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China Maritime Report No. 41: One Force, Two Force, Red Force, Blue Force: PLA Navy Blue Force Development for Realistic Combat Training

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PLA Navy Blue Force Development for Realistic Combat Training

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Main Findings

- China's People's Liberation Army Navy (PLAN) is developing a maritime blue force (海上蓝军) as a key component of a broader training campaign with a central focus to build and refine PLAN combat capabilities to defeat the U.S. military at sea.[1]
- The developing PLAN maritime blue force integrates Western warfighting concepts and simulated capabilities. It capitalizes on recent advances in uncrewed systems, electronic signature generation, and live-virtual-constructive training as well as battlespace data collection and analysis.
- Crewed ships, submarines, and aircraft playing blue opposition forces combined with uncrewed systems and virtual battlespace representations offer the PLAN increasingly realistic training environments to develop combat skills against potential adversaries.
- Increasingly sophisticated maritime blue force simulations also provide PLAN training audiences with accurate representations of complex electromagnetic environments that include U.S. and allied military signals and jamming effects.
- To date, the progress toward a dedicated and substantial maritime blue force has been slow.
- Training against a realistic blue OPFOR may allow the PLAN to generate experience, develop more effective tactics, and gain confidence against potential adversaries. These advances may increase threats to U.S. and allied military forces and ultimately undermine deterrence.

Introduction

Since the mid-2010s, there has been a concerted effort to professionalize a PLAN "blue force" as an opposition force, or OPFOR, in maritime exercises and training. The People's Liberation Army (PLA) routinely refers to its blue forces as metaphorical "whetstones" used to sharpen the PLA for a future fight against enemies of the People's Republic of China (PRC). Efforts to develop a PLAN blue force appear to have accelerated over the past several years in response to Chairman Xi Jinping's decade-long demand for more realistic combat training.

This report examines recent developments in the PLAN's blue force. It comprises four sections. Part one provides background on PLAN efforts to professionalize its maritime blue force. Part two describes the PLAN's blue force training units. Part three examines companies producing equipment and virtual environments for China's blue force units, while part four discusses current blue force capabilities. The report concludes with a summary of findings and implications for the United States, its allies, and partners.

PLA Blue Force Development

OPFOR is a military force that simulates potential real-world adversaries to train friendly forces. In PLA training scenarios, friendly military elements are "red" forces, while adversary, or OPFOR militaries, are "blue" forces. This is a mirror image of U.S. military convention in which "red" forces are adversaries and "blue" forces are friendly. In PRC military writings, the PLAN's maritime blue force is also referred to as a "synthetic blue force" (合成蓝军), "electronic blue force" (电子蓝军) or "digital blue force" (数字蓝军).

Since assuming control of China's Communist Party and the PLA in 2012, Chairman Xi Jinping has called on his military to increase the realism of its training and prepare for war against a "strong enemy," a common euphemism for the United States. The PLA Air Force (PLAAF) and PLA Army (PLAA) have long maintained standing blue forces for advanced training. Sometimes described as China's "Top Gun," the PLAAF's Flight Test and Training Base (飞行试验训练基地) in Cangzhou has conducted elite pilot training

[1] See training references in the section 踏浪蹈海 ["Walking on the Waves"], in 益西拉 [Yi Xila], ed., 舰指深蓝 向海图强 ["Warships Pointing to the Deep Blue, Striving for Strength at Sea"], 瞭望 [*PLA Outlook Weekly*], 20 April 2024, archived on 31 July 2024: https://web.archive.org/web/20240422232307/http://www.81.cn/yw_208727/16302205.html.

using blue aggressor squadrons since the 1980s.[2] In 2014, the PLAA established the "Blue Wolves" of the 195th Combined Arms Brigade at the Zhurihe Training Base (朱日和训练基地).[3] The PLAA appear to have modeled the "Blue Wolves" and its OPFOR program after the opposition forces at the U.S. Army's Fort Irwin National Training Center.

