A Comparative Analysis of EMP Defensive Measures of the PRC, United States, and Taiwan

Pak, Tin[1]

Rainier Institute for Foreign Affairs

The electromagnetic spectrum is emerging as a critical domain of warfare, where attacks using electromagnetic pulses (EMP) aim to jam, disable, or destroy electronics. As reliance on electronics grows in military forces globally, EMP threats pose exponentially significant risks to critical infrastructures.

In response, the United States, the People's Republic of China (PRC), and Taiwan are not only advancing their EMP weapon capabilities but are also investing heavily in hardening measures to protect vital networks and infrastructure from these threats.

This article first analyzes the EMP weapon capabilities of these countries. It then examines the defensive measures they have taken to mitigate vulnerabilities and improve resilience in the face of potential EMP attacks.

1. PRC:

The PRC fields two main types of EMP weapons: high-power microwave (HPM) devices and high-altitude EMPs (HEMPs). The PRC leads globally in HPM development, holding 90% of HPM-related patents,

[1] President & Co-founder of Rainier Institute for Foreign Affairs.

with its technology exponentially improving in strength and precision.[2] HPMs are devices that emit rays of high-frequency EMPs at a narrow target. Notably, the PRC unveiled its FK-4000 land-based HPM system at the 2024 Zhuhai Airshow, and some other HPM designs are reportedly compact enough to be equipped onto missiles, raising concerns about integration with their growing arsenal of hypersonic missile systems.

Additionally, the People's Liberation Army's (PLA) HEMP arsenal is growing rapidly. HEMPs can generate pulses over wide areas, inducing destructive electrical charges across critical systems. With 600 nuclear warheads today, the PRC plans to have 1,000 by 2035 delivered by systems like the DF-26—each warhead representing a potential HEMP.[3]

These weapons reflect the PLA's informatized warfare doctrine, targeting technological nodes to paralyze adversary forces. When paired with its active defense doctrine, which increasingly embraces preemptive strikes, EMP weapons serve as a modern "Assassin's Mace" type weapon.[4] A few well-placed HEMPs over Taiwan, combined with precision HPM strikes, could achieve strategic surprise and cripple that nation's electronic infrastructure.

As the PRC develops its EMP arsenal, it has also taken steps to protect its own infrastructure from potential EMP attacks.

The PRC's State Administration for Market Regulation enforces EMP

---

[2] Tin Pak and Yu-cheng Chen, "Weaponizing the Electromagnetic Spectrum: The PRC's High-Powered Microwave Warfare Ambitions," *China Brief 25*, No. 9, May 9, 2025, *The Jamestown Foundation*, https://jamestown.org/program/weaponizing-the-electromagnetic-spectrum-the-prcs-high-powered-microwave-warfare-ambitions/.

[3] Hans M. Kristensen, Matt Korda, Eliana Johns, and Mackenzie Knight, "Chinese Nuclear Weapons, 2025," *Bulletin of the Atomic Scientists 81*, No. 2, March 12, 2025, pp. 135-60, https://doi.org/10.1080/00963402.2025.2467011.

[4] Tin Pak and Chen Yu-cheng, "China Has Found Its Assassin's Mace," Taipei Times (Taipei), May 6, 2025, sec *Editorial & Opinion*, https://www.taipeitimes.com/News/editorials/archives/2025/05/06/2003836382.

hardening standards for commercial electronics, which aim to ensure a level of protection against EMP disturbances. However, unlike their IEC counterparts, they stop short of specifying exact shielding attenuation levels or frequency requirements within their open source regulations. That said, the PRC's GB/T 17626.3 regulation sets out the required frequencies needed for electromagnetic immunity testing, and these appear consistent with most international practices.[5]

On the military side, the PLA is actively exploring strengthening its EMP defense research and development, as reflected in a variety of reports published by PLA-affiliated institutions. For example, the Laboratory on Electromagnetic Effects and Electro-optical Engineering at the Army Engineering University in Nanjing conducts research into defensive EMP measures, including protection for naval vessels against electromagnetic disturbances.[6] A 2023 paper from the PRC's National University of Defense Technology, presented at the 11th China Conference on Command and Control, focused on electromagnetic mobile defense tactics.[7]

Additional studies published in the Journal of China Academy of Electronics Science focus on examining the effects of EMPs on critical electronic systems. The China Luoyang Electronic Equipment Test Center

---

[5] GB/T 17626.3-2023, Electromagnetic Compatibility — Testing and Measurement Techniques — Part 3: Radiated, Radio-Frequency, Electromagnetic Field Immunity Test, issued December 28, 2023, implemented July 1, 2024, by the Standardization Administration of China and State Administration for Market Regulation.

