CHAPTER 9

HIGH ALTITUDE ELECTROMAGNETIC PULSE (HEMP) EQUIPMENT AND CONTROLS

9-1. Description of HEMP protection for mechanical systems

HEMPs, generated from the explosion of a nuclear bomb at high altitude, are of the most concern to Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) facilities because they cover such a large area. The burst from the bomb may cause large currents or potential differences to be induced in many types of conductors. This energy can couple to wires or any conductor above or below ground and induce signals which cause malfunctioning of sensitive equipment or induce energy of significant magnitude to damage and destroy sensitive equipment used in C4ISR facilities. For these reasons HEMP protection must be employed. HEMP protection involves shielding, bonding, and grounding. Shielding for the facility is usually provided by sheets of steel welded together to enclose the entire facility. Continuous welding provides a continuous bond and a uniform shield around the facility. Grounding of the shield is accomplished through the earth electrode system in a grounding plan with calculated number, size, type, and ground locations. There are essentially two mechanical items which require HEMP protection, ports and penetrations.

a. Ventilation ports. In C4ISR facilities ventilation ports are needed to provide fresh air and exhaust relief air from the facility. HEMP protection is provided by using honeycomb ducts at the port or a screen bonded over the port.

b. Pipe and ventilating duct penetrations. Pipe and ventilating ducts penetrating facility shielding should be minimized. Where penetrations are needed HEMP protection is provided by minimizing the number of penetrations, maintaining them at a common location, and bonding them to the shield wall. Bonding is accomplished preferably by continuously welding, brazing, hard soldering, or other fused metal process. Collets or clamps can also be used. Bonding the circumference of the pipe or duct to the shield at their entry point is needed. Another method is to use a dielectric section of pipe or duct at the shield to prevent energy inducted in the external metallic pipe and ducts from being conducted through the shield.

c. HEMP protection for mechanical systems. More information on HEMP sources and effects, and HEMP protection design, maintenance, and testing for ventilating ports, and pipe and ventilating duct penetrations can be found is the American Society of Mechanical Engineers (ASME) B 31.3, Process piping, the Department of the Army: TM 5-692-1 Maintenance of Mechanical and Electrical Equipment at C4ISR Facilities, Recommended Maintenance Practices, chapter 27, TM 5-692-2 Maintenance of Mechanical and Electrical Equipment at C4ISR Facilities, System Design Features, chapter 27, and TM 5-690, chapter 5

9-2. Operation of HEMP protection for mechanical systems

As HEMP protection systems are passive, their degradation has little effect on normal facility operation. For mechanical ports and penetrations there are no moving parts. Therefore there are no operating requirements. Once properly designed and installed only the effectiveness of the HEMP protection system can be measured and is required to be checked as part of the hardness maintenance and hardened surveillance programs.

9-3. Pre-functional test plan and functional performance test plan for HEMP protection of mechanical systems

As part of a commissioning procedure each component should be checked for damage, deterioration, failures, missing parts, openings, dirt, corrosion, weld integrity, dust, foreign debris, bonded electrical resistance, wave radiated fields, and shielded enclosure leaks.

a. Safety, HEMP protection of mechanical systems. Many tests on equipment take place around high voltages, high currents, and rotating or moving equipment. These can be dangerous to personnel and damaging to equipment. A procedure should be followed to insure adequate safety rules are instituted and practiced to prevent injury to personnel performing the tests and other personnel who might be in the local area.

b. Test equipment, HEMP protection of mechanical systems. It is important that in any test program the proper equipment is used. The equipment should be calibrated, in good condition, and used by qualified operators as required by a procedure. Any test equipment used for calibration shall have twice the accuracy of the equipment to be tested. All equipment should be operated in accordance with its instruction manual. A procedure defining installation inspection and a system test needs to be provided.

c. Tests, HEMP protection of mechanical systems. An inspection checklist for HEMP protection of mechanical systems is presented in figure 9-1, Example of a completed DA Form 7486-R, HEMP protection of mechanical systems inspection checklist.