The PLA's approach to blue force and OPFOR integration reflects its approach to "informationized warfare" (信息化作战) and its underlying system-of-systems warfare (体系作战) concept. According to some PLA scholars, experimentation with a committed and capable blue force can reveal the "emergent properties" in combat systems-of-systems. That is, the PLA recognizes that modern military operations are so complex that theoretical simulation and analysis are insufficient to reveal the hidden properties and phenomena in actual combat.[4] Requirements to engage in simulated combat with an actual blue force also reflects the PLA's shift from operations that are "platform- and firepower-centric" to informationized operations that are "information- and decision making-centric." There is also a broad recognition across PLA training commands that they must shift training from "single-domain, manned, and centralized" to "cross-domain/ multi-domain, manned-unmanned teamed, and decentralized." These changes are critical for the PLA to compete successfully with evolving U.S. military operational concepts.[5]

An historical lack of investment in dedicated PLAN OPFOR appears to have hindered the service's ability to effectively reach Xi's combat training goals. Prior to 2018, there were apparently no full-time PLAN blue forces. PLAN blue forces in exercises were usually regular forces drafted from the fleet on a temporary basis to play OPFOR. The quality of those ad hoc OPFOR varied significantly from event to event. For larger exercises, the PLAN attempted to compensate for its blue force shortcomings by enlisting instructors and researchers from PLAN academies and command colleges who were versed in foreign naval operations. These experts manned exercise headquarters to advise and direct the blue force in the fight.[6] However, red forces at-sea continued to face OPFOR that was poorly trained in blue force operations, executing PLAN tactics with familiar Chinese equipment and electronic signatures.

Analysis of open-source materials and commercial satellite imagery has revealed a professional maritime blue force developing across the PRC defense industry and key PLAN training commands since the late-2010s and especially since 2022. The PLAN appears to be building this blue force on a foundation of weapons test and evaluation bases infused with recently fielded virtual capabilities and physical platforms that simulate adversary ships, aircraft, and missiles. In recent years, training has also incorporated more focus on blue force operations—employing blue force equipment and simulations with realistic Western military tactics to mimic actual combat both at sea and in the electromagnetic spectrum.

PLAN Blue Force Training Units

Central Military Commission (CMC) training guidance in the late-2010s to pursue "combat, trials, and training integration" (战试训一体) may have spurred the PLAN to begin developing a dedicated maritime

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[2] Michael S. Chase, Kenneth W. Allen, and Benjamin S. Purser III, *Overview of People's Liberation Army Air Force "Elite Pilots,"* RR 1416-AF (Santa Monica, CA: RAND Corporation, 2016), p. 4, https://www.rand.org/content/dam/rand/pubs/research_reports/RR1400/RR1416/RAND_RR1416.pdf.

[3] Gary Li, "The Wolves of Zhurihe: China's OPFOR Comes of Age," *China Brief* 15, no. 4 (February 2015), https://jamestown.org/program/the-wolves-of-zhurihe-chinas-opfor-comes-of-age/.

[4] 钱东 [Qian Dong] and 赵江 [Zhao Jiang], 海上实兵作战实验综述 ["Summary of Live Warfighting Experimentation at Sea"], 水下无人系统学报 [*Journal of Unmanned Undersea Systems*] 28, no. 3 (June 2020), p. 249.

[5] 杨继坤 [Yang Jikun] and 齐嘉兴 [Qi Jiaxing], 美军作战概念对蓝军建设作用研究 ["Research on the Role of U.S. Military Operational Concepts in Blue Force Construction"], 舰船电子工程 [*Ship Electronic Engineering*] 41, no. 8 (August 2021), p. 8.

[6] 范江怀 [Fan Jianghuai], 吴永华 [Wu Yonghua], 郭兹平 [Guo Ziping], and 郭鹏 [Guo Peng], 编外蓝军, 无处不在的睢缠对手 ["Organizing an External Blue Force, the Ubiquitous Osprey Entangling Adversaries"], 人民海军 [*People's Navy*], 21 August 2018, p. 3.

blue force.[7] Combat, trials, and training integration sought to more closely align weapons and equipment testing and training with combat training.[8] Concurrent with that guidance, the PLAN began to discuss developing a professional blue force in its well-established weapons and equipment test and evaluation commands.[9] These technical organizations were a logical place to study blue force tactics and operations and apply them to fleet training.