[6] Gaofei, Pei, Chen Hailin, and Gao Cheng. "Lightning Protection Evaluation Technology of Surface Ship Based on Leader Progression Model," *强激光与粒子束 30,* No. 1,2018, p. 013202-1.

[7] LIN Dong-Xu and WANG Jin-Song, "Analysis on Electromagnetic Maneuver Defense Tactics," *College of Electronic Engineering, National University of Defense Technology*, October 24, 2023, document no. ZHKZ202310001133.

conducted research on the probability of detection for radars that are being electromagnetically jammed.[8] Another paper from the PRC's National University of Defense Technology simulated the effects of electromagnetic disturbances on air defense platforms.[9]

This emphasis on EMP hardening among the PRC's leading military technology institutions reflects growing recognition of the electromagnetic domain's strategic importance for future conflicts.

Regarding exact standards of EMP protection for military facilities, the PLA adheres to the "中华人民共和国国家军用标准" (National Military Standards of the PRC). This regulatory framework includes provisions for EMP defense. For instance, GJB 8848-2016 sets out electromagnetic environmental effects test methods for systems and equipment as provided in its commercial standards.[10] However, documents detailing exact EMP protection thresholds remain restricted.

2. United States:

The United States' research and development of EMP weaponry is

---

[8] Zhang Zhengchao, Xu Peiwei, Li Wenchen, and Li Hong, "Research on Detected Probability of Radar Network under Complex Electromagnetism Jamming," *Science & Technology Review (Kejì Pínglùn)*, National Key Laboratory of Complex Electromagnetic Environment Effects on Electronic Information Systems and China Luoyang Electronic Equipment Test Center, 2023, https://kjpl.cbpt.cnki.net/WKD/WebPublication/paperDigest.aspx?paperID=58f6d254-4028-47ea-a154-fc6447537984.

[9] Dai Huanyao, Li Lin, Cui Jianling, Qiao Huidong, and Zhao Jing, "Analysis and Simulation of Air Defense Weapon System Complicated Electromagnetic Environment Effect," National Key Laboratory of Complex Electronic Environmental Effects on Electronic Information Systems and School of Electronic Science and Engineering, *National University of Defense Technology*, 2023, CNKI, https://kjpl.cbpt.cnki.net/WKD/WebPublication/paperDigest.aspx?paperID=aa40951b-0888-436a-aa2c-e257f0f3f80e.

[10] Equipment Development Department of the Central Military Commission, 系统电磁环境效应试验方法 [System Electromagnetic Environmental Effects Test Methods], GJB 8848–2016 (Beijing: *Equipment Development Department*, 2016), http://detech.net.cn/uploads/soft/20200402/1585798138.pdf.

significantly more advanced than that of the PRC. The United States has not only developed missile-borne EMP weapons, but also possesses a nuclear arsenal approximately three times larger than the PRC's, totaling around 3,700 nuclear warheads—each of which is a potential HEMP weapon.[11] Coupled with its flexible nuclear use policy and a wide range of yields and delivery mechanisms, the United States maintains a diversified and highly capable HEMP arsenal.

The United States is also actively developing advanced non-nuclear EMP systems. In 2016, the Office of Naval Research Science & Technology and the Air Force Research Laboratory launched the High Power Joint Electromagnetic Non-Kinetic Strike (HiJENKS) project.[12] Designated as the successor to the Air Force's Counter-electronics High Power Microwave Missile Project (CHAMP), HiJENKS aims to produce a missile-borne HPM weapon intended to disable or destroy electronic systems as it flies above its targets. Although many details about the HiJENKS weapon remain classified, the Air Force reported that it successfully conducted battlefield tests in 2022. Its predecessor, CHAMP, integrated the Air Force Research Laboratory's HPM payload with Boeing's AGM-86 Conventional Air-Launched Cruise Missile. In a 2012 test, it was able to disable seven separate electronic targets in a single mission.[13]

---

[11] Hans M. Kristensen, Matt Korda, Eliana Johns, and Mackenzie Knight, "United States Nuclear Weapons, 2025," *Bulletin of the Atomic Scientists 81*, No. 1, January 2025, pp. 53-79, https://thebulletin.org/premium/2025-01/united-states-nuclear-weapons-2025/.

