

# Equipment theft mitigation

## The Eskom experience



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### 1 Synopsis

Eskom experienced conductor theft since the late 1980's. The mitigation strategy followed up to 1994 was to replace copper conductor with aluminium conductor, which paid off until the recent increase in the price of aluminium. Eskom therefore had to review its strategy since the incidents increased significantly in the last 3 years.

This paper describes the strategy followed by Eskom to address the scrap market, apprehend the conductor thief and to apply technology to secure its assets. Eskom was extremely successful in that theft levels have now dropped to pre-2001 levels.

The first part paper of the paper tries to quantify the problem and examine the market structure and operation of syndicates in this market. Secondly, Eskom's strategy is discussed in detail and success stories are shared. The application of the technology of alarm systems and security systems are discussed. Finally, an industry approach to the problem is proposed.

### 2 Introduction

An analysis of the scrap market (Figure 1) reveals the fact that conductor theft is in essence driven by a need created by market forces, such as the demand for aluminium in today's industrial world. An electrical conductor contains 99.5% pure aluminium with several uses in the manufacturing of Aluminium alloys and as a de-oxidizing agent in the steel industry. Any strategy to combat conductor theft can therefore only be successful if the whole market is addressed in the strategy.

Research revealed the following contributing factors to theft of non-ferrous metals:

- Sosio-economic problem of increasing numbers of unemployed people;
- Increasing numbers of illegal immigrants becoming involved in thefts;
- Involvement of organised groups/syndicates in the thefts;
- Increasing demand for copper and aluminium locally and internationally;
- Insufficient control/legislation regarding processing, sale, import or export of non ferrous metals;
- Low risk involved in accessing some of the networks (low voltage); and
- Accessibility to networks.

The most important contributing factor has been identified as perpetrators having a readily available scrap market to sell stolen material, which is routed through various ways back into the chain of processing, manufacturing and supply. Evidence was also gathered that large amounts of stolen material are exported to markets abroad.

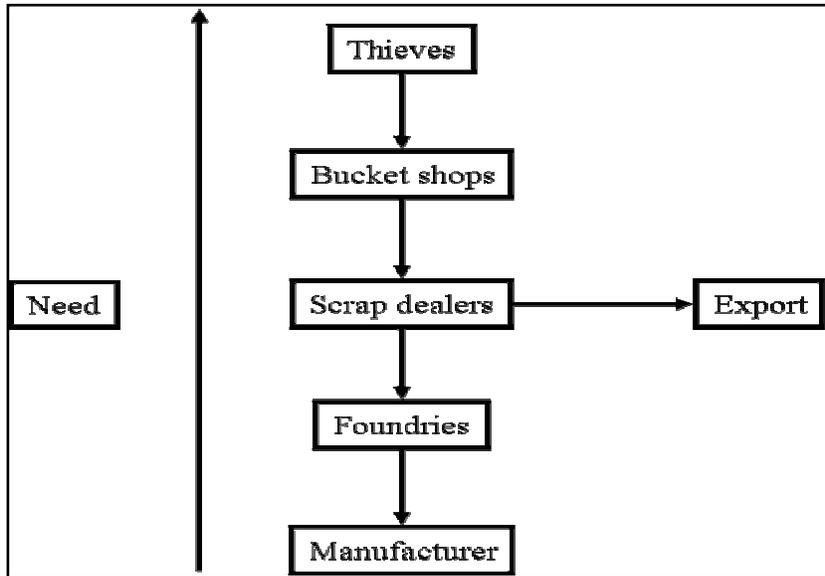


Figure 1. Scrap market structure

In the early 1990's, Eskom experienced an upsurge in conductor theft, but the crime was perceived as copper related. The main thrust of Eskom's theft prevention was thus aimed at removing copper from Eskom's network, with little attention paid to the wider market. Initial results proved this a successful strategy and incidents decline until 2000. At this stage, the price of aluminium increased to exceed the value of copper for equal weights. Conductor thieves changed their focus and a 200% increase in conductor thief was experienced. See Figure 2.

