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# Electromagnetic Pulse (EMP) Protection and Resilience Guidelines for Critical Infrastructure and Equipment

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Arlington, Virginia

# Electromagnetic Pulse Emp Threat To Critical Infrastructure

**Tao Wei**



## **Electromagnetic Pulse Emp Threat To Critical Infrastructure:**

**Electromagnetic Pulse (Emp)** Infrastru Subcommittee on Cybersecurity, and Security Technologies of the Committee on Homeland Security House of Representatives, Infrastructure Protection Subcommittee on Cybersecurity, Infrastructure Protection, and Security Technologies of the Committee on Homeland Security House of Representatives, 2014-11-09 EMP is simply a burst of electromagnetic radiation that results from certain types of high energy explosions or from a suddenly fluctuating magnetic field EMPs can be generated by nuclear weapons from naturally occurring sources such as solar storms or specialized non nuclear EMP weapons In 1962 the United States conducted a test named STARFISH Prime where the military detonated a 1.4 megaton thermonuclear bomb about 25 miles above Johnston Atoll in the Pacific In space six American British and Soviet satellites suffered damage and 800 miles away in Hawaii burglar alarms sounded street lights blinked out and phones radios and televisions went dead While only 1 percent of the existing street lights were affected it became clear that electromagnetic pulse or EMP could cause significant damage Some would say it is a low probability but the damage that could be caused in the event of an EMP attack both by the sun a solar event or a man made attack would be catastrophic We talk a lot about a nuclear bomb in Manhattan and we talk about a cybersecurity threat the grid power grid in the Northeast and all these things would actually probably pale in comparison to the devastation that an EMP attack could perpetrate on Americans *Electromagnetic Pulse (EMP)* United States. Congress. House. Committee on Homeland Security. Subcommittee on Cybersecurity, Infrastructure Protection, and Security Technologies, 2014

**Electromagnetic Pulse Emp** United States. Congress, United States House of Representatives, Committee on Homeland Security, 2017-09-23

Electromagnetic pulse EMP threat to critical infrastructure **Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack** Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack, 2008

**2011 Essential Guide to Electromagnetic Pulse (EMP) Attack - Reports of the EMP Commission on the Threat and Critical National Infrastructure - the Danger from High-Altitude Nuclear Explosions** Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack, U. S. House of Representatives, U. S. Government, 2017-08-21

Comprehensive guide to the threat of an electromagnetic pulse EMP attack with a high altitude nuclear weapon detonation including both reports of the Commission to Assess the Threat to the United States from Electromagnetic Pulse EMP Attack Executive Report and 2008 Critical Infrastructure Report plus testimony given at hearings before the House of Representatives Committee on National Security Military Research and Development Subcommittee on the threat posed by EMP to U S military systems and civil infrastructure The commission report abstract states Several potential adversaries have or can acquire the capability to attack the United States with a high altitude nuclear weapon generated electromagnetic pulse EMP A determined adversary can achieve an EMP attack capability without having a high level of sophistication EMP is one of a small number of threats that can hold our society at risk of