The PLAN Test Base (中国人民解放军海军试验基地), also known as the 92493 Unit (92493 部队), appears to have assumed much of the responsibility for PLAN blue force development and operational training.[10] The PLAN Test Base is similar in many ways to U.S. Naval Base Ventura County, California that encompasses the Point Mugu Sea Range and Port Hueneme.[11] The PLAN Test Base headquarters is located on a 20 square kilometer complex on the northwest corner of the Bohai Gulf in Huludao, Liaoning Province. The Test Base berths blue force ships and target barges at the nearby Huludao Naval Base (Figure 1).

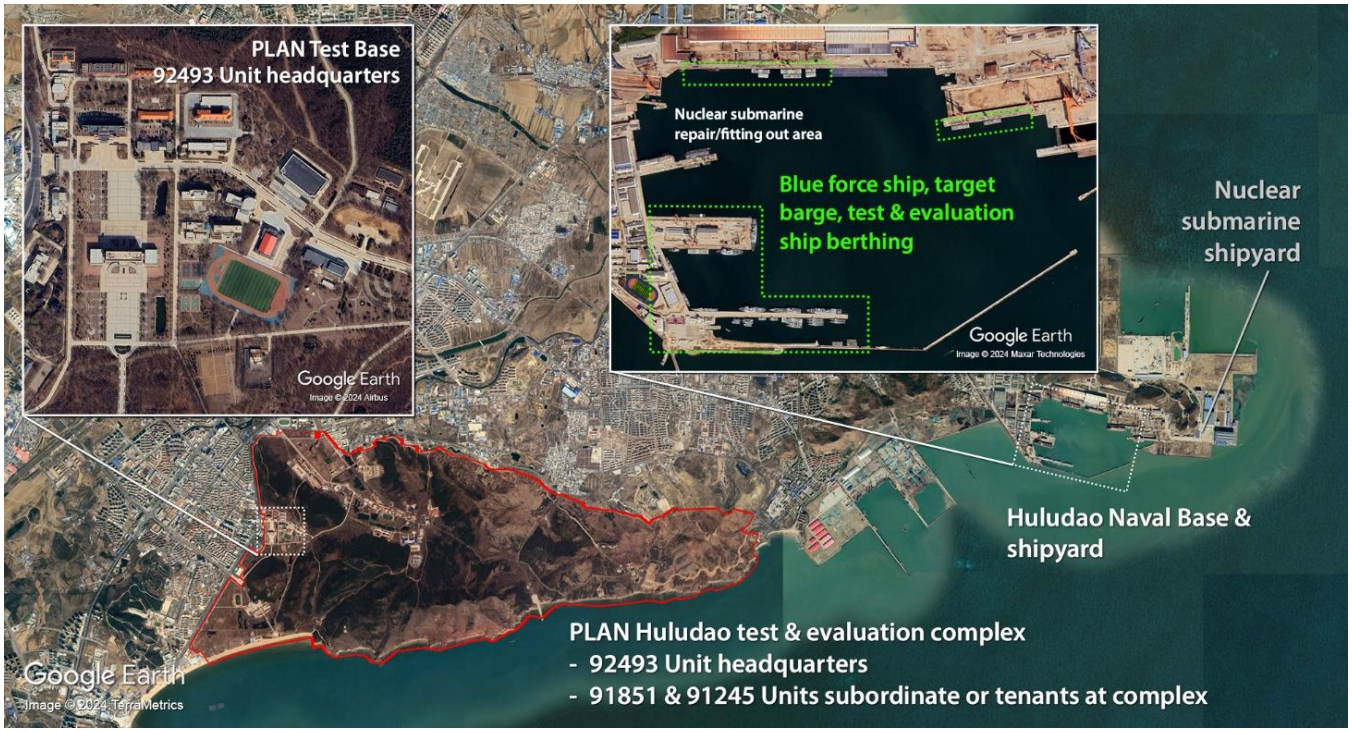

Figure 1. PLAN Huludao Test & Evaluation Complex (Google Earth/TerraMetrics, Maxar Technologies, Airbus) [12]

