

СПРАВОЧНЫЕ МАТЕРИАЛЫ

ЭМИ ЯВ И ЕГО ВОЗДЕЙСТВИЕ НА ЭЛЕКТРОЭНЕРГЕТИЧЕСКИЕ СИСТЕМЫ: СТАНДАРТЫ И ОТЧЕТЫ

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Целью данной публикации является предоставление гражданским специалистам информации о доступных стандартах и отчетах по теме «Электромагнитный импульс высотного ядерного взрыва» (ЭМИ ЯВ), которые они могут использовать при оценке опасности ЭМИ ЯВ для силового электрооборудования и электронных приборов энергосистем и при разработке средств защиты.

Ключевые слова: электромагнитный импульс высотного ядерного взрыва (ЭМИ ЯВ), геомагнитно-индуцированные токи (ГИТ), преднамеренные электромагнитные деструктивные воздействия.

Проблема преднамеренных электромагнитных деструктивных воздействий (ПЭДВ) на энергосистемы становится в последнее время все более и более актуальной в связи с двумя современными тенденциями: расширяющимся применением микроэлектроники и микропроцессорной техники в электроэнергетике, с одной стороны, и интенсивной разработкой специальных технических средств, предназначенных для дистанционного разрушения микроэлектроники, – с другой. Самым мощным средством разрушения микроэлектроники является электромагнитный импульс высотного ядерного взрыва (ЭМИ ЯВ). История экспериментов с ЭМИ ЯВ насчитывает уже полвека. За это время были написаны многие десятки статей, книг, отчетов, стандартов, детально описывающих явление ЭМИ ЯВ, его влияние на электронную аппаратуру и электроустановки, а также средства защиты от него. Однако большинство гражданских специалистов во многих областях техники по-прежнему остаются в неведении относительно этого феномена и средств защиты от него.

Целью данной публикации является предоставление гражданским специалистам информации о доступных в Интернете стандартах и отчетах по данной теме, которые они могут использовать при оценке опасности ЭМИ ЯВ для силового электрооборудования и электронных приборов энергосистем и разработке средств защиты.

СТАНДАРТЫ

1. Стандарты Международной Электротехнической Комиссии (МЭК):
2. Стандарты Института инженеров электриков и электронщиков США (IEEE)
3. Стандарты Европейской Комиссии
4. Военные стандарты США
5. Стандарты НАТО

ОТЧЕТЫ

1. Теория ЭМИ ЯВ
2. Геомагнитно-индуцированные токи и их влияние на энергосистему
3. Влияние ЭМИ ЯВ на энергосистему

Summary

The purpose of the given publication is to give to civil specialists the information on accessible standards and reports in the field of EMP/HEMP which they can use at an estimation of danger of EMP for the power electrical and electronic equipment and development of means of protection.

Key words: high altitude electromagnetic pulse, HEMP, EMP, geomagnetically induced currents, GIC, intentional destructive electromagnetic impacts.

The problem of intentional destructive electromagnetic impacts on electrical power systems becomes recently more and more actual in connection with two modern trends: an extending application of microelectronics and microprocessor-based devices and systems in electric power industry - on the one hand, and intensive designs special equipment for distance destruction of electronic devices and systems - with another. The most powerful method for such destruction is the High-Altitude Electromagnetic Pulse (HEMP) as a result of high-altitude nuclear explosion. The history of experimental high-altitude nuclear explosions includes already half a century. During this time many tens the scientific articles, books, reports and standards in details presenting this phenomenon and measures of protection from it, have been published. However, a civilian specialists working in the various technical sectors had no idea until recently about this phenomenon, or of the dangers that it posed (and some are still not aware even now). The purpose of the given publication is to give to civil specialists the information on accessible in Internet standards and reports in the field of EMP/HEMP which they can use at an estimation of danger of EMP for the power electrical and electronic equipment and development of means of protection.

STANDARDS

1. Standards of International Electrotechnical Commission:

1.1. **IEC TR 61000-1-3** Electromagnetic compatibility (EMC) — Part 1–3: General—The effects of high-altitude EMP (HEMP) on civil equipment and systems.

1.2. **IEC 61000-1-5** High power electromagnetic (HPEM) effects on civil systems.

1.3. **IEC 61000-2-9** Electromagnetic compatibility (EMC)—Part 2: Environment—Section 9: Description of HEMP environment—Radiated disturbance. Basic EMC publication.

1.4. **IEC 61000-2-10** Electromagnetic compatibility (EMC)—Part 2–10: Environment—Description of HEMP environment—Conducted disturbance.

1.5. **IEC 61000-2-11** Electromagnetic compatibility (EMC)—Part 2–11: Environment—Classification of HEMP environments.