9-4. Possible failures and corrective measures for HEMP protection of mechanical systems

Table 9-1 on page 9-4 lists general problems that may arise during the testing of equipment and systems along with possible troubleshooting techniques. For all problems, consult equipment and component manuals for troubleshooting directions. Check for continuity, check test equipment calibration and settings, and look for faulty equipment and connections.

HIGH ALTITUDE ELECTROMAGNETIC PULSE (HEMP) PROTECTION OF MECHANICAL SYSTEM INSPECTION CHECKLIST

For use of this form, see TM 5-697; the proponent agency is COE.

SECTION A - CUSTOMER DATA

1. PLANT	2. LOCATION	3. JOB NUMBER
South Building	Washington, DC	SB03-101
4. EQUIPMENT	5. SYSTEM DESIGNATION HEMP 02	6. DATE (YYYYMMDD) 20030122
7. TEST EQUIPMENT ASTM 1851-02 Std suggested testing practice with calibrated equipment		8. TESTED BY David Ryan

SECTION B - EQUIPMENT DATA

9. MANUFACTURER	10. MODEL NO	11. SERIAL NO	12. TYPE

SECTION C - VISUAL AND MECHANICAL INSPECTION

13. CHECK POINT	COND*	NOTES	CHECK POINT	COND*	NOTES
IDENTIFICATION	A		LABELING AND TAGGING	A	
COMPLETENESS OF INSTALLATION	A		SAFETY INTERLOCKS	A	
ELECTRICAL/MECHANICAL INTERLOCKS	A		COMPARISON TO DRAWINGS	A	
PROPER SHIELDING	R	1	WELD INTEGRITY	A	
PROPER BONDING	A		DIRT, CORROSION, DUST, DEBRIS	A	
PROPER GROUNDING	A		DAMAGE	R	2
PROPER INSULATION	A				

SECTION D - CALIBRATION

14.	DESCRIPTION	NOTES
TEST INSTRUMENTS	See frequency ranges in note 3 below	3

SECTION E - SYSTEM TESTS

15.	OPERATING MODES	TEMPERATURES	PRESSURES	FLOWS	LEVELS	NOTES
BONDED ELECTRICAL RESISTANCE TEST	Standby	Ambient	Ambient	NA	Resistance	5
WAVE RADIATED FIELD TEST	Operate/Transmit	Ambient	Ambient	NA	Test	4
SHIELDED ENCLOSURE LEAK TEST	Operate/Transmit	Ambient	Ambient	NA	Test	4

16. NOTES

1. Break in the door seal
2. Damaged door
3. This test method is for use in the following frequency ranges: 140 - 160 kHz, 14 - 16 MHz, 300 - 500 MHz, 900 - 1000 MHz and 8.5 - 10.5 GHz. Additional measurements in the range of 10 kHz to GHz may be performed. For specific applications, the frequency range may be extended from 50 Hz to 40 GHz. This provides guidance on selecting measurement frequencies.
4. Record resonnance reaction at each test level as indicated in section D.
5. Record variations depending upon ambient temperature and ambient pressure.

*CONDITION: A - ACCEPTABLE; R - NEEDS REPAIR, REPLACEMENT OR ADJUSTMENT; C - CORRECTED; NA - NOT APPLICABLE

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Figure 9-1: Example: DA Form 7486-R

Table 9-1. Possible failures and corrective actions for HEMP protection of mechanical systems

	Areas to Check
Ventilation Ports	
HEMP protection is breached	Check bonding, shielding, and grounding Check for mis-wired circuits Check weld impedance Check screen covering the port opening

Pipe and ventilating duct penetrations	
HEMP protection is breached	Check bonding, shielding, and grounding Check for mis-wired circuits Check for continuous welds of pipe and duct, to shielding Check weld impedance