[7] 邹维荣 [Zou Weirong] and 成子龙 [Cheng Zilong], 战试训一体+组训新模式, 解锁作战新姿势 ["Combat Trial Training Integration + New Mode Training, Unlocking New Combat Positions"], 解放军报 [*PLA Daily*], 9 February 2018, archived 31 July 2024: https://web.archive.org/web/20240731155555/http://www.81.cn/2018xczjy/2018-02/09/content_7939033.htm.

[8] What is translated here as "trial training" (试训) could also be translated as "test training" and may simply be shorthand for testing and training (试验训练). However, in an operational context, "trial training" (试训) seems to be distinct from something like weapons and equipment testing and training (武器装备试验训练). In a sports context, "trial training" (试训) is better translated as "tryouts" and implies an internal competition for purposes of evaluation versus competition against another team.

[9] 杨继坤 [Yang Jikun], 张传友 [Zhang Chuanyou], 常秀丰 [Chang Xiufeng], and 周浩 [Zhou Hao], 海军试训蓝军体系建设与运用研究 ["Navy Trial Training Blue Force System Construction and Application Research"], 现代防御技术 [*Modern Defense Technology*], no. 2 (2017), pp. 22-23.

[10] "Base" (基地) in this context refers to a division grade or deputy corps grade command in the PLA hierarchy and not necessarily a place. Five-digit codes in this section are military unit cover designators (MUCDs) that the PLA uses in public documents or media to conceal a unit's true name or command affiliation. PLAN series MUCDs are 91XXX and 92XXX.

[11] "Naval Base Ventura County," U.S. Navy, accessed August 20, 2024, https://cnrsw.cnic.navy.mil/Installations/NAVBASE-Ventura-County.

[12] Google Earth Pro 7.3.6.9796, 92493 Test Base Headquarters, China, 40.700N, 120.851E, 25 March 2024, Airbus 2024; Huludao Naval Base, China, 40.713N, 121.000E, 15 October 2022, Maxar Technologies 2024.

The Test Base also maintains a network of land-based test facilities that extends 150 kilometers southwest of Huludao to Qinhuangdao (Hebei) (Figure 2).