1.6. **IEC 61000-2-13** Electromagnetic compatibility (EMC)—Part 2–13: Environment—High power electromagnetic (HPEM) environments—Radiated and conducted.

1.7. **IEC 61000-4-23** Electromagnetic compatibility (EMC) - Part 4-23: Testing and measurement techniques - Test methods for protective devices for HEMP and other radiated disturbances.

1.8. **IEC 61000-4-24** Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 24: Test methods for protective devices for HEMP conducted disturbance - Basic EMC Publication.

1.9. **IEC 61000-4-25** Electromagnetic compatibility (EMC) - Part 4-25: Testing and measurement techniques - HEMP immunity test methods for equipment and systems.

1.10. **IEC 61000-4-32** Electromagnetic compatibility (EMC) – Part 4-32: Testing and measurement techniques – High-altitude electromagnetic pulse (HEMP) simulator compendium.

1.11. **IEC61000-4-33** Electromagnetic compatibility (EMC) – Part 4-33: Testing and measurement techniques – Measurement methods for high-power transient parameters.

1.12. **IEC 61000-4-35** Electromagnetic compatibility (EMC) - Part 4-35: Testing and measurement techniques - HPEM simulator compendium.

1.13. **IEC 61000-4-36** Electromagnetic compatibility (EMC) - Testing and measurement techniques - IEMI Immunity Test Methods for Equipment and Systems.

1.14. **IEC/TR 61000-5-3** Electromagnetic compatibility (EMC)—Part 5–3: Installation and mitigation guidelines—HEMP protection concepts.

1.15. **IEC/TS 61000-5-4** Electromagnetic compatibility (EMC)—Part 5: Installation and mitigation guidelines—Section 4: Immunity to HEMP—Specifications for protective devices against HEMP radiated disturbance. Basic EMC Publication.

1.16. **IEC 61000-5-5** Electromagnetic compatibility (EMC)—Part 5: Installation and mitigation guidelines—Section 5: Specification of protective devices for HEM conducted disturbance. Basic EMC Publication.

1.17. **IEC 61000-5-6** Electromagnetic compatibility (EMC) – Part 5-6: Installation and mitigation guidelines – Mitigation of external EM influences.

1.18. **IEC 61000-5-7** Electromagnetic compatibility (EMC) - Part 5-7: Installation and mitigation guidelines - Degrees of protection provided by enclosures against electromagnetic disturbances (EM code).

1.19. **IEC 61000-5-8** Electromagnetic compatibility (EMC) - Part 5-8: Installation and mitigation guidelines - HEMP protection methods for the distributed infrastructure.

1.20. **IEC 61000-5-9** Electromagnetic compatibility (EMC) - Part 5-9: Installation and mitigation guidelines - System-level susceptibility assessments for HEMP and HPEM.

1.21. **IEC 61000-4-36** Electromagnetic compatibility (EMC) - Testing and measurement techniques - IEMI Immunity Test Methods for Equipment and Systems.

2. Standard of Institute of Electrical and Electronics Engineers (IEEE)

2.1. **IEEE P1642** Recommended Practice for Protecting Public Accessible Computer Systems from Intentional EMI.

3. Standard of European Commission

3.1. **Topic SEC-2011.2.2-2** Protection of Critical Infrastructure (structures, platforms and networks) against Electromagnetic (High Power Microwave (HPM)) Attacks.

4. Military Standards of USA

4.1. **MIL-STD-2169B** High –Altitude Electromagnetic Pulse (HEMP) Environmental, 2012 (Classified).

4.2. **MIL-STD-188-125-1** High –Altitude Electromagnetic Pulse (HEMP) Protection for Ground Based C4I Facilities Performing Critical. Time-Urgent Mission. Part 1 Fixed Facilities, 2005.

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5. Standards of NATO

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5.2. **NATO AECTP-250** Ed.2 – Electrical and Electromagnetic Environmental Conditions, 2011.

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2. Geomagnetically Induced Currents and its Impact on Power System

2.1. Report ORNL/Sub-83/43374/1/V3: Study to Assess the Effects of Magnetohydrodynamic Electromagnetic Pulse on Electric Power Systems / J. R. Legro, N. C. Abi-Samra, and F. M. Tesche. - Oak Ridge National Laboratory, 1985.

2.2. Report ORNL-6665: Electric Utility Industry Experience with Geomagnetic Disturbances / P. R. Barnes, D. T. Rizy, B. W. McDonell. - Oak Ridge National Laboratory, 1991.

2.3. High-Impact, Low-Frequency Event Risk to the North American Bulk Power System. - A Jointly-Commissioned Summary Report of the North American Electric Reliability Corp. and the U. S. Department of Energy's November 2009 Workshop. NERC, 2010.

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