catastrophic consequences EMP will cover the wide geographic region within line of sight to the nuclear weapon It has the capability to produce significant damage to critical infrastructures and thus to the very fabric of US society as well as to the ability of the United States and Western nations to project influence and military power The common element that can produce such an impact from EMP is primarily electronics so pervasive in all aspects of our society and military coupled through critical infrastructures Our vulnerability is increasing daily as our use of and dependence on electronics continues to grow The impact of EMP is asymmetric in relation to potential protagonists who are not as dependent on modern electronics The current vulnerability of our critical infrastructures can both invite and reward attack if not corrected Correction is feasible and well within the Nation s means and resources to accomplish Commission executive report contents include Nature of the EMP Threat Prevention Protection and Recovery of Civilian Infrastructures Strategy And Recommendations Intelligence Interdiction and Deterrence Protecting Critical Components of the Infrastructure Maintaining the Capability to Monitor and Evaluate the Condition of Critical Infrastructures Recognizing EMP Attack Planning to Carry Out a Systematic Recovery of Critical Infrastructures Training Evaluating Red Teaming and Periodically Reporting to the Congress Defining the Federal Government s Responsibility and Authority to Act Recognizing the Opportunities for Shared Benefits Conducting Research and Development Electric Power Infrastructure Telecommunications Importance of Assured Telecommunications EMP Effects on Telecommunications Recommended Mitigation Activities Banking And Finance Fuel Energy Infrastructure Transportation Infrastructure Food Infrastructure Water Supply Infrastructure Emergency Services Space Systems Government Keeping The Citizenry Informed Protection Of Military Forces The Critical National Infrastructures report includes Infrastructure Commonalities SCADA Systems Impact of SCADA Vulnerabilities on Critical Infrastructures Historical Insight Infrastructures and Their Interdependencies Commission Sponsored Modeling and Simulation M S Activities Electric Power Description Vulnerabilities Test Results Historical Insights Distinctions Strategy Recommendations Telecommunications Telecommunications Support During Emergencies EMP Impact on Telecommunications Recommendations Banking and Finance The Financial Services Industry Vulnerability to EMP Consequences of Financial Infrastructure Failure Petroleum and Natural Gas Infrastructure Description Direct Effects of EMP on Petroleum and Natural Gas Infrastructure Petroleum Infrastructure and SCADA Natural Gas Infrastructure and SCADA Effects of an EMP Event on the U S Petroleum and Natural Gas Infrastructures

**Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack** Bernan,United States,2008      **21st Century Complete Guide to Electromagnetic Pulse (EMP)** Department of Defense,U. S. Congress,Federal Energy Regulatory Commission (FERC),National Aeronautics and Space Administration (NASA),Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack,U. S. Government,2017-05-09 This revised up to date and comprehensive ebook presents a superb collection of authoritative documents detailing the threat posed by electromagnetic pulse EMP caused by

nuclear weapons and geomagnetic storms Contents Part 1 Overview of the Threat Part 2 High Altitude Electromagnetic Pulse HEMP and High Power Microwave HPM Devices Threat Assessments Part 3 Electromagnetic Pulse Threats in 2010 Part 4 Interim Report of the Defense Science Board DSB Task Force on the Survivability of Systems and Assets to Electromagnetic Pulse EMP and other Nuclear Weapon Effects NWE Part 5 Electronic Systems Failures and Anomalies Attributed to Electromagnetic Interference Part 6 Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse EMP Attack Volume 1 Executive Report Part 7 Report Of The Commission To Assess The Threat To The United States From Electromagnetic Pulse EMP Attack Critical National Infrastructures Part 8 Threat Posed By Electromagnetic Pulse EMP To U S Military Systems And Civil Infrastructure Hearings Before the U S House Of Representatives Committee On National Security Part 9 Space Weather Part 10 The Sun the Earth and Near Earth Space A Guide Part 11 Congressional Hearings about Electric Grid Threat The nation s power grid is vulnerable to the effects of an electromagnetic pulse EMP a sudden burst of electromagnetic radiation resulting from a natural or man made event EMP events occur with little or no warning and can have catastrophic effects including causing outages to major portions of the U S power grid possibly lasting for months or longer Naturally occurring EMPs are produced as part of the normal cyclical activity of the sun while man made EMPs including Intentional Electromagnetic Interference IEMI devices and High Altitude Electromagnetic Pulse HEMP are produced by devices designed specifically to disrupt or destroy electronic equipment or by the detonation of a nuclear device high above the earth s atmosphere EMP threats have the potential to cause wide scale long term losses with economic costs to the United States that vary with the magnitude of the event The cost of damage from the most extreme solar event has been estimated at 1 to 2 trillion with a recovery time of four to ten years while the average yearly cost of installing equipment to mitigate an EMP event is estimated at less than 20 cents per year for the average residential customer HEMP is produced by a nuclear weapon detonated above the atmosphere No blast shock or radiation is felt at the Earth s surface however electromagnetic fields do reach the surface IEMI is a term that is applied to the non explosive non nuclear intentional generation of intense electromagnetic fields that are used to introduce signals into electronic equipment for the specific purpose of disrupting confusing or damaging these electronics IEMI devices are malicious in nature and are used for terrorist or criminal purposes Many types of IEMI are commercially available and can be as compact as a briefcase in size In many ways the IEMI threat is similar to that of the early time threat of high altitude EMP and can be addressed in a similar fashion

**Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack: Critical National Infrastructures**, 2008 This report presents the Commission s assessment of the effects of a high altitude electromagnetic pulse EMP attack on our critical national infrastructures An earlier report Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse EMP Volume 1 Executive Report 2004 provided an overview When a nuclear explosion occurs at high altitude the EMP

signal it produces will cover a wide geographic region within the line of sight of the detonation Because of the dependence of U S society on the electrical power system its vulnerability to an EMP attack coupled with the EMP s particular damage mechanisms creates the possibility of long term catastrophic consequences The consequences of an EMP event should be prepared for and protected against to the extent reasonably possible Cold War style deterrence is not likely to be an effective threat against potential protagonists that are either failing states or trans national groups Therefore making preparations to manage the effects of an EMP attack is critical to reducing the consequences and thus probability of attack The appropriate national level approach should balance prevention protection and recovery This volume focuses on a description of the potential vulnerabilities of our critical national infrastructures the chapters in this document deal individually with the EMP threat to each critical infrastructure separately It is also important to understand that not only mutual interdependence may be enabled by technology advances but also technologies that have facilitated this growing interdependence may be common across the many individual infrastructures In particular the Commission thought it important to single out the growth and common infrastructural infiltration of one particular transformative technology the development of automated monitoring and control systems known as Supervisory Control and Data Acquisition SCADA systems

*Threat Posed by Electromagnetic Pulse (EMP) Attack* United States. Congress. House. Committee on Armed Services,2009 Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse (Emp) Attack Critical National Infrastructures,2011-09 This is the 2008 in depth report to Congress on the threat to the United States from an EMP They conducted tests on equipment and vehicles and project what would happen if the U S was subjected to an EMP Chapters include Electric Power Telecommunications Banking and Finance Petroleum and Natural Gas Transportation Infrastructure Food Infrastructure Water Infrastructure Emergency Services Government and more

Understanding America's Greatest Existential Threats Dr. J. R. Maxwell,2020-12-08 In this introductory volume readers will learn about the vital role that the various Critical Infrastructure CI sectors play in America in the context of homeland security The protection maintenance and monitoring of these interdependent CI assets is a shared responsibility of governments private sector owner operators first responders and all those involved in homeland security and emergency management As this foundational learning resource demonstrates rapidly advancing technologies combined with exponential growth in demand on the aging infrastructure of America s power grid is setting the stage for a potentially catastrophic collapse that would paralyze each and every facet of civilian life and military operations This meticulously researched primer will guide readers through the known world of power failures and cyber attacks to the emerging threat from a High altitude Electromagnetic Pulse HEMP A HEMP would cause cascading failures in the power grid communications water treatment facilities oil refineries pipelines banking supply chain management food production air traffic control and all forms of transportation Each chapter in America s Greatest Existential Threat Vol 1 begins with learning objectives and ends with a series of review questions to assess take up of the

chapter material Similarly subsequent volumes will explore HEMP and emerging issues in closer detail with current research and analysis now in development

Electromagnetic Pulse (EMP) United States. Congress. House. Committee on Homeland Security. Subcommittee on Cybersecurity, Infrastructure Protection, and Security Technologies, 2014 **21st Century Complete Guide to Electromagnetic Pulse (EMP)** Progressive Management, 2013 This revised up to date and comprehensive ebook presents a superb collection of authoritative documents detailing the threat posed by electromagnetic pulse EMP caused by nuclear weapons and geomagnetic storms

