Summary of Lessons Learned to Date from Trial Deployment of HPEM Detectors

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***Abstract*—** The Totem® detector developed by QinetiQ Ltd. has now been deployed on a trial basis by several different organizations worldwide.
The detector has been devised and developed to detect High Power Electromagnetic (HPEM) environments that may pose a threat to mission critical electronics, and is specifically designed for ground based critical infrastructure settings.
This paper describes the features of the Totem® detector and summarizes some observations and lessons learned from trial deployments.

I. INTRODUCTION

The Totem® detector provides prompt detection of radiated transient E-fields that could pose a threat to the function of electronic systems [1]. The detector has a novel broadband spiral antenna and uses a logarithmic receiver [2]. The detector has on-board flash memory for storing event data, an integral uninterruptable power supply, fiber-optic connections for event data transmission and can be configured to interface with a 24/7 web service. A photograph of the TOTEM detector is shown in Figure 1.

Figure 1. TOTEM detector, Courtesy of QinetiQ Ltd.

II. FEATURES

The characteristics of this detection system are as follows:

- Frequency Range: 10 MHz to 10 GHz
- Instantaneous bandwidth: ~ 100 MHz – proven to detect Hyperband environments (200 ps pulse width)
- GPS/GNSS interference detection
- Event Log: EM protected event logger recording event time, date and magnitude – approx. 1e^6 event records
- Includes integrated battery backup in the event of power outage in normal operating conditions
- Fiber-optic ports for data transmission

EM detection is a vital component for efficient, effective and timely recovery of a system function, if a Resilience approach to EM threat mitigation is used [3].
The primary use and benefits of detection of man-made HPEM is to aid efficient and timely recovery and provide condition monitoring/data intelligence. Such data can be used to identify the prevalence of radiated EM threats and guide the adoption of cost-effective protection. The installation of detectors also serves to raise awareness of the plausible existence of the threat to system operators.

II. RESULTS

Figure 2 shows data gathered from deployment of the Totem® detector at a High Voltage (HV) electrical sub-station site in Scandinavia.

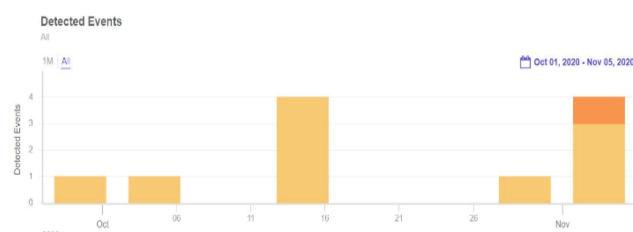

Figure 3. Event data from a Scandinavian HV sub-station

After some analysis and comparisons with data from substation switching logs it was identified that the recorded events correlated perfectly (within 1 second) with a particular circuit breaker switching (closing). No malicious events were detected during the 9 month trial and all events were correlated to the radiated fields from the circuit breaker. Interestingly, the events on the right hand side of figure were quite severe in magnitude, yet no malfunction of equipment at the substation was reported.
We will explain and provide further examples in our presentation.

REFERENCES

[1] D. Herke, L. Chatt, B. Petit and R. Hoad 'Lessons Learnt From IEMI Detector Deployments', EUROEM 2016, Imperial College, London, UK, July 2016

[2] Hoad R., Herke, D. L., 'Electromagnetic Interference Indicator and Related Method', International Patent Publication Number: WO17/125465 A1, filing date 19 January 2017

[3] IEC 61000-5-6 Ed. 2.0: Electromagnetic compatibility (EMC) – Part 5-6: Installation and mitigation guidelines – Mitigation of external EM influences (in development)