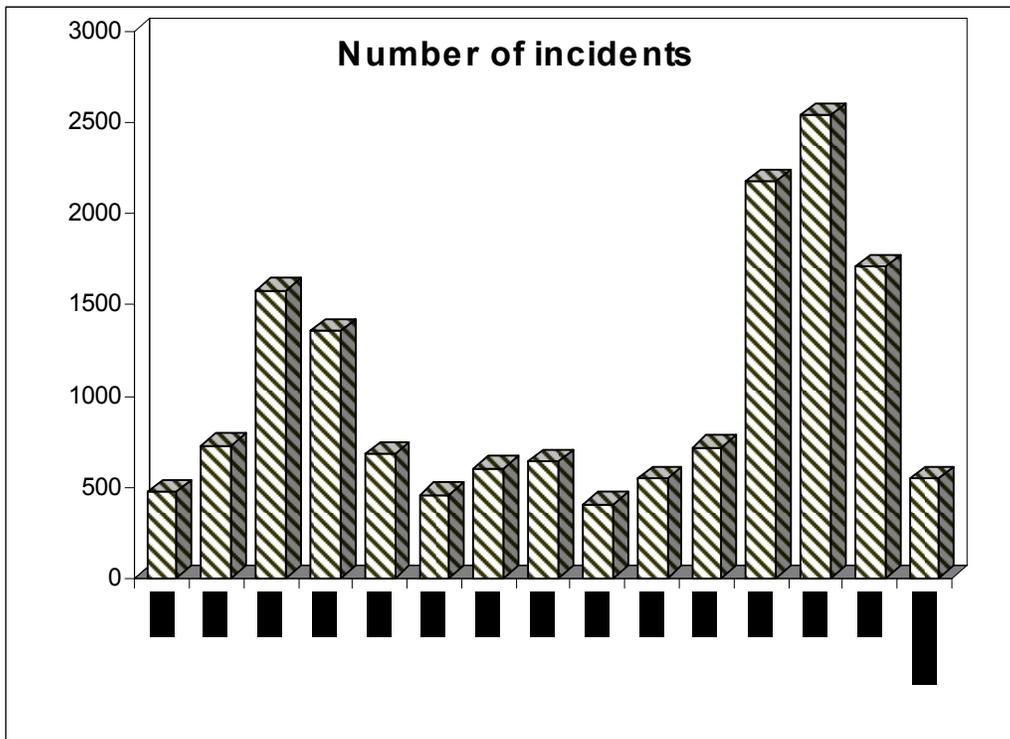


Figure 2. Conductor theft incidents

It must be realised that conductor theft is in essence a criminal activity, mainly performed by syndicates in the scrap market. Eskom's current strategy is therefore a crime fighting and prevention strategy. This approach has proven successful as demonstrated in Figure 2.

