in the terminal in respect of electrical and optical power associated with the cable system during powering, terminating, testing and electroding signal application. The TPSO is also responsible for ensuring that actions taken at the terminal do not compromise the safety of the cable ship or other remote location personnel.
- The TPSO will control access to the key for the Terminal PFE.
- The TPSO will be responsible for maintaining the local Power Safety Log and the exchange of Power Safety Messages (PSMs) between the terminal and any other locations during the cable operation.
- The TPSO will ensure that the terminal PFE is not energised to power the cable system during the cable operation without the express approval of the controlling cable ship's Power Safety Officer.
- The TPSO will ensure that the terminal staff use safe procedures in respect of transmission and power-feed equipment, and that safe powering, wiring and earthing arrangements are employed.
- The TPSO will ensure that optical testing is not carried out without written permission from the controlling cable ship's Power Safety Officer.
- The TPSO will immediately act upon and comply with all requests made by the controlling cable ship's Power Safety Officer.

4 POWER SAFETY MESSAGES (PSM), PROTOCOL AND MESSAGE CONTENT

The Power Safety Message or PSM is the primary mechanism by which each Power Safety Officer conveys communications, normally by fax, regarding the status of power on the system. It is used to request any changes to the cable head condition and to request and grant permission from or to another location in view of actions being carried out on the cable such as testing, or jointing tasks. Because it is signed and logged, a PSM can be considered a formal record of instructions, agreements and actions undertaken to ensure the safe coordination of any activities requiring cooperation between two or more locations. The simple provision and use of a base template has been found to greatly improve consistency by reducing variation. This leads to reduction in the possibility of errors. The

following revised guidelines have been applied for power safety messages:

- All verbal and written messages are to be in English.
- All times to be in GMT (often referred to internationally as UTC) unless otherwise agreed prior to commencement of operations.
- The PSM must include a line containing GMT Date and Time at which the PSM is about to be transmitted to its first addressee.
- The name and fax number of each location the PSM is being sent to should be included close to the top of the PSM.
- The name and fax number that the PSM is being sent from should be included close to the top of the PSM.
- Each PSM must have a sequential PSM Reference number for each of the locations it is being sent to or copied to.
- The PSM must be signed by the duty PSO or DPSO. The name of whom should be printed below the signature.
- The role of the person sending the PSM, for example, PSO or DPSO must be shown.
- The instructions within the PSM must be clear and precise in simple language.
- Aim to keep PSMs brief.
- Each line giving an instruction or note for information should be numbered sequentially.
- If a PSM is being sent to more than one location each instruction within the PSM must clearly state which location the instruction is for.
- If a PSM is being sent to more than one location and an instruction requires the action of two locations simultaneously, for example if two terminals are required to Double End Feed, then the message should request that the terminals coordinate to perform the task instructed.
- When referring to power always be careful to make it clear whether the message refers to optical power, electrical power or both.
- Ensure all PSMs sent and received are unambiguous. If an ambiguous PSM is received, seek clarification from the sending location and await a replacement PSM which has eliminated any ambiguity before acting on the PSM.

These rules enable consistent PSMs to be generated and therefore safer operations by eliminating ambiguity. The emphasis must be placed on the Power Safety Officer using discretion within these instructions to consider the prevailing scenario in order to generate a message appropriate for the request he wishes to make.

4.1 Guidance for Concise Safety Messages and Background Checks

The communication system via Power Safety Messages should ensure that it is simple for a recipient to understand what is being requested, and therefore affirm positively and clearly whether the request is complied with or not. Power Safety Messages were reviewed in order to ascertain the aspects that could be improved. The considered view is that simplicity and clarity are the most effective rules of thumb for Power Safety Messages. Concise requests are easier for a recipient to follow and respond to. Large attachments to messages can cause the original request to be ‘swamped’ with unnecessary information. Therefore if a message can be kept to a single page there is an advantage. The exceptions are; when reporting a condition requiring additional data, or where the information forms part of the outcome of an agreed test and where the results have been requested.