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The nation's power grid is vulnerable to the effects of an electromagnetic pulse EMP a sudden burst of electromagnetic radiation resulting from a natural or man made event EMP events occur with little or no warning and can have catastrophic effects including causing outages to major portions of the U S power grid possibly lasting for months or longer Naturally occurring EMPs are produced as part of the normal cyclical activity of the sun while man made EMPs including Intentional Electromagnetic Interference IEMI devices and High Altitude Electromagnetic Pulse HEMP are produced by devices designed specifically to disrupt or destroy electronic equipment or by the detonation of a nuclear device high above the earth's atmosphere EMP threats have the potential to cause wide scale long term losses with economic costs to the United States that vary with the magnitude of the event The cost of damage from the most extreme solar event has been estimated at 1 to 2 trillion with a recovery time of four to ten years while the average yearly cost of installing equipment to mitigate an EMP event is estimated at less than 20 cents per year for the average residential customer HEMP is produced by a nuclear weapon detonated above the atmosphere No blast shock or radiation is felt at the Earth's surface however electromagnetic fields do reach the surface IEMI is a term that is applied to the non explosive non nuclear intentional generation of intense electromagnetic fields that are used to introduce signals into electronic equipment for the specific purpose of disrupting confusing or damaging these electronics IEMI devices are malicious in nature and are used for terrorist or criminal purposes Many types of IEMI are commercially available and can be as compact as a briefcase in size In many ways the IEMI threat is similar to that of the early time threat of high altitude EMP

and can be addressed in a similar fashion      **Catastrophic Possibilities Threatening U.S. Security** Kristen Boon, Aziz Z. Huq, 2011 Terrorism Commentary on Security Documents is a hardbound series that provides primary source documents and expert commentary on the worldwide counter terrorism effort Among the documents collected are transcripts of Congressional testimony reports by such federal government bodies as the Congressional Research Service CRS and the Government Accountability Office GAO and case law covering issues related to terrorism Most volumes carry a single theme and inside each volume the documents appear within topic based categories The series also includes a subject index and other indices that guide the user through this complex area of the law Volume 119 Catastrophic Possibilities Threatening U S Security discusses the nightmare scenario of a catastrophic attack on the United States While the U S national security apparatus remains focused on the wars in Iraq and Afghanistan and appears to be postulating a future international security environment defined largely by threats increasingly posed by weak failing and failed states astute strategists are not discounting the possibility of a catastrophic attack on the United States In this volume Douglas Lovelace presents a number of documents that help describe explain and assess the nature and severity of the threat of a catastrophic attack Offering expert commentary for each section Lovelace groups the documents into three categories Catastrophic Potentialities in the International Security Environment Countering the Proliferation of Nuclear Weapons and Nuclear Materials and Catastrophic Cyber Attack Documents include a Department of Defense overview of the four categories of strategic challenges a Government Accountability Office report addressing weapons of mass destruction and the actions needed to allocate resources for counterproliferation programs and an insightful overview of the threat of catastrophic cyber attack by the Department of Homeland Security The commentary and primary sources in Volume 119 will apprise researchers and practitioners of international law and national security of the perils of a catastrophic attack against the United States posed by terrorists radicals state failure and humanitarian disasters      *Electromagnetic Pulse (EMP): Threat to Critical Infrastructure, Serial No. 113-68, May 8, 2014, 113-2 Hearing* United States. Congress. House. Select Committee on Homeland Security, 2014\*      **Project on Nuclear Issues** Mark Cancian, 2018-03-09 The role that nuclear weapons play in international security has changed since the end of the Cold War but the need to maintain and replenish the human infrastructure for supporting nuclear capabilities and dealing with the multitude of nuclear challenges remains essential Recognizing this challenge CSIS launched the Project on Nuclear Issues PONI in 2003 to develop the next generation of policy technical and operational nuclear professionals through outreach mentorship research and debate PONI runs two signature programs the Nuclear Scholars Initiative and the Annual Conference Series to engage emerging nuclear experts in thoughtful and informed debate and research over how to best address the nuclear community s most pressing problems The papers in this volume comprise research from participants in the 2017 Nuclear Scholars Initiative and PONI Conference Series PONI sponsors this research to provide a forum for facilitating new and innovative thinking and a platform for

emerging thought leaders across the nuclear enterprise Spanning a wide range of technical and policy issues these selected papers further discussion in their respective areas

**Securing the Modern Electric Grid from Physical and Cyber Attacks** United States. Congress. House. Committee on Homeland Security. Subcommittee on Emerging Threats, Cybersecurity, and Science and Technology, 2009

*Assessing the Threat from Electromagnetic Pulse (EMP)*, 2017 The critical national infrastructure in the United States faces a present and continuing existential threat from combined arms warfare including cyber and manmade electromagnetic pulse EMP attack as well as from natural EMP from a solar superstorm Protecting and defending the national electric grid and other critical infrastructures from cyber and EMP could be accomplished at reasonable cost and minimal disruption to the present systems that comprise U S critical infrastructure In summary the Commission sees the high altitude nuclear explosion generated electromagnetic pulse as an existential threat to the survival of the United States and its allies that can be exploited by major nuclear powers and small scale nuclear weapon powers including North Korea and non state actors such as nuclear armed terrorists

*Vulnerabilities of the U. S. to an Electromagnetic Pulse Attack* Maryanne Schneider, 2016 The physical and social fabric of the United States is sustained by a system of systems a complex and dynamic network of interlocking and interdependent infrastructures critical national infrastructures whose harmonious functioning enables the myriad actions transactions and information flow that undergird the orderly conduct of civil society in this country The vulnerability of these infrastructures to threats deliberate accidental and acts of nature is the focus of greatly heightened concern in the current era a process accelerated by the events of 9 11 and recent hurricanes including Katrina and Rita This book presents the results of the Commission s assessment of the effects of a high altitude electromagnetic pulse EMP attack on our critical national infrastructures and provides recommendations for their mitigation Moreover as of July 2015 the Department of Homeland Security DHS reported taking several actions that could help address electromagnetic threats to the electric grid This book also addresses the extent to which DHS has taken action to address recommendations from the 2008 EMP Commission Report and coordinated with other principal federal agencies such as DOE and industry stakeholders to mitigate risks to the electric grid from electromagnetic threats

**Iran's Revolutionary Guard** Steven O'Hern, 2012-10-31 Since the Iranian Revolution more than thirty years ago the Islamic Revolutionary Guard Corps IRGC also known as the Revolutionary Guard has conducted covert and overt military operations built an economic empire and trained financed and guided terrorists to pursue one goal the preservation and expansion of the Islamic revolution Inside Iran the IRGC influences the country s politics economy and foreign policy and controls its nuclear program Outside Iran the operations of the IRGC and its proxies including Hezbollah in Lebanon and Shiite militias in Iraq have left a trail of death from the 1983 truck bombings in Beirut that killed 241 U S peacekeepers and 58 French paratroopers to numerous attacks on U S and allied troops in Iraq and Afghanistan Now no longer content to strike in Iraq and Afghanistan or at targets in the Middle East and south Asia the IRGC and Hezbollah operate throughout

North and South America developing the capability to strike the continental United States and deliver a blow to America's economy far worse than today's financial crisis. In Iran's Revolutionary Guard, Steven O'Hern reveals new information about the IRGC and Hezbollah operations inside America based on interviews with former and active members of the FBI, CIA, local law enforcement, military intelligence, and even one former Revolutionary Guard officer. The author details how the IRGC has grown into such a dangerous foe and explains how its members' activities have put the American economy and American lives at risk. His research suggests that the IRGC may be planning to explode high above a Midwestern city a nuclear weapon that would emit an electromagnetic pulse strong enough to render anything with a computer chip useless, including the hundreds of transformers that control the country's electrical grid. One thing is certain according to O'Hern: the Revolutionary Guard is a serious threat to the well-being of all U.S. citizens.

## Unveiling the Power of Verbal Art: An Emotional Sojourn through **Electromagnetic Pulse Emp Threat To Critical Infrastructure**

In some sort of inundated with displays and the cacophony of fast interaction, the profound energy and emotional resonance of verbal beauty often diminish into obscurity, eclipsed by the constant barrage of sound and distractions. However, located within the musical pages of **Electromagnetic Pulse Emp Threat To Critical Infrastructure**, a fascinating perform of literary brilliance that impulses with raw feelings, lies an unique trip waiting to be embarked upon. Composed by a virtuoso wordsmith, this enchanting opus guides viewers on a mental odyssey, softly exposing the latent possible and profound impact embedded within the delicate web of language. Within the heart-wrenching expanse with this evocative examination, we can embark upon an introspective exploration of the book is key styles, dissect their captivating publishing model, and immerse ourselves in the indelible impact it leaves upon the depths of readers souls.

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moment  $m$  w/2 kn  $m$  draw shear force and bending

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