[12] High Power Joint Electromagnetic Non-Kinetic Strike (HIJENKS), AD 1195640, *Defense Technical Information Center*, March 9, 2023, https://apps.dtic.mil/sti/trecms/pdf/AD1195640.pdf.

[13] Robert Johnson, "Boeing Now Has a Missile That Destroys Only Electronics and Leaves All Else Intact," *Business Insider*, October 25, 2012, https://www.businessinsider.com/beoings-counter-electronics-high-power-microwave-advanced-missile-project-2012-10?0=defense.

Beyond missile-borne HPM systems, the United States is also investing heavily in land-based HPM weapons to counter unmanned aerial drones. In 2019, the Air Force Research Laboratory began development of the Tactical High-power Operational Responder (THOR), a land-based HPM weapon designed primarily for anti-drone operations.[14] Additionally, beginning in 2023, the U.S. Army started to procure land-based Leonidas HPM systems to defend its installations from drones.[15]

In terms of defense measures, the United States has been the most publicly proactive among the three nations on this front.

Within the military, the U.S. Department of Defense adheres to its regulation MIL-STD-188-125-1 when hardening its critical infrastructures and systems.[16] It states that hardened facilities must be able to withstand an EMP with an intensity of 80 decibels at a one gigahertz frequency. The extent of hardening across military facilities is classified. It is likely confined to strategically critical facilities.

The Trump Administration's 2019 Executive Order on Coordinating National Resilience to Electromagnetic Pulses marked the first time EMP protections were directly addressed at the national level.[17] The order directed the Department of Homeland Security (DHS) to coordinate

---

[14] Air Force Research Laboratory, "TACTICAL HIGH POWER OPERATIONAL RESPONDER (THOR)," *Air Force Research Laboratory*, accessed June 26, 2025, https://afresearchlab.com/technology/thor.

[15] Epirus, Inc., "U.S. Army Awards Epirus $66.1 M Contract for Leonidas™ Directed Energy System," press release, *Los Angeles*, CA, January 23, 2023, Epirus Inc., https://www.epirusinc.com/press-releases/u-s-army-awards-epirus-66-1m-contract-for-leonidas-tm-directed-energy-system/.

[16] DEPARTMENT OF DEFENSE, MIL-STD-188-125-1: High-Altitude Electromagnetic Pulse (HEMP) Protection for Fixed Facilities, *U.S. Military Standard*, July 17, 1998, public release, https://www.volta.it/wp-content/uploads/2017/09/MIL-STD-188-125-1.pdf.

[17] Donald J. Trump, Executive Order 13865: Coordinating National Resilience to Electromagnetic Pulses, March 26 2019, published in Federal Register 84 FR 12041 (March 29 2019), *Trump White House Archives*, https://trumpwhitehouse.archives.gov/presidential-actions/executive-order-coordinating-national-resilience-electromagnetic-pulses/.

national EMP defense, review protection standards, and develop an integrated, cross-sector plan to address identified gaps. However, the order framed private-sector participation as collaborative rather than mandatory. DHS is directed to only share its analyses on EMP threats to private utilities and other agencies, and as appropriate, provide "incentives" to private-sector partners to address these vulnerabilities.

The executive order lacks a strong legal imperative granting agencies the authority to enforce EMP protections. A similar weakness characterized the Department of Energy's 2017 Electromagnetic Pulse Resilience Action Plan, which did not specify EMP protection levels that utilities must meet, unlike those provided in the military standard.[18] Instead, it remained consultative, focused on sharing best practices and promoting mitigation strategies rather than setting requirements.

Since the implementation of the 2019 executive order, the energy utilities represented by the North American Electric Reliability Corporation (NERC) formed an Electromagnetic Pulse Task Force in accordance with the executive order. The outcome of this initiative was its Strategic Recommendations report.[19] In line with the presumably voluntary and collaborative nature of the executive order, the recommendations they delivered are just that, recommendations for which no promise of implementation is made.