### 3 Analysis of the problem

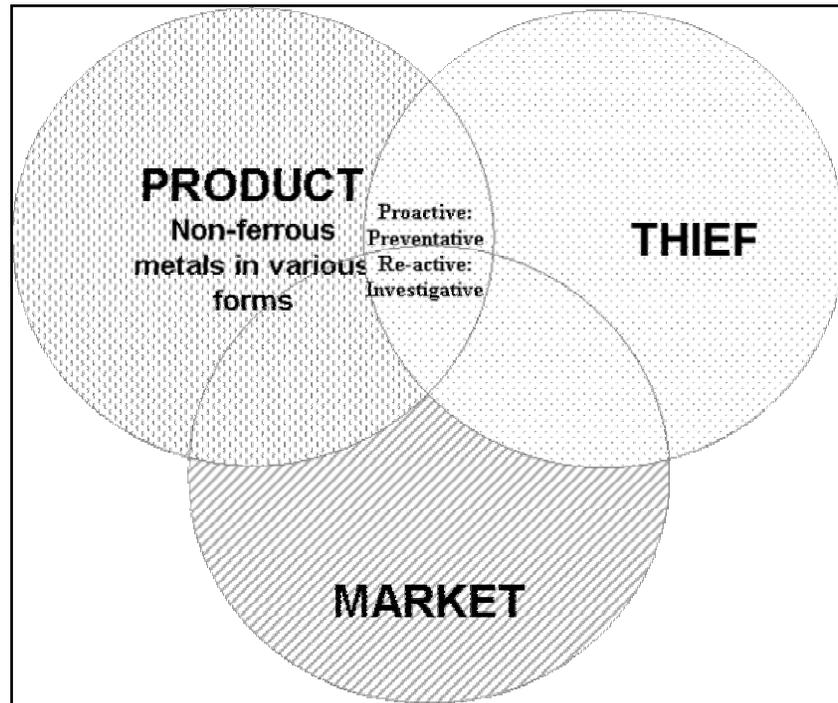


Figure 3. Strategy elements

Eskom experience led to the realization that three critical elements need to be addressed to minimise lost of assets. These elements relates to firstly the thief, secondly the product and finally the market. Research into each of these elements revealed the following interesting facts:

- The thief
  - Large numbers.
  - Steal for survival.
  - Minimum risk – lines in remote areas.
  - 94% unorganised – responsible for 40% losses.
  - 6% organised syndicates responsible for 60% losses.
- The product
  - Overhead lines/underground cables/earthing.
  - 11 to 88 kV overhead lines mostly targeted.
  - 60% Copper 40% Aluminium (history).
  - 30% Copper 70% Aluminium (current)
- The market
  - +/- 4500 “bucket shops”
  - Regulated by the Second-hand Goods Act

## 4 The strategy

Eskom developed a strategy to combat conductor theft. The crime prevention strategy relies upon intelligence gathering and research to ensure effective policing and related processes. Eskom also ensures that the full criminal justice process is followed, often with support to local prosecutors and police.

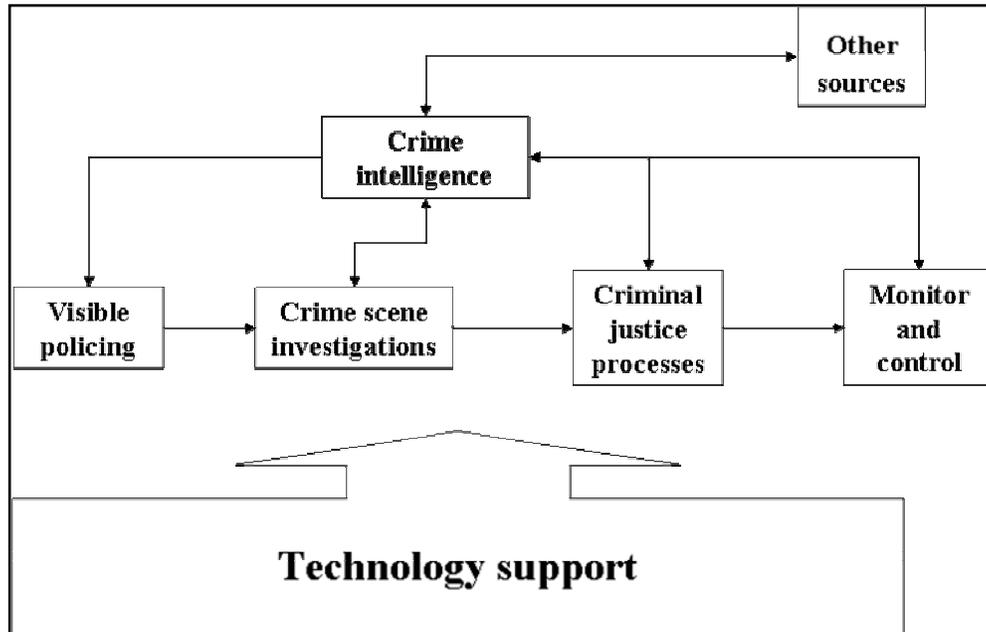


Figure 4. Eskom Conductor theft strategy

The Eskom conductor theft strategy (see Figure 4) consists of the following elements:

- Visible policing
  - Line patrol (security related)
  - Observation
  - Arrests
- Crime scene investigations
  - Information gathering
  - Criminal/Syndicate profile
- Criminal justice process
  - Bail
  - Evidence and witnesses
  - Support to prosecution
- Monitor and control
  - Follow up after release
- Crime intelligence
  - Market research and analysis
  - Database and incident recording system
  - Informants
- Technology
  - Enabler
  - Conductor marking
  - Alarms

- Camera equipment
- Alternative materials

## 5 Industry Co-operation

Industry-wide co-operation has been established by all role players. The Non-ferrous theft combating committee (NFTCC) is an integrated body of key role-players that provides strategic guidance and direction for the process of prevention and eradication of theft of non-ferrous metal so that quality of supply of strategic services can be ensured to the benefit of all the people in

South Africa Role-players currently represented on the national committee are as follows:

- ESKOM
- TELKOM
- TRANSNET (Including SPOORNET and METRORAIL)
- Chamber of Mines representing several mine groups
- Recycling Industry
- Manufacturing Industry
- City Power Johannesburg, several metros and municipalities.
- SA Police Services
- Department of Justice (including the Nation Prosecuting Authority and Directorate of Special Operations)
- Department of Trade and Industry
- Customs & Excise
- SARS
- Business Against Crime

The NFTCC's strategic direction is set below:

- Establishment of effective management information systems
  - Database
  - Intelligence cycle
- Effective co-operation and commitment
  - Policing of hot spots +
  - Joint operations +
- Standardised interpretation and application of relevant legislation
  - Common understanding
  - Standardised application
  - Enforcement
- Establishment and coordination of formal regional structures
  - Regional committees & standardised agenda
  - Monthly reporting
- Effective marketing and communication (internal / external) initiatives
  - Strategic partnership with key stakeholders
  - Newsletter
  - Awareness campaign

## 6 Technology as an enabler

### 6.1 Material

Eskom's unique conductor marking scheme assisted at numerous court cases to establish ownership of material. Scrap conductor, generated by Eskom, is disposed of in a controlled

manner. Eskom appointed a sole supplier agreement to ensure that no illegal conductor can enter the market. Similar approaches is used by Transnet.

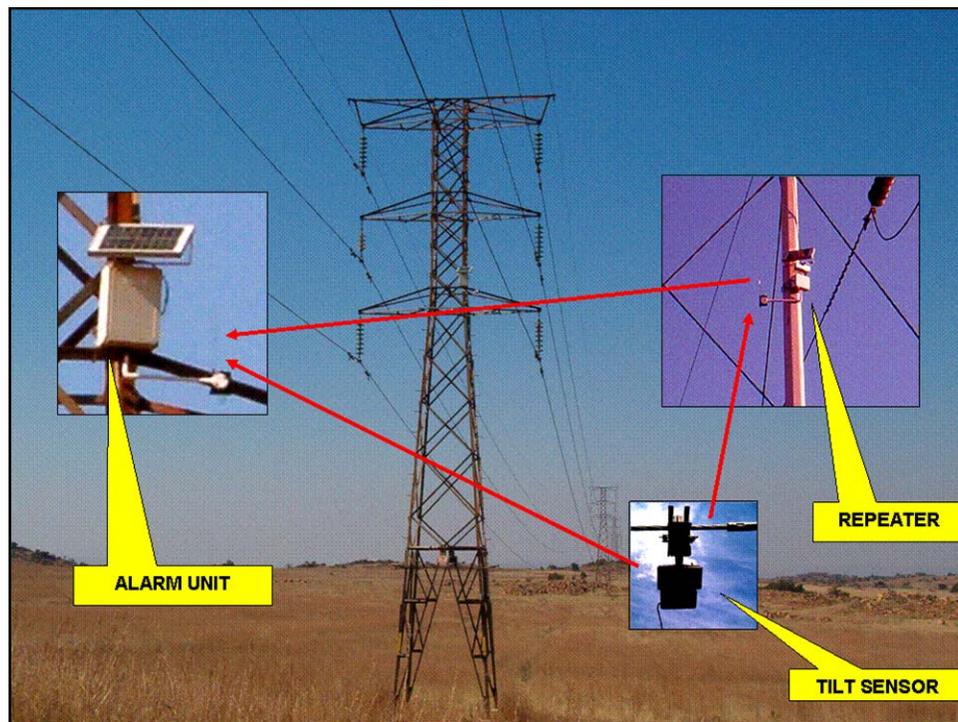
Conductor doping, currently being researched, provide for opportunities to contaminate aluminium to render it worthless to the scrap market.