Effective Power Safety Procedures must provide instruction regarding *coordination of power safety* and the duties that the power safety officer must carry out prior to, at the start of, and during operations. It is important that procedures also positively include a reminder of the operational checks that a Power Safety Officer must carry out, for example *checks prior to the powering of a cable onboard* and *checks after a cable is de-powered.* The process for *emergency communications* should also be written. Whilst Global Marine has placed the emphasis on the shipboard view, these main elements are equally applicable to the terminal station, where the cable head condition can be periodically altered, and test equipment is often interfaced during operations. For example, Insulation Resistance (IR) measurement equipment may be connected to the cable and the test applied at various times. Ensuring that a set of checks are performed will circumvent the possibility that such equipment is left in an unsafe state.

5 POWER SAFETY LOGS

Global Marine has reviewed the use of shipboard Power Safety Log in order to enhance the structure of entries recorded in line with the revised stipulated requirements. Whilst the rules for Power Safety Messages determine the primary format and content expected, the associated Power Safety Log book is an important operational record of events. As such there is a need to provide instruction as to what should be recorded in the log. There are some common requirements for all locations such as recording the dates and times when the system is energised and de-energised by applying or removing power, and summary information on all Power Safety Messages sent and received. The power safety log, along with the

actual Power Safety Messages received must be viewed as the *primary references* to system status. A structured, accurate Power Safety Log is viewed as an essential requirement for all terminal stations and ships.

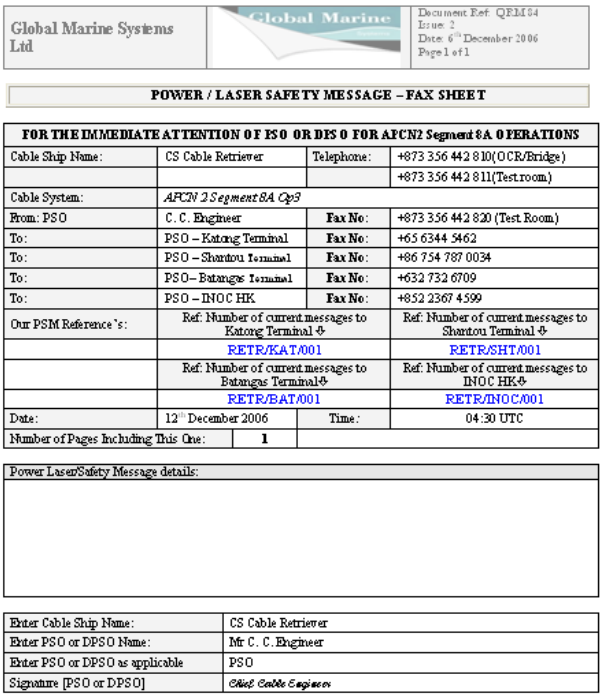
6 METHODS OF COMMUNICATING THE MESSAGE

The method of communication of written power safety messages by facsimile between a ship and the terminals is well understood. It does, however, depend on there being adequate communication facilities within the shore station. Global Marine has experienced a number of operations where this has not been the case. In these situations, a specified verbal method has been used. It is essential that all parties are aware of the use of such a procedure, and continue to familiarise themselves with all of the available methods of communication and circulation of a Power Safety Message. Global Marine has stipulated methods by which the power safety message should be circulated, accounting for such requirements as that of forwarding the message to a shore based 'central' contact, which may be a Network Operations Centre (NOC) that wishes to view the power safety status at all times, or sending messages via a Coordinating Terminal that acts as a distribution centre for other stations. The latter method, as an example, reduces the number of messages that a ship might have to send to different contact points and therefore makes the process of messaging more efficient and timely. The revised procedures also account for the method of sending Power Safety Messages by email, by using a prescribed method. Indeed, Global Marine has under certain conditions received email power safety messages onboard a cable ship. It is plausible that the role of email may develop as a means of delivering Power Safety Messages. This would require, however that ships acquire a permanent 'internet' facility whilst at sea. As email communication can suffer from some of the same defects as fax communication, and message delays, the robustness of a reliance on email would require a detailed assessment.

