Partial Review and Independent EMP Test Results of IAN, LLC Equipment

Performed by SARA, Inc.
Scientific Applications and Research Associates 4680 Edison Ave. Suite A Colorado Springs, CO 80915

1. BACKGROUND AND SUMMARY

"This document is the Test Report for the MIL-STD- 188-125-2 Acceptance Testing and simulated Verification of the EMP POD and EMP RV to Units One at Arundel Metal Products located in Glen Burnie, MD. (U) MIL-STD-188-125-2 Appendix A stipulates the test protocols for performing SE tests of mobile systems Appendix B stipulates the test protocols for performing PCI tests.

The two Units tested were designed by Instant Access Networks, LLC (IAN) and is the subject matter of two pending US and International patents of Charles Manto. The project was partially funded by Maryland Technology Development Corporation (TEDCO) and the University of Maryland MIPS grant program. EMP RV and EMP POD are preliminary names for both Units and do not reflect the actual name under patent. IAN is developing commercial-off-the-shelf (COTS) solutions that can protect mission-critical facilities and infrastructure from electromagnetic interference (EMI) by sources that range from severe solar storms and high-altitude nuclear explosions to directed energy weapons.

These solutions include shielded rooms that can be inserted into ISO standard cargo containers and cargo trailers. IAN also plans to provide electromagnetic pulse (EMP)-protected renewable energy systems to support these modules so that mission-critical systems may be eligible for carbon credits and may be able to function even though power from regional electric grids becomes unavailable. For these reasons, IAN is attempting to create product that would meet or exceed the most stringent military specifications that would be as much as 70% lighter in weight than traditional military systems and less expensive than custom-built systems. By being lighter in weight, IAN modular systems would be far more capable of being mobile or placed on or in existing buildings for retrofit purposes. By creating products that could be mass-produced and rapidly deployed, IAN believes that it can help protect the most civilian critical infrastructure in the shortest period of time.

This first set of tests has been designed to evaluate the first layer of a two-layer system that IAN plans to deploy. By demonstrating that it exceeded military specifications with its first layer, IAN finished a second layer EM barrier that also included EMP-protected connections to commercial power. The second test showed the final shielded value of each Unit and also a complete simulated verification test (Final qualification test) to demonstrate that the current IAN configurations could be used to protect against HEMP related events and continue to provide time critical and urgent missions without interruption (either mobile or transportable). This is important since power lines can conduct a disruptive or damaging pulse to equipment connected to it unless that equipment is protected from those conducted pulses. In addition to these standard tests, SARA also conducted additional pulse tests on a solar panel and wind turbine that IAN had protected. Those results are in a separate addendum of this report.

The mobile unit is light enough to be driven by drivers with ordinary driver's licenses since the combined gross vehicle weight of the trailer and GMC pick-up truck is less than 26,000 pounds. This first mobile unit also includes living quarters so that field personnel could work, eat, sleep and wash within the unit making it possible to be field deployed without the pick-up truck portion for extended

periods of time. This makes the EMP-protected Resilient Emergency Management Operations Transportable Environment (REMOTE) Vehicle ™ or EMP-RV ™ far more energy efficient and less expensive than a comparable motor-home command center that is not EMP-protected. The EMP protection is obtained without regard to the shielding value of the cargo trailer by Pace American (steel frame with aluminum sides and ceiling), though it is further enhanced by it.

The Resilient Emergency Management Operations Transportable Environment (REMOTE) Portable Operations Defense (POD) unit, can be acquired within a standard ISO cargo container for transport, environmental protection, stacking, or camouflage. The PODs could be used individually or in combination. The EMP protection is achieved without the ISO container, although it is further enhanced by it. For the purposes of this test, wiring of the mobile unit included single phase and triple phase connections to commercial power and wiring for one or more generators with attendant transfer switches. The mobile unit supported two independent 100 amp systems. The transportable pod supported a three phase 225 amp system. Both units had internal power distribution systems in place that supported lights, heating and two fully functional computer systems. Additional low power and data conduits were also in place in each unit. Each system had its own common ground and was grounded for the duration of the tests.