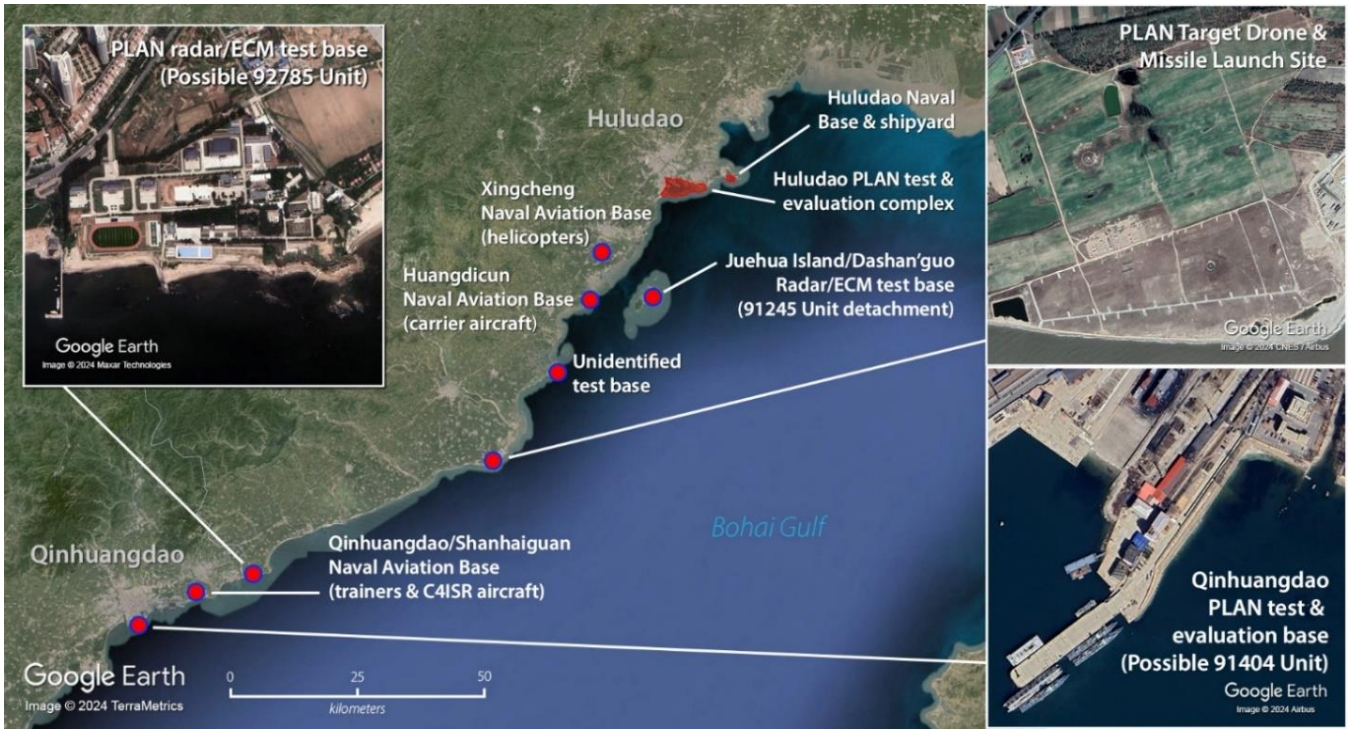

Figure 2. PLAN Bohai Gulf At-Sea Range Test Bases (Google Earth/TerraMetrics, Maxar Technologies, Airbus)[13]

Test Base related facilities, which include a drone/missile launch site, support an at-sea test range in the northern Bohai Gulf suitable for live-fire and force-on-force testing and experimentation. Aircraft and UAVs launched from local PLAN aviation bases also appear to participate in weapons tests, evaluations, and exercises. How the Test Base controls or tasks those aircraft is not clear. Other Test Base subordinate units probably include the 91404 and 92785 units in or near Qinhuangdao. The 92493 Unit also maintains Test Base detachments in several additional Northern and Southern Theater Navy locations including Dalian (Liaoning), Yantai (Shandong), Zhanjiang (Guangdong), and Sanya (Hainan).[14]

The PLAN Test Base purportedly faced a number of challenges establishing an operationally focused maritime blue force.[15] By some accounts, following its creation in the late-2010s, the blue force was not "blue" enough. Surveyed PLAN commanders decried the blue force effort stating, "Participating in training is a waste of time!"[16] The Test Base responded by assembling an "operational problem research group" (作战问题研究组) and an "adversary research small group" (作战对手研究小组).[17] By 2023, reports indicated

[13] Google Earth Pro 7.3.6.9796, Qinhuangdao Test Base, China, 39.907N, 119.607E, 28 March 2024, Airbus 2024; 92785 Unit Base, China, 39.993N, 119.873E, 15 June 2022, Maxar Technologies 2024; Missile & Drone Launch Site, China, 40.197N, 120.438E, 4 October 2019, CNES Airbus 2024.

[14] PLA 92493 Unit, "Recruitment Announcement: Direct Recruitment of Military Officers and Open Recruitment of Civilian Personnel," (PLAN brochure, 2022), p. 12.

[15] Evidence for this assessment is based largely on reports from the *PLA Daily* and *People's Navy* newspapers, which, admittedly, follow a storytelling formula that has leaders of organizations successfully overcoming real or manufactured adversity to teach lessons about innovation or perseverance.

[16] 奉云鹤 [Feng Yunhe], 陈海涛 [Chen Haitao], and 赵言 [Zhao Yan], 为了打赢明天的战争 ["To Win Tomorrow's War"], 人民海军 [*People's Navy*], 12 August 2022, p. 1.

