

Ensuring resilience in air force base infrastructure

By Paul Currie, director, MPE Ltd



The resilience of power systems against interruption or damage caused by hostile electromagnetic interference (EMI) and electromagnetic pulse (EMP) threats is nowhere more important than in critical defence infrastructure such as air force bases.

High-performance protection filters with high reliability address the demands for resilience – as well as compliance with exacting military standards – and have become mandatory in the interests of national security.

High performance means the achievement of high insertion losses across the full frequency

spectrum. MPE's power line filters provide very high insertion loss performance (dB against frequency in Hz) across the full frequency spectrum from Very Low Frequency (VLF) to Super High Frequency (SHF). Hence their performance in protecting against electrical noise well exceeds the industry benchmarks for say mains supply applications, which can be as high as 100dB in a frequency range across 10kHz to 10GHz.

There has always been a need to ensure effective electromagnetic compatibility (EMC) between disparate systems co-located in an environment congested with equipment, but more recently concerns about resilience have risen to the top of the agenda. In most applications, systems must now be available 24 hours a day, seven days a week and operate safely and securely without any interruption in service due to interference.

Among USAF sites for which MPE has provided its Mil-Std-188-125 HEMP protection filters in recent years in the context of ICBM missile defence have been the northernmost base of the US Air Force – the Thule Airforce Base (AFB) on the north-west coast of Greenland



The Mantis battery-electric towing traverser from Curtiss-Wright Defense Solutions

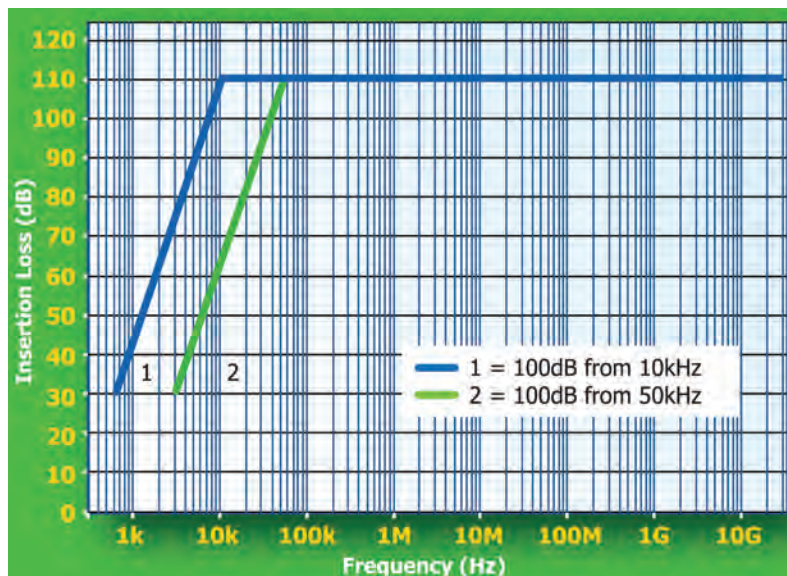
– for its Ballistic Missile Early Warning System (BMEWS) and the Clear AFB in Denali Borough, Alaska. HEMP is the pulse generated by a high-altitude, nuclear type detonation, or from natural phenomena such as geomagnetically induced currents (GICs) from solar storms.

In 2016 the US Army Corps of Engineers (USACE) Engineering and Support Center in Huntsville, Alabama awarded Serco, Inc a five-year, \$38 million contract to upgrade and modernise HEMP protection for Thule AFB's BMEWS system. As part of this



1200A MPE HEMP filter

Array of high-performance power line filters from MPE



The relationship of insertion loss (dB) to frequency (Hz), an essential criterion of filter performance

contract award, following extensive design work MPE was engaged to supply a suite of HEMP filters compliant with Mil-Std-188-125 and all the specified site requirements. The filters were successfully tested by specialist test house Jaxon, Inc of Colorado Springs, USA, in late 2018.

In the application in Alaska, the high-performance HEMP solutions supplied by MPE are being used to harden the site's power plant, referred to as "Special Protection Measures". The primary power brought into the power plant is conducted back out of the shielded volume to power chillers, heating systems and site-wide power requirements.

These MPE protection filters, installed by systems integrator ATEC Shielding LLC of Elkridge, Maryland, were of modular



USAF Clear Airforce Base (AFB), Denali Borough, Alaska

construction and included both two-line and four-line variants, ranging from 32A through to 400A current ratings. Requirements included compliance not only with the present Mil-Std-188-125 but also with UL1283.

Additionally, compliance with the USACE filter test specification as well as the US Department of Defence (DoD) Unified Facilities Guide Specification (UFGS) was called for, requiring additional testing in the USA. Furthermore, the MPE filters had to be independently evaluated and rated for seismic survivability.

A quite different application in air force infrastructure is the towing traverser for warplanes. The Mantis is a battery-electric towing traverser from Curtiss-Wright Defense Solutions, designed specifically for the deck and ground handling of military helicopters and fighter aircraft, especially low ground clearance aircraft such as the Lynx Mark 8 and also the Merlin, Harrier and Apache.

The Mantis provides the capability to manoeuvre helicopters and fixed wing aircraft within the confines of a hangar, flight deck or ground apron. The device has the ability to drive in four directions and spin on the spot around the tow point.

