According to the copper cable theft barometer of the South African Chamber of Commerce and Industry (SACCI), copper to the total value of R259 M was stolen in 2010 with the impact on the economy estimated at R5 billion per year. Proof of ownership has been a big hurdle in securing convictions of cable thieves. To deal with this challenge and reduce cable theft, CBi-electric: African cables has embarked on an innovative approach to identifying cables. Since January 2010, more than 10 million cable core metres have been successfully marked using CBiD.

The cost of direct theft is now monitored by the SACCI through their Copper Theft Barometer [1], indicated in Figure 1. To assist in this fight against crime, CBi-electric: African cables has been inserting CBiD tape into their cables since January 2010. This innovative solution has evolved through consideration of many alternative options, each having its pros and cons.

The scales in Figure 2 are considered to be radial. Closer to the centre of the circle indicates that the attribute is more favourably met. To avoid any fuzzy logic, a limit of acceptability can be set, which is indicated by the coloured circles. Each solution with regard to each attribute can then be plotted for the following analysis:

**Cost**
This is always a factor. The cheaper the solution, the easier it is to get it generally accepted. This has a direct impact on the probability of prosecution.

**Difficulty of removal**
This speaks for itself. The closer to the cables conductor, the more difficult it is to remove.

**Availability**
Whatever solution is chosen, it must not impact on cable production or processes. It needs to be available without delay (eg long delivery components or in-line printing).

**Risk of process errors**
Many traditional security solutions fail short here. A cables conductor is produced in long lengths but the final cable is sold in much shorter lengths. For example, 3 600 m of 95 mm² copper conductor may find its way to 12 different customers each buying a 300 m length of cable on a standard drum. Putting a customer specific identification on the conductor would be a logistical nightmare to ensure that a specific 300 m of conductor only ever went to that customer. Furthermore, typographical errors need to be avoided.

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**Cable identification and evaluation criteria**

Several options are available for asset identification, and amongst these, the following can be applied to power cables:
- Embossing
- Embedded printed tapes
- Etched wires
- Microdot marking
- DNA trace marking

In order to arrive at a most favourable option, four basic attributes can be considered for each available solution as indicated in Figure 2. In evaluating a solution, each attribute is adjudicated and assigned an appropriate value.

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*Electric cable theft is a scourge that is costing the South African economy billions of rand each year. As a consequence of cable theft, many consumers experience power interruptions or are left without power for several hours when utilities have to replace stolen sections of the circuit. CBiD is the solution!*
Combining the four attributes in a 'Venn diagramme' (see Figure 3), the relative merits of each solution can be determined. The overlapping areas indicate shared attributes. For example, an etched wire is expensive, very difficult to remove, not readily available and has a high risk of process error. If it became more readily available it would move into the ‘Removal + Availability’ region. Embossing on the sheath shares three of the four favoured attributes, but is easy to remove and falls outside the ‘Difficult to remove’ region. Although DNA trace and Microdot have higher cost with a high risk of process errors, they are difficult to detect and remove. It is apparent then that the most ideal solution is that which shares all the favoured attributes, and in this case, it is the embedded tape option.

CBiD solution

The embedded tape option being the most favourable was explored further by CBi-electric: African cables. To arrive at an innovative and effective solution, a continuous length of embedded tape containing a printed sequence of unique identification (ID) numbers was created for embedding into the conductor of each cable. Each 150 mm of conductor within a cable contains a unique CBiD number as indicated in the example in Figure 5.

The CBiD numbers change in a known sequence along the cable length allowing intermediate numbers to be predicted from any two exposed numbers. The printed barcode facilitates a scanning process and reduces the risk of typographical errors. These identification numbers are scanned and associated with the customer details just prior to despatch from the factory. The large size allows for reading with the unaided eye. Since there are no specific external identifiers, manufactured stock is available to any customer.

Through the CBiD number system design, the owner of the core can be discerned through any two partial numbers from the same core. Furthermore, each core is uniquely identified through this process thus any core can be associated to its original cable. The appropriate records are stored off site at a reliable and secure data management centre. For this purpose, CBi-electric: African cables has engaged an appropriate Service Provider which is fully endorsed by the Business Against Crime, South African Police Service, Interpol and the Insurance industry.

Probability of conviction

In reality, there is no risk-free solution. An ‘all bells and whistles - very expensive’ solution applied to a small volume of cable is only effective if that specific cable is stolen. An ‘easy to remove’ solution is only effective if the cable is found before it has been stripped. The optimum solution is therefore to place a ‘difficult to remove’ in as much product as practical. This is demonstrated in Figure 4 below.
The database is populated with the details of every drum of cable sold. The data includes: the manufacturer; drum number; serial numbers of each core; product description; date manufactured and of course the product owner. Cable owners are therefore able to build their own database of cable product and their allocation to specific projects. On finding a piece of cable, the CBiD numbers in one or more cores can therefore be checked against the database to establish the original owner and access more information.

Performance tests

CBiD tape with its relatively high melting temperature is suitable for embedding into the conductor and will not disintegrate during cable manufacturing. It will also withstand temperatures generated at rated conductor operating temperatures or even at rated short circuit conductor temperatures. It also does not affect the electrical or mechanical properties of the conductor.

Although CBiD readily burns when in the open air, when embedded inside the conductor, it is starved of oxygen and thus does not burn or melt easily. Tests conducted on a piece of cable subjected to conditions simulating a field fire, verified that the CBiD tape was still legible as indicated in Figure 6.

Figure 6: Cable sample stripped after a field fire – CBiD tape still intact within the conductor and legible for identification.

Despite the good fire performance, it must also be emphasised that the Second Hand Goods Act [2] now makes it an offence for any person to possess burnt cable which could result in a conviction of up to 10 years imprisonment.

Conclusion

After years of development, CBI-electric: African cables is proud to be the leader in the field of cable identification and theft reduction. Since January 2010, more than 10 million cable core metres have been successfully marked using an innovative solution called CBiD.

CBiD tape embedded in cable conductors is certainly an initiative that allows for four potential prosecution options:

- Possession of stolen goods: rightful owner can be identified with certainty.
- A piece of stolen cable can be related to a specific crime scene.
- The Second Hand Goods Act [2], Clause 21(1)(b) requires a dealer to keep a record of serial numbers.
- Clause 22(1)(c) requires the dealer to report any attempt made to damage the marking. Melted tape remains as evidence.

There is no doubt that once the implementation of CBiD becomes more widespread and more legal action is taken against the perpetrators, a significant reduction in cable and copper theft, as reflected on SACCI’s Copper Theft Barometer, can be expected.

References


About the author

Kieron Leeburn is currently employed as chief engineer at CBI-electric: African Cables. He is a registered professional engineer and has 25 years experience in the cable industry. He is also the chairman of the Association of Electric Cable Manufacturers in South Africa, and has technical representation on SABS TC66, Cigre and IEC. Enquiries: Kieron Leeburn. Tel. 016 430 6165 or email kieron.leeburn@cbi-electric.com.