## 6.2 Substation technologies

The purpose of applied technology in a substation environment is to improve access control, monitor intruder and Eskom staff movements and to initiate rapid deployment of security staff. The fact that a substation environment is well a defined and controlled environment lead to effective deployment of modern infra-read monitors, security fences and alarm systems. A system of grading of substations in terms of risk has been developed and is deployed through out Eskom.

Earthing of structures and equipment is done through the structures' steel and via copper conductor in the concrete plinth.

## 6.3 Line technologies



**Figure 5. Eskom designed line alarm**

Line alarm technology, as developed by Eskom is shown in Figure 5. Detection of a conductor theft event takes place through a mechanical tilt sensor, which relays information to the alarm unit. Radio or GPRS (cell phone-based) communication provides for feedback to a control room and security staff. The concept has been tested throughout Gauteng and major successes in arresting thieves have been achieved.

Future improvements of this unit involve the miniaturization of the unit. These mobile units will be applied by a single operator under live-line conditions.

## **6.4 What does not work!**

During 2003 Eskom deployed a high definition camera on an 88 kV line to monitor and identify potential conductor thieves. One of the criteria used to procure this camera cost, since it was foreseen that successful implementation would lead to the purchase of more such units. Although the camera worked perfectly during daylight hours, it failed to produce any meaningful images after sunset. The digital camera technology used consists of near infrared, which has severe limitations in darkness. It was also found that background lighting, such as cars driving by, easily saturated the CCD sensor of the digital camera. Alternative technologies are very expensive and were not deemed to be cost beneficial as an Eskom application.

## **7 Conclusion – the road ahead**

Conductor theft has been targeted as a key strategic issue by all role players. This has led to a major reduction in the number of incidents but the problem has by no means been eradicated. It is therefore important that organizations remains vigilant and current projects must be resourced and funded to ensure success in this area. Future improvements in the second-hand goods act will also go long way to improve society's ability to reduce this crime to acceptable levels.

Affordability of technology plays a major role in selecting solutions. Military technology is becoming more available although the cost of such systems is still prohibitive. Satellite surveillance, Infrared cameras, tracking and GPS devices all have promises of enhancing current security operations. The successful partnership between the security and technology communities need to be fully explored to determine priorities for development and to obtain the funds for future projects.

## **8 Acknowledgements**

Mr. Leon van den Berg, Senior Advisor (Forensic investigations) and Manager of Eskom's Conductor theft unit.

## **9 References**

The following Eskom documents have relevance:

- DISASADJ6rev0: Standard For Security Requirements At Distribution Substations
- SCSSCAAR4rev0: Specification For Non-Lethal Electrified Fence Structure And Associated Equipment For Distribution Sites.
- DISSCABM6rev0: Specification For Cctv Surveillance Systems At Distribution Substations
- DISSCABL1rev0: Specification For Intruder Alarm Systems Used At Distribution Substation
- DISSCABL2rev0: Specification For Security Fences At Distribution Substations
- DISSCABK9rev0: Specification For Electronic Access Control At Distribution Substations
- DISSCABK1rev0: Specification For Infrared Detectors Used At Distribution Substations
- DISSCABM7rev0: Specification For Overhead Conductor Alarm Systems Used On Distribution Lines