[17] Ibid.; also, 徐剑雨 [Xu Jianyu], 魏桐 [Wei Tong], and 路海涛 [Lu Haitao], 叱咤海天一"蓝剑" ["The 'Blue Sword' that Dominates the Sea and Sky"], 人民海军 [*People's Navy*], 28 July 2021, p. 2.

increasing satisfaction among PLAN commanders. The Test Base blue force now reportedly offers its red training audience with a more realistic adversary force and a more representative electromagnetic environment in which to train and experiment with new tactics and techniques.[18] A 2023 recruiting video for the 92493 Test Base shows the phrases on the wall behind its control center, "Focus on warship combat simulation | Decisive victory in the future deep blue battlefield" (Figure 3).

Figure 3. 92493 Unit Test Base Control Center [19]

For years, the PLAN Test Base operated a number of test and evaluation ships as well as target ships and barges. These include the Type 636B *Shupang*-class AGE and Type 909 *Dahua*-class AGE (weapons test and trial auxiliary ships). Huludao and Qinhuangdao Naval Bases are also home to two older Type 053 *Jianghu I*-class frigates as well as several Type 037IG *Houxin*-class guided missile patrol craft and Type 037IS *Haiqing*-class patrol craft employed by the Test Base for evaluation and training.[20] Legacy target craft also include 70-meter target barges fitted with radar reflectors to simulate blue targets as well as remote controlled 32-meter high-speed catamarans, the *Dubei*-class YGT (Figure 4).

Figure 4. Two *Dubei*-class YGT High-Speed Target Craft [21]

[18] 钱晓虎 [Qian Xiaohu], 奉云鹤 [Feng Yunhe], and 陈海涛 [Chen Haitao], "海上蓝军"搅动"未来战场" ["The 'Maritime Blue Force' Stirs Up the 'Future Battlefield'"], 人民海军 [*People's Navy*], 13 January 2023, p. 2.

[19] "Combat simulation" (作战仿真) may also be translated as "operational simulation." However, in related Chinese-language journal articles with English abstracts, a majority prefer the former translation. 92493 Unit, "(Navy 92493 Unit recruitment promotional video)," video, 1:13, Douyin, 21 March 2023, https://www.douyin.com/video/7212914186618178876.

[20] Auxiliary order of battle from Manfred Meyer, *Modern Chinese Maritime Forces*, ed. Larry Bond and Chris Carlson (Admiralty Trilogy Group, 2023), confirmed by analysis of recent commercial satellite imagery.

[21] Coatepeque, "Remote Control Target Ships of the China Navy," China Defense Blog, 17 December 2011, archived 23 November 2023, https://web.archive.org/web/20231123092915/http://china-defense.blogspot.com/2011/12/photo-of-day-remote-control-target.html

PRC Maritime Blue Force Defense Industry

Subsidiaries of the PRC defense conglomerate China Aerospace Science and Industry Corporation (CASIC, 中国航天科工集团有限公司) appear to be leading the development of PLAN maritime blue force equipment and simulation capabilities. These companies also likely have a role in developing blue forces for other military services.[22] One of CASIC's seven listed companies, the Aerospace Industry Development Co., Ltd. (Aerospace Development, 航天工业发展股份有限公司) appears to be largely responsible for fulfilling blue force system requirements across the PLA.[23]

Aerospace Development's four main lines of business include "digital blue force and blue force equipment" (数字蓝军与蓝军装备), 5G communications and control systems, cyberspace security, and microsystems.[24] Blue force related business reportedly accounts for half of the company's net profits.[25] The military products generated by Aerospace Development and its subsidiaries include "embedded semi-physical simulation systems, radio frequency (composite) simulation systems, combat effectiveness evaluation systems, electromagnetic environment reconnaissance simulation equipment, radar return simulation equipment, radar/communication signal simulation equipment, radar/communication interference simulation equipment, and land, sea, and air target platforms."[26]