7 TRAINING

At Global Marine, we have considered the ways by which Power Safety can be constantly improved, in keeping with the high priority that Safety as a whole is given within the company's operational philosophy. Firstly, all prospective Power Safety Officers must be trained in *Power Safety and Power Safety Messages* before then being authorised as being competent for the role of PSO. Currently there is an ongoing programme of refresher training following Global Marine's revised procedures. All current Global Marine Power Safety Officers will attend this course as a mandatory in house requirement. Whilst it is for each individual organisation to satisfy itself that its Power Safety Officers are adequately trained to carry out the role, Global Marine has been offering intensive training courses to customers upon request. This has enabled attendees to gain a further appreciation of the repair operation from the shipboard point of view, alongside the expected requirements of the Terminal Station Power Safety Officer.

Towards working to common procedures, Global Marine has begun to disseminate procedures to interested parties, and also given, at the start of operations, message tracking sheets which include the sequential numbers of all the Power Safety Messages that each location might send to the relevant terminals or ship. This method provides proactive guidance to each party on the sequence to use. This has already been used successfully, with terminal stations complying with the system without due difficulty. An example of Global Marine's Power Safety Message, produced from the company standard template is shown in figure 3. The tracking sheet also used for the repair operation, as issued to Batangas (BAT) is shown in figure 4. The terminal stations involved found the sequence beneficial and were able to adopt this for the repair operation.



Global Marine Systems Ltd

Global Marine

Document Ref: QFM 84
Issue: 2
Date: 6th December 2006
Page 1 of 1

POWER / LASER SAFETY MESSAGE – FAX SHEET

FOR THE IMMEDIATE ATTENTION OF PSO OR DPSO FOR AFCN2 Segment 8A OPERATIONS			
Cable Ship Name:	CS Cable Retriever	Telephone:	+873 356 442 810(OCR/Bridge)
			+873 356 442 811(Test room)
Cable System:	*AFCN 2 Segment 8A Cp3*		
From: PSO	C. C. Engineer	**Fax No:**	+873 356 442 820 (Test Room)
To:	PSO – Katong Terminal	**Fax No:**	+65 6344 5462
To:	PSO – Shantou Terminal	**Fax No:**	+86 754 787 0034
To:	PSO– Batangas Terminal	**Fax No:**	+632 732 6709
To:	PSO – INOC HK	**Fax No:**	+852 2367 4599
Our PSM Reference's:	Ref: Number of current messages to Katong Terminal		Ref: Number of current messages to Shantou Terminal
	RETR/KAT/001		RETR/SHT/001
	Ref: Number of current messages to Batangas Terminal		Ref: Number of current messages to INOC HK
	RETR/BAT/001		RETR/INOC/001
Date:	12th December 2006	Time:	04:30 UTC
Number of Pages Including This One:	1		

Power Laser/Safety Message details:

Enter Cable Ship Name:	CS Cable Retriever
Enter PSO or DPSO Name:	Mr C. C. Engineer
Enter PSO or DPSO as applicable	PSO
Signature [PSO or DPSO]	*Chief Cable Engineer*

Figure 3 Example PSM based on Global Marine template. Some actual message details have been altered or removed.

Full Ship/Terminal Name	Short Ship/Terminal Name
Batangas	BAT
CS Cable Retriever	RETR
Shantou	SHT
Katong	KAT

Sent to CS Cable Retriever	Received from CS Cable Retriever	Sent to Shantou	Received from Shantou	Sent to Katong	Received from Katong
BAT/RETR/001	RETR/BAT/001	BAT/SHT/001	SHT/BAT/001	BAT/KAT/001	KAT/BAT/001
BAT/RETR/002	RETR/BAT/002	BAT/SHT/002	SHT/BAT/002	BAT/KAT/002	KAT/BAT/002
BAT/RETR/003	RETR/BAT/003	BAT/SHT/003	SHT/BAT/003	BAT/KAT/003	KAT/BAT/003
BAT/RETR/004	RETR/BAT/004	BAT/SHT/004	SHT/BAT/004	BAT/KAT/004	KAT/BAT/004
BAT/RETR/005	RETR/BAT/005	BAT/SHT/005	SHT/BAT/005	BAT/KAT/005	KAT/BAT/005
BAT/RETR/006	RETR/BAT/006	BAT/SHT/006	SHT/BAT/006	BAT/KAT/006	KAT/BAT/006
BAT/RETR/007	RETR/BAT/007	BAT/SHT/007	SHT/BAT/007	BAT/KAT/007	KAT/BAT/007
BAT/RETR/008	RETR/BAT/008	BAT/SHT/008	SHT/BAT/008	BAT/KAT/008	KAT/BAT/008
BAT/RETR/009	RETR/BAT/009	BAT/SHT/009	SHT/BAT/009	BAT/KAT/009	KAT/BAT/009
BAT/RETR/010	RETR/BAT/010	BAT/SHT/010	SHT/BAT/010	BAT/KAT/010	KAT/BAT/010

Figure 4 PSM tracking sheet for a cable repair involving vessel (RETR) and three terminals (BAT, SHT, KAT). The sheet is for the Batangas point of view where BAT/RET/001 signifies the sequential message number 1 from Batangas to Cable Ship Cable Retriever.

8 FURTHER WORK

Further developments, in the longer term, will see the invitation of customers to interact with Global Marine ships during exercises based on a repair scenario, whereby the ships and relevant terminal stations will perform Power Safety communication exercises during normal standby periods. These exercises, it is proposed, will follow the sequence of Power Safety Messaging between the respective locations that would be potentially involved with an actual cable repair on the system. The benefit will be to allow a check that the communication systems and procedures to be used during an actual cable repair are in place and effective. A perhaps greater benefit would be in the interaction between the respective Engineers, and the broader familiarisation that will result from such an exercise. Global Marine already undertakes this with one customer who is aware of the benefits to both shipboard staff and terminal station staff. These exercises have been termed Simulated Repair Exercises (SRE). It is recommended that such tools be considered for the benefit of working to the globally common objective of ensuring safe operations by operating to a globally accepted set of procedures. Global Marine's revised procedures have been implemented having had detailed Power Safety specific discussions with one respected customer and further broader discussions with other customers, accommodating their input. It is acknowledged that some organisations are already conversant with Power Safety procedures and at least one even includes a written section referring to Power Safety Issues within each repair method of procedure they generate, which clearly shows an advanced understanding of the relevance of this aspect of a cable operation. A global approach in the industry will enable all parties to be at a heightened level of awareness, also keeping in touch with developments in the training, development, operation and practise of Power Safety. A particular issue that will benefit from a wider discussion is that of 'working with light' on the fibres. Global Marine procedures give guidance on this issue and refer to the circumstances under which laser light could be present on the fibre, and the standpoint taken regarding whether work can be conducted in such a situation. A global approach will be beneficial to all cable ship and terminal station operators with the aim of working together to further reduce the risk of accidents occurring during work on submarine cable systems.

9 CONCLUSION

The paper has discussed the important elements of power safety procedures and how these have been revised and implemented following consultation with customers. The in house procedures accommodate the fact that they must be applied equally during cable operations in the different parts of the world that Global Marine operates, where there may be language barriers and time zone differences even within the same operation. The case is made for an industry wide approach to power safety procedures, concentrating on global acceptance of common objectives centred on responsibilities, written instructions and training. Dissemination of these responsibilities can help to underpin the principle that both shipboard Engineers and terminal station Engineers should be operating as a team, with responsible counterparts. Ultimately this will lead to improved performance and a safer working environment for all.

10 ACKNOWLEDGEMENTS

The authors would like to thank Guy Harding for subject review contribution.