Typically, the Mantis cradles the nose wheel of warplanes on an aircraft carrier and thereby facilitates their multi-axis movement into position above and below deck. Offering fast, precise control from an umbilically connected operator chest pack, the Mantis fits wholly within the aircraft footprint to permit high-precision, high parking densities and make the best use of valuable parking space.

So, the critical protection for the power compartment of the Mantis against electrical noise is currently provided by MPE's filters. They were manufactured and circuit-tested during the design and prototyping process to the applicable military standards. Mechanically the pre-compliance testing work also highlighted the very tight space constraints for the installation. The custom unit produced by MPE is a six-line, 7A 28V, DC filter based upon MPE's established range of military vehicle equipment filters.

EMC and EMP protection technology from MPE is keeping pace with the latest developments, as defence systems and assets evolve with increasing rapidity in the 21st century. As drivers of technological innovation, considerations of national defence are on a different level altogether to the pressures of commercial competition.

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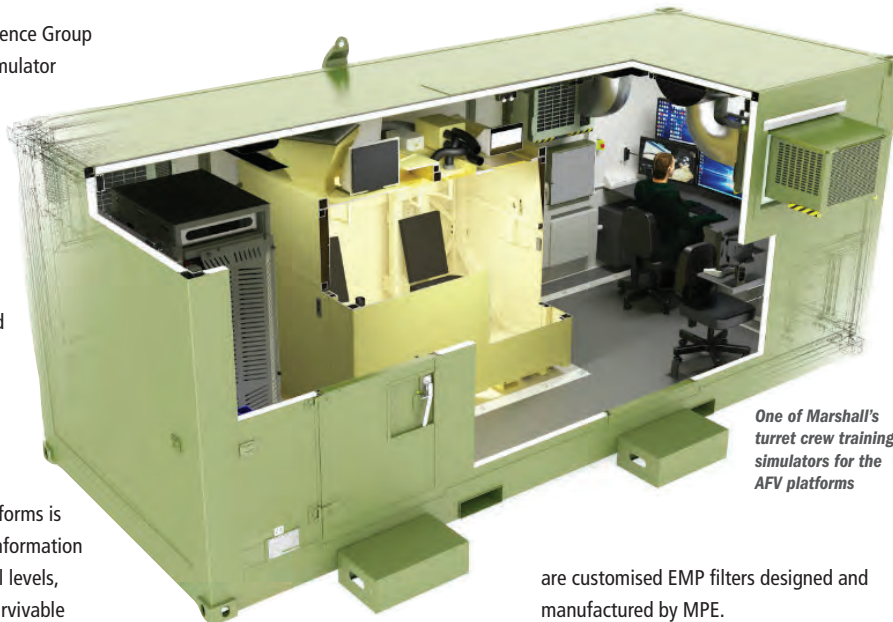
Filters for UK MoD turret crew training simulator

The Marshall Aerospace and Defence Group was chosen to supply 25 new simulator shelters to Lockheed Martin for use by the UK MoD and specifically the British Army.

The simulators facilitate the training of turret crews on the British Army's new multi-role family of medium armoured fighting vehicles (AFVs) designed to be the medium weight core of the British Army's deployable Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR) capability.

The primary role of these platforms is to provide accurate and timely information to support decision-making at all levels, providing commanders with a survivable and capable Ground Mounted Manned Reconnaissance (GMMR) platform, which gives them the flexibility to perform a range of roles across the spectrum of conflict.

This is in support of a contract received by Lockheed Martin from General Dynamics Land Systems-UK, who are responsible for delivery of the simulator capability and service contract to the UK Ministry of Defence.



One of Marshall's turret crew training simulators for the AFV platforms

There are three variants of the training simulator:

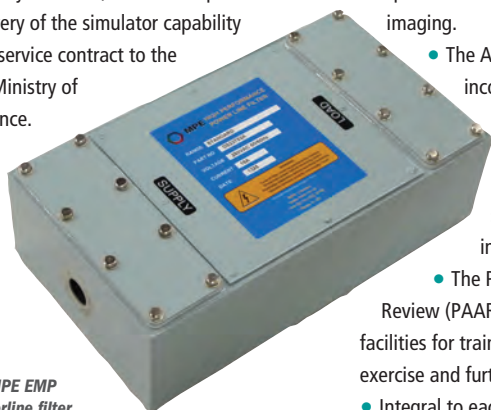
- The Crew Turret Trainer (CTT), which provides a high-fidelity replica of the turret, complete with controls and high-definition imaging.
- The Appended Trainer (AT), which incorporates a full computing facility, generating the imagery for injection into an actual turret and giving students the ability to train inside their own vehicle.
- The Performance After Action Review (PAAR) module, which provides facilities for trainers to completely re-run the exercise and further develop students' skills.
- Integral to each simulator shelter variant

are customised EMP filters designed and manufactured by MPE.

Following extensive engagement and testing with Marshall during the design stage, MPE developed two 63A three-phase custom filters. These custom filters are designed to ensure EMP integrity and protection for each simulator shelter.

Marshall delivered the first batch of shelters, used to prove the system capability, and MPE manufactured and supplied 26 custom filters to support this.

The follow-on units were delivered over the next 12 months, giving the British Army the freedom to move them to wherever they were required, rather than having to bring troops to fixed locations. MPE manufactured filters throughout this period to support this delivery phase. This is the second contract that Marshall has won for training systems, having also been selected to provide cabins for the driver training simulators.



An MPE EMP powerline filter