At the state level, several governments have attempted to strengthen

---

[18] U.S. Department of Energy, "Electromagnetic Pulse Resilience Action Plan," January 10, 2017, *U.S. DOE*, https://www.energy.gov/sites/prod/files/2017/01/f34/DOE%20EMP%20Resilience%20Action%20Plan%20January%202017.pdf.

[19] EMP Task Force, EMP Task Force: Strategic Recommendations Report, draft, North American Electric Reliability Corporation, August 30, 2019, *NERC*, https://www.nerc.com/pa/Stand/EMP%20Task%20Force%20Posting%20DL/EMP_Task_Force_Strategic_Recommendations_Report_08302019.pdf.

EMP protections for critical infrastructure, with limited success. In 2013, Maine passed An Act To Secure the Safety of Electrical Power Transmission Lines, directing its Public Utilities Commission to examine grid vulnerabilities to geomagnetic and electromagnetic interference and issue recommendations for utilities to address these threats.[20] However, the law stopped short of granting the government authority to compel utilities to implement these recommendations. Two subsequent bills that attempted to establish such authority were vetoed and died in the legislature.

Another example is Virginia. In 2015, Virginia amended its legal code to require the Department of Emergency Management to plan for disasters caused by EMP incidents.[21] Yet, as of a 2019 Virginia Joint Commission on Technology and Science report, EMP considerations had not been incorporated into the department's annual assessments.[22] Moreover, this measure focuses on response rather than prevention.

Other states, including Texas and South Carolina, drafted bills to assess the EMP resilience of their electric grids and propose protective measures. All these bills failed to become law.

3. Taiwan:

Taiwan's investment in EMP weapons is the weakest among the three nations explored in this article. Beyond their procurement of

---

[20] Resolve, Directing the Public Utilities Commission To Examine Measures To Mitigate the Effects of Geomagnetic Disturbances and Electromagnetic Pulse on the State's Transmission System (Resolve Chapter 45, L.D. 131, 126th Legislature of Maine), August 6, 2013, https://www.ourenergypolicy.org/wp-content/uploads/2013/08/Maine-126-HP-106-item-3.pdf.

[21] Virginia General Assembly, Joint Subcommittee to Study State Preparedness for an Electromagnetic Pulse (EMP) or Geomagnetic Disturbance (GMD) Event, State Electromagnetic Pulse (EMP) and Geomagnetic Disturbance (GMD) Preparedness Assessment (Report SD5), published 2019, *Richmond*, VA: Virginia General Assembly, https://rga.lis.virginia.gov/Published/2019/SD5/PDF.

[22] Virginia General Assembly, State Electromagnetic Pulse (EMP) and Geomagnetic Disturbance (GMD) Preparedness Assessment (Report SD).

electromagnetic hand-held jamming guns aimed at disabling aerial drones, they do not have any EMP weapons.

Similarly, Taiwan's efforts at defending against EMPs are also the weakest, leaving the nation acutely vulnerable. A large-scale EMP attack, whether through targeted HPM strikes on critical nodes or broad-based HEMP attacks, could trigger cascading failures across both Taiwan's military and civil society.

EMP attacks can swiftly disable military command and control systems, paralyzing defensive operations. Key assets such as Taiwan's Patriot and Tien Kung surface-to-air missile batteries, which rely on vulnerable electronic sensors and radar, would be at significant risk. While many of Taiwan's critical military installations are hardened to withstand HEMP-grade attacks following U.S. military standards, these protections remain susceptible to higher-frequency HPM attacks, which can operate at frequencies many times greater than those of HEMPs.[23]

The civilian sector faces even greater dangers. Essential services, including telecommunications, water treatment, transportation—and most importantly, its energy grid— depend on electronics that are highly vulnerable to EMPs. Taiwan's Bureau of Standards, Metrology and Inspection enforces International Electrotechnical Commission (IEC) EMP hardening standards for commercial infrastructure.[24] However, these standards are designed primarily to address naturally occurring EMP events, such as lightning strikes or solar storms, and fall short of protecting

---

[23] Tin Pak and Yu-cheng Chen, "Could Taiwan Survive an EMP Attack by China?" *The Diplomat*, May 7, 2025, https://thediplomat.com/2025/05/could-taiwan-survive-an-emp-attack-by-china/.