Among Aerospace Development's ten main subsidiaries, its core blue force enterprise is the Nanjing Changfeng Aerospace Electronics Technology Co., Ltd. (南京长峰航天电子科技有限公司). Nanjing Changfeng has specialized in blue force system research and development since 2010. CASIC's Aerospace Development acquired Nanjing Changfeng in 2015. According to the company's website, Nanjing Changfeng is the first high-technology enterprise in China to develop radio frequency and composite, semi-physical simulation systems.[27] These systems combine virtual blue forces running on a computer with physical blue forces that move through the battlespace into a synthetic force that reacts to red forces and mimics the electronic signals and radar returns of real-world adversary forces.[28]

Aerospace Development's blue force enterprise has realized noteworthy growth in recent years. In 2016, Aerospace Development acquired another subsidiary, CASIC's Aerospace Science and Industry System Simulation Technology (Beijing) Co., Ltd. (航天科工系统仿真科技(北京)有限公司), combining sophisticated virtual simulation capabilities with Nanjing Changfeng's platform and electromagnetic simulation capabilities.[29] In 2022, Nanjing Changfeng established the "Blue Force Equipment Research

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[22] Available reporting supports these companies' involvement in the development of a maritime blue force for the PLAN. However, corporate literature indicates efforts to at least expand blue force development to the PLAA, PLAAF and PLA Rocket Force. Further research is required to substantiate CASIC subsidiary development of blue forces across the PLA.

[23] 黎韬扬 [Li Taoyang] and 鲍学博 [Bao Xuebo], 航天发展深度之一 [*Aerospace Development In-Depth*], Securities Research Report, Aerospace Development (Beijing: CITIC Securities Research and Development Department, 29 October 2019), p. 1.

[24] 公司简介 ["Company Profile"], Aerospace Industry Development Co., Ltd., archived 9 March 2023, https://web.archive.org/web/20230309201646/http://www.casic-addsino.com/n4078332/n4078334/index.html.

[25] Li and Bao, *Aerospace Development In-Depth*, p. 1.

[26] 数字蓝军与蓝军装备 ["Digital Blue Military and Blue Military Equipment"], Aerospace Industry Development Co., Ltd, accessed 5 May 2024, http://www.casic-addsino.com/n4078360/n27093272/index.html.

[27] 南京长峰航天电子科技有限公司 ["Nanjing Changfeng Aerospace Electronics Technology Co., Ltd."], Aerospace Industry Development Co., Ltd, 14 October 2022, accessed 5 May 2024, http://www.casic-addsino.com/n4078332/n4078348/c24994422/content.html.

[28] 王来贺 [Wang Laihe] and 崔雪静 [Cui Xuejing], 海上无人化试验训练体系构建问题研究 ["Research on the Construction of Maritime Unmanned Test and Training System"], 兵工学报 [*Acta Armamentarii*], (September 2023): pp. 10-13, http://www.co-journal.com/EN/10.12382/bgxb.2023.0633#1.

[29] Li and Bao, *Aerospace Development In-Depth,* p. 1.

Institute" (蓝军装备研究院) dedicated to developing blue force capabilities across the land, sea, air, and space domains for all PLA military services.[30]

Nanjing Changfeng appears to have two subsidiaries, the Nanjing Aerospace National Instruments Intelligent Equipment Co., Ltd. (南京航天国器智能装备有限公司) and the Jiangsu Dayang Marine Equipment Co., Ltd. (江苏大洋海洋装备有限公司).[31] Nanjing Aerospace Intelligent Equipment develops rotary-wing uncrewed aerial vehicles (UAVs) and airborne target drones.[32] In 2017, Nanjing Changfeng acquired 65 percent controlling interest in Jiangsu Dayang Marine for its experience and ability to produce high-speed target ships and offshore simulation platforms.[33] Jiangsu Dayang Marine has designed increasingly sophisticated blue force ships and simulation platforms described in the next section. Its shipyard is located on the Yangtze River, approximately 200 kilometers upriver from Shanghai.[34]

According to industry analyses, blue force equipment military sales were responsible for Aerospace Development and