The EMP POD has been assigned the following:

Type Designator: EMP POD Item Name: EMP Portable Operations Defense Part Number: Unit 1

The EMP RV has been assigned the following:

Type Designator: EMP RV Item Name: EMP Road Vehicle Part Number: Unit 1

A simulated verification test was performed on both Units each with one shielded room and a semi protected Personal Entry Vestibule (PEV). The installation of the power filters was completed when this test was done. A post filter installation MIL-188-125-2 SE test was completed to ensure no shielding effectiveness loss occurred. The SE test was done in lieu of a CWI test according to MIL-STD-188-125 paragraph C.4.11 to maximize the measurement range and reduce interference with commercial business. The power filters were tested for acceptance and verification under MIL-STD-188-125 after installation, but before power is applied and for verification after power is applied. The standard for mobile systems was used on both Units tested, although one Unit could be considered a fix facility depending on application. The MIL-188-125-2 standard was used in case of one of the Units (EMP POD) becomes a future transportable system since it could be transported with a flatbed trailer. The planned equipment located in the shielded room of each Unit will perform certain time critical functions which are required to be HEMP survivable."

5. DESCRIPTION OF EMP POD UNIT 1 AND EMP RV UNIT 1

"The EMP RV is the more mobile of the two shielded units and plans to contain mission critical equipment (MCE) for each individual specification as it pertains to their industry. The EMP RV shielded enclosure consists of two barriers, one thin steel layer and one thin aluminum layer. The entire shielded barrier is built inside the aluminum exterior body of the RV. The aluminum exterior outside shell contributes to the SE at the test points located furthest from the back or side door but is not part of the MIL-STD structure. The EM barrier is made of thin metal in order to reduce weight but have thick enough skin depth to effectively shield HEMP frequencies. The shield is

approximately 8x20ft inside the aluminum exterior. Two HEMP filters are installed toward the back of the EMP RV just outside the shield as shown in Figure 5-1. The HEMP filters provide protected main or generator power. The HEMP door is located at the front end with access from the side exterior door. There are two RF doors for entry inside the EMP RV, only the first main door in considered part of the shielded enclosure, the second RF door serves the same purpose as the aluminum layer which is to increase the shielding effectiveness of the entire Unit. The SE test had all exterior doors wide open in order to illuminate the EM barrier as best possible. There are fourteen test points located on sides, bottom and top. The EMP RV Unit 1 had all penetrations, filters and shield installed and completed when tested."







6. (U) BASELINE TEST RESULTS

"The test results section is broken into three sections including the EMP RV Unit 1 SE test overall results, EMP RV PCI acceptance, EMP RV verification, EMP POD Unit 1 SE test overall results, EMP POD PCI acceptance, EMP POD PCI verification. The entire data results for SE (Appendix A), PCI acceptance (Appendix B) and PCI verification (Appendix C) are contained in following attached power point presentations."

6.1. (U) EMP RV UNIT 1 SE RESULTS

Radiated pulse tests:

"SARA: The data shows almost no leakage at all frequencies (black curve). At mid and high frequencies specifically between 25 MHz and 1 GHz the SE measures above 140 dB and averages at 160dB. This is well above the MIL-188-125-2 80dB requirement. In terms of shielding effectiveness this is 1000 times better than the MIL-188-125-2 requirement at worse case and 10000 times better on an average case. There is no low frequency leakage between 10 kHz and 25 MHz which is in the magnetic fields and would show skin depth and/or material issues."

6.2. EMP RV PCI RESULTS

Pulse injection tests:

6.2.1. EMP RV Acceptance PCI Results: "

Sample E1 and E2 residual current waveforms for Main Power CDEUL100A6-S SN001, at all drive levels, are presented in Figure 6-2 and Figure 6-3, respectively. **The E1 peak current residual norm from all samples meets the 10 A limit given in MIL-STD-188-125. While there are no limits imposed on the E2 residuals, the norm values (and waveforms) measured are typical for this type of PPD**. The E2 residual current waveforms show that the MOV on this PPD does not "turn on" until the 250 A injections, as can be seen by the change in waveform shape and sub-linear increase in peak current between the 125 A and 250 A injections. "

"Pre- and post- E2 quality checks of this PPD are presented in Figure 6-4. There was no indication of PPD damage resulting from either the E1 or E2 testing, as was confirmed by the agreement between pre- and post- E2 test measurements of MOV breakdown voltage (given in Appendix B) and other quality checks. "

6.2.2. EMP RV Verification PCI Results

"A complete set of all PCI test data for EMP RV is found in Appendix C. Included in the appendix are matrices which summarize the E1 drive levels and plots of the drive levels. All injections were taken with commercial power connected to a phase transfer switch. The phase transfer switch was tested in two configurations three phase and single phase. The EMP RV was loaded with heaters and PC's to simulate operational conditions. The EMP RV was monitored by PC's , supplied by Instant Access Networks. Since the EMP RV was tested connected to commercial power the downstream current load (Commercial Breaker) was smaller than the upstream current load (EMP RV) no residuals were seen in any configuration. This is normal and an uncontrollable situation which simulates real life scenario when connected to this particular commercial power. However, Instant Access Networks monitored PC's status during testing and no upsets or damage occurred. Also, checks were made to ensure all powered equipment was completely functional during testing.

A matrix summarizing the measured residual current norms at all drive levels for the E1 and E2 testing performed on the EMP RV main power and generator power filter assemblies samples is presented in Table 7 and Table 8, respectively. Sample E1 residual current waveforms for Main Power CDEUL100A6-S SN001, at all drive levels, are presented in Figure 6-5. The E1 peak current residual norm from all samples meets the 10 A limit given in MIL-STD-188-125. There are a few exceeded residuals for root action however this is cause by the ambient environment exceeding the root action limits as shown in the E1 verification matrix. There is no requirement for E2 residuals inside from no damage or upset occurred to PPD or simulated mission equipment. (U) Pre- and post-E2 quality checks of this PPD are presented in Appendix C. There was no indication of PPD damage resulting from either the E1 or E2 testing, as was confirmed by the agreement between pre- and post-E2 test measurements of MOV breakdown voltage (given in Appendix C) and other quality checks."

EMP POD TEST RESULTS

Radiated pulse: 6.3. EMP POD SE RESULTS

"The data shows some small leakage at all frequencies (black curve). At mid and high frequencies specifically between 25 MHz and 1 GHz the SE measures above 120 dB and averages at 140dB. This is well above the MIL-188-125-2 80dB requirement. In terms of shielding effectiveness this is 100 times better than the MIL-188-125-2 requirement at worse case and 1000 times better on an average case. There is no low frequency leakage between 10 kHz and 25 MHz which is in the magnetic fields and would show skin depth and/or material issues."

Injected pulse: 6.4.1. (U) EMP POD PCI Acceptance Results

"A matrix summarizing the measured residual current norms at all drive levels for the E1 and E2 testing performed on the EMP POD main power filter assemblies samples is presented in Table 10 and Table 11, respectively. Sample E1 and E2 residual current waveforms for Main Power CDEUL225B6-S SN001, at all drive levels, are presented in Figure 6-7 and Figure 6-8, respectively. The E1 peak current residual norm from all samples meets the 10 A limit given in MIL-STD-188-125. While there are no limits imposed on the E2 residuals, the norm values (and waveforms) measured are typical for this type of PPD. The E2 residual current waveforms show that the MOV on this PPD does not "turn on" until the 250 A injections, as can be seen by the change in waveform shape and sub-linear increase in peak current between the 125 A and 250 A injections."

6.4.2. (U) EMP POD PCI Verification Results

"A complete set of all PCI test data for EMP POD is found in Appendix C. Included in the appendix are matrices which summarize the E1 drive levels and plots of the drive levels. All injections were taken with commercial power connected to the main power filter assembly. The EMP POD was loaded with heaters and PC's to simulate operation conditions. The EMP POD was monitored by a PC's , supplied by Instant Access Networks. Since the EMP POD was tested connected to commercial power the downstream current load (Commercial Breaker) was smaller than the upstream current load (EMP POD) no residuals were seen in any configuration. This is normal and

an uncontrollable situation which simulates real life scenario when connected to this particular commercial power and has been seen in the past several times. Instant Access Networks monitored PC's status during testing and no upsets or damage occurred. Also, checks were made to ensure all powered equipment was completely functional during testing.

A matrix summarizing the measured residual current norms at all drive levels for the E1 and E2 testing performed on the EMP POD main power filter assembly samples is presented in Table 12 and Table 13, respectively. Sample E1 residual current waveforms for Main Power CDEUL225B6-S SN001, at all drive levels, are presented in Figure 6-10. **The E1 peak current residual norm from all samples meets the 10 A limit given in MIL-STD-188-125**. There are a few exceeded residuals for root action however this is cause by the ambient environment exceeding the root action limits as shown in the E1 verification matrix. **There is no requirement for E2 residuals inside from no damage or upset occurred to PPD or simulated mission equipment**."

Test Report MIL-STD-188-125-2 HEMP Acceptance and Simulated Verification Testing of EMP POD Unit 1 and EMP RV Unit 1 at Glen Burnie, MD

January 2009
Prepared By Scientific Applications and Research Associates, Inc.
D. Fromme
S. Eldridge
J.McClure

(The portions of the test report have been chosen by Charles Manto in order to fit into 6 pages. The full report can be obtained from him by emailing: cmanto@stop-EMP.com)