[24] U.S. Department of Commerce, International Trade Administration, "Taiwan – Standards for Trade," *International Trade Administration Country Commercial Guide,* last updated January 10, 2024, https://www.trade.gov/country-commercial-guides/taiwan-standards-trade.

against the more high-intensity pulses generated by HEMPs or HPMs.

Unlike the United States, Taiwan has not enacted a single piece of legislation focused on strengthening civilian EMP defenses. Nevertheless, there are encouraging signs that Taiwan is beginning to recognize and address this critical vulnerability. Under President Lai Ching-te's whole-of-society defense resilience strategy, asymmetric threats like EMPs have gained greater prominence.[25] This initiative seeks to enhance civil-military cooperation and build a more integrated defense posture.

Moreover, Taiwan's military is also showing increasing awareness of electromagnetic threats, as evidenced by its acquisition and integration of hand-held anti-drone electromagnetic rifles into its forces.[26] As more electromagnetic weapons are integrated into its operations, the military's understanding of its own vulnerabilities to similar weapons wielded by its adversaries will likely sharpen, potentially driving further policy action on this front.

Yet, time is a critical factor. Failure to act swiftly could leave Taiwan greatly exposed. A 2019 South Carolina legislative proposal to harden that state's energy grid estimated it would take a decade to fully implement protective measures.[27] Taiwan may not have that long; some experts suggest that the People's Liberation Army could be ready for an attack as early as 2027, or perhaps by 2035. Therefore, the window to take action is narrowing, and Taiwan's resilience will depend on how quickly its

---

[25] Office of the President, Republic of China (Taiwan), "Whole-of-Society Defense Resilience Committee," accessed June 26, 2025, *Policy Vision page*, https://english.president.gov.tw/Page/670.

[26] Kelvin Chen, "Taiwan Completes Anti-Drone Gun Deployment," *Taiwan News*, February 19, 2024, https://www.taiwannews.com.tw/news/5098108.

[27] South Carolina Revenue and Fiscal Affairs Office, Statement of Estimated Fiscal Impact: H. 4954, introduced January 25, 2024, analyzed March 21, 2024, *Columbia*, SC, https://www.scstatehouse.gov/sess125_2023-2024/fiscalimpactstatements/H4954%202024-01-25%20introduced.pdf.

government can begin implementing nationwide EMP security measures aimed at defending against higher-intensity EMP attacks.

4. Conclusion:

With the increasingly digitization and electronification of warfare, EMP weapons will be critical for any future conflict involving these three nations. Regarding their offensive capabilities, the United States and the PRC have advanced EMP arsenals, and Taiwan is beginning to invest in these systems. However, defenses against EMPs are lagging behind. Most discussions of EMPs in policy circles focus mainly on their battlefield applications, particularly in terms of their anti-drone capabilities. On the other hand, threats towards critical civilian infrastructures by HPM-borne missiles or HEMPs receive less attention due to their novelty and a pervasive normalcy bias surrounding the non-use of nuclear warheads.

A Comparative Analysis of EMP Defensive Measures of the PRC, United States, and Taiwan

Tin, Pak

Rainier Institute for Foreign Affairs

Abstract

The electromagnetic spectrum is a key warfare domain, with electromagnetic pulses (EMP) threatening electronic systems amid growing military digitization. The U.S., PRC, and Taiwan advance offensive EMP capabilities while hardening defenses, though gaps persist. This article analyzes their arsenals and resilience strategies.

The PRC excels in high-power microwaves (HPM), unveiling systems like FK-4000, and expands high-altitude EMPs (HEMPs) via a nuclear arsenal projected to 1,000 warheads by 2035. Defenses include commercial standards like GB/T 17626.3 and military research on EMP protections.

The U.S. leads with 3,700 nuclear warheads for HEMPs and non-nuclear projects like HiJENKS and THOR. Military hardening follows MIL-STD-188-125-1, but civilian efforts via 2019 Executive Order remain voluntary and limited.

Taiwan lags, with only anti-drone jammers offensively and U.S.-standard military hardening vulnerable to HPMs; civilian IEC standards are inadequate. Conclusion: Offenses outpace defenses, underscoring biases against civilian threats.

Keywords: Electromagnetic Pulse (EMP), Defensive Measures, Geopolitical Comparison