EXTENDING THE USE OF IN SERVICE REPAIR TECHNOLOGY TO MOBILE AND LAND JOINTING CABLE OPERATIONS

Andrew Thomas
andrew.thomas@octl.org.uk
Ocean Cable Technologies Ltd., 3.4 Central Point, Kirpal Rd, Portsmouth, Hants, PO3 6FH, UK
Franck Tortey
Franck.Tortey@alcatel-lucent.fr
Alcatel Lucent, 536 Quai de la Loire, Calais, 62225, France

Abstract: For well over a decade the industry has benefited greatly from the introduction of various in- service repair technologies, installed on the global fleet of maintenance and installation vessels. However, as system architecture has evolved and the resulting installation programs have become ultimately more complex, the commercial advantages of utilising this technology in terrestrial locations, will by far outweigh those offered by its predecessor.

Over the last year Ocean Cable Technologies Ltd and Alcatel Lucent have worked jointly to overcome some unique engineering barriers, to introduce the industries first mobile in-service repair system (ISRSystem Mobile). The system has been engineered specifically for use in terrestrial and mobile locations.

Together with a discussion on the technical issues that have been resolved, this paper will look into the work undertaken by both organisations to implement the first system, the role that this new technology will provide and also the benefits offered to the system owner, system installer and maintenance provider alike.

1 INTRODUCTION

The need to provide in-service repair capability was clearly identified about 15 years ago, during the build and implementation of the first branch systems. In-service repair technology provides a safe working environment for both operator and the vessel, by protecting against a deactivated leg of a cable system potentially becoming live again during a repair operation.

Over this 15 year period various systems were developed offering a variety of benefits and advantages over each other. The latest system developed by the authors company, and used extensively throughout Alcatel's fleet, has taken the technology to the next level providing robust levels of safety and greatly improved jointing times.

By using in-service repair technology, the system maintenance provider has the ability to undertake cable repair operations, on a segment of a system while the remaining segments remain active. The in-service repair system protects against the de-powered segment suddenly becoming active again, should the branching unit inadvertently be switched back over for any reason. Clearly without this capability the entire cable system would need to be taken out of service prior to a repair operation commencing. With this in mind the commercial advantages are clear to be seen.

As cable system architecture has evolved the need to provide similar levels of technology was identified for less serviceable locations, such as land sections of a submarine cable system at the beach manhole or shallow areas only accessible by barge. However, once exposed, the need for such technology was soon realised for many different reasons other than for repair operations. For example, by having the same in-service repair technology available for beach jointing, the system installer would not be limited to stringent installation programs to install all segments in accordance with the in service deadline. Further more, should a landing permit be delayed, the associated segment of the cable system can be installed after the main trunk, and be spliced in at any time without the need to take the entire system out of service. It would also mean that the system could be completed without the need to deploy a cable vessel, saving on time and cost. As a result of this it was decided that the ISRSystem be utilised as the back bone of a new mobile technology for use in land jointing and mobile locations.

2 APPLICATION

At this juncture it is worthwhile clarifying one point. In-service repair technology is not designed for use on active cables. It is designed to protect the operator and vessel should a cable become live during a jointing operation. The system operates on the principle that at all times, the potentially live components of the cable are verifiably earthed throughout the entire jointing operation, where an operator could come into contact with that portion of cable. The system consists of a compliment of specialist tools and equipment for earthing the cable, and a series of specific procedures for all cable handling and jointing operations. Both tools/equipment and procedures are designed for, and used, in conjunction with industry standard jointing technologies.

Along side the equipment and procedures, there are a series of cable monitoring devices which alert the

operator to the presence of the electricity on the cable through both audible and visual alarms. Upon detection of current on the cable, the ship's personnel are required to immediately stand clear until the power is removed.

When introducing the ISRSystem Mobile the exact same principles of operation have been adopted. However, so that the technology can be used in remote and mobile locations, the system has been incorporated into a single unit containing all monitoring controls and alarms. The stand alone system is also self-powered. Additional alarm units are provided so that the perimeter of the site can be suitably managed. In addition to the above, the system is taken to earth through a unique series of pre-installed earthing points which can be verified ensuring that the system is entirely safe to use. These earthing points can be installed either directly into the surrounding terrain, or into nearby sea water, or a combination of both whichever is most appropriate and effective.

The resulting technology is both fully transportable and can be operated fully independent of its surrounding environment without the need for supplementary resources.

3 TECHNICAL REVIEW

By far the most important aspect of the ISRSystem Mobile is the safety of the operator. As previously mentioned the technology is used as a precaution against the cable system becoming live, and not for use on permanently live cables. However, irrespective of this point the ISRSystem Mobile must be designed as if it could be used on a permanently live cable as the safety criteria are identical.

While this paper informs the reader of the mobile in-service repair system it should be noted that the technical specification naturally parallels that of the ship board system. In respect of this the build of the ISRSystem Mobile is identical, in that both are derived from four constituent parts.

The first part of the technology is a mobile unit containing active current sensors and alarms. The alarm and sensor unit provides continuous monitoring for current on the cable throughout the entire cable operation. To account for regional variations, the system will activate upon the sudden presence of a current above 100mAmp or 250mAmp (selectable). The taylor-made switching unit is rated to 10kV (tested to 25kV for 1 minute), has passed 28kV impulse +/- 15 times and has been tested to 400A. The switching unit permits IR testing of the system and is capable of withstanding a BU failure when the switch is in the open or closed circuit condition. See Fig 1.

Fig 1

The second part of the technology includes earthing tools and equipment. Again designed specifically for this application the tools provide continuous earth protection to each power conductor within the cable. Tested up to 400A the simple to use tools provide effective and complete protection for the operator with ease of use in mind. See Fig 2.

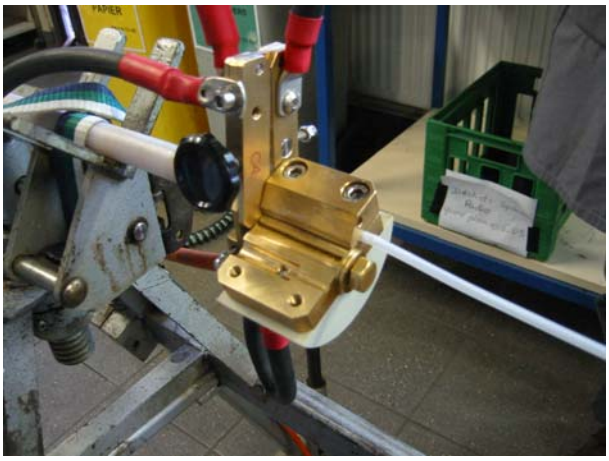

Fig 2

The third part of the technology are the procedures which are used in conjunction with the land joint procedures, and will in time cover nearly all current cable types in use. Those cable types not currently covered can be easily and quickly introduced as and when required. See Fig 3.

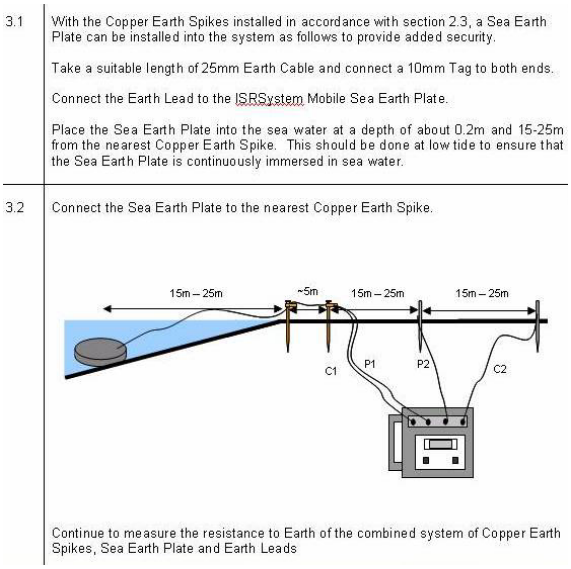

Fig 3

In order that the entire mobile system is developed and engineered to satisfy both safety and operational requirements, a structured approach to implementing the technology is utilised. Firstly the tools are developed to suit the cable sizes required. As part of the development process they are trialled for their ability to be handled. To complete the process they are then electrically tested to ensure their performance to take a given current, whilst maintaining acceptable low levels of resistance. The main sensing and alarm units are designed firstly with function in mind, and then re-engineered considering production requirements. Once the pre-production units have been completed the main sensing unit, which is required to take the full current, is subjected to a stand alone test to rate it to 10kV. Provisions are being made to increase this to 15kV. With the above process complete, the tools and sensing equipment are brought together, and in conjunction with the jointing procedures, are used for cable operation trials from which the procedures are drafted and subsequently produced.

No part of the technology is any more or any less important than the other. However, it is reasonable to say that in terms of providing the best levels of protection and safety, the technology can only operate as good as the earth that it is attached to. In the ship board environment this is easily achieved by connection to a permanent ship's earth. However, in a terrestrial location this is clearly not possible. To overcome this situation, the fourth part of the technology comprises of a specialised process which has been devised to provide a verifiable earthing point close to the operation site, and which provides the principle point of protection. See Fig 4.

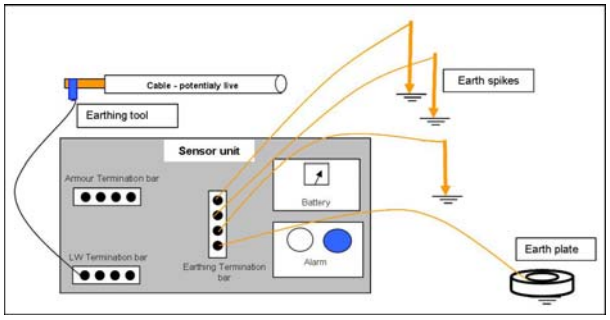

Fig 4

Unfortunately it is not possible to install an earth in the ground, or attach the technology to the earth point installed in the beach manhole, and assume that it provides sufficient protection. Any earth point must be tested and verified. This is done, by first surveying the area to ensure that the ground used is in the best possible position and provides suitable levels of resistivity. Following this the soil resistivity must be obtained. By doing this the operator is obtaining a bench mark from which the final earth can be measured and thus quantified. Only until an acceptable verified earth measurement is obtained can the operator proceed with the operation. For rocky areas the sea its self can be used by installing sea-earth plates to provide the earth. In this instance a measuring process similar to that used for soil installation is used to verify that a safe working condition has been achieved. In some circumstances a mixture of both techniques can be used.

4 BENEFITS

Used solely on branched repeatered submarine systems, the benefits provided remain consistent between both marine and land sections of the submarine cable system. By using the ISRSystem the operator has the ability to undertake cable operations without disruption to traffic on the main trunk. However, with the recent introduction of the mobile system the emphasis has been taken away from what has been for many years a cable maintenance tool, to one which is ultimately more beneficial to the modern day installation environment.

For example, the completion of the final splice of a branched submarine system can now take place on the beach, or within the land section of the system without impact to the remainder of the installation program. This factor seems particularly important when considering the varied constraints driven from timely securing of shore-landing permits.

With the above in mind it is now possible to install a point to point (A to B) system, together with strategically placed branching units which can be connected, as and when required without the need to interrupt the previously installed main trunk.

Building further on this strength, the mobile system will allow for a system manufacturer to install the first part of the system, whilst manufacture of the remaining

segments is still in progress. Subsequent legs can then be installed as and when available, thus reducing the overall time scale in system manufacture and implementation.

The land cable linking the beach manhole to the power feed equipment can often be damaged due to civil works, human intervention or on some occasions route change. With a more traditional application of the technology, the user will be able to undertake cable operations to beach joints and land sections of a submarine system, again without disturbing the entire network.

Finally, the use of the technology can still take on board another more traditional role. The use of the ISRSystem in the marine environment has been exclusive to large deep water cable vessels. With the new mobile technology it is now possible to equip small vessels of opportunity such as barges to undertake in-service repairs in shallow water locations.

5 FUTURE DEVELOPMENT

The ISRSystem Mobile has been designed and qualified for use at the beach joint or at the intermediate joint. For greater flexibility it is intended to extend its application to the installation of the shore end onto the beach. This shall include installation via duct or trench and provide protection to those handling the cable during this operation. In the meantime, the shore end installation program can be adjusted in such a way that the cable can be laid from the beach manhole to the sea, before connection to the system using normal ship board ISRSystem techniques. Under these conditions the Mobile system would be used for shore end jointing at the beach manhole.

At present the ISRSystem Mobile technology has been developed and qualified for use with ASN OALC-4 LW and LWP cables, in conjunction with the Alcatel Lucent beach joint (PEL). However, the next stages of development will undoubtedly involve extending its adaptation to other cables according to their qualification with the beach joint technology. This will include Single Armour and Double Armour variants.

The design and qualification process can be undertaken on a case by case basis and according to market demand. Further more, the ISRSystem Mobile can also be qualified for other beach joint technologies as and when required.

Although only recently introduced, it is expected that the ISRSystem Mobile will follow the anticipated evolution of the next generation of submarine system. With this in mind plans are already underway to increase the systems capacity to deal with line voltages of up to 15kV.

6 CONCLUSION

“In-service repair” is a term commonly recognised with marine cable maintenance and repair operations. However, as this paper highlights the knowledge and experience gained throughout the years, has meant that this critical technology can, and has been, re-engineered to provide significant advantages to the whole life scenario of a cable system.

Through working together, Ocean Cable Technologies Ltd and Alcatel Lucent have introduced new technology which will simplify the process of new system planning, manufacture and implementation, add flexibility in gaining shore-landing permits, provide greater ship flexibility and extend the boundaries of system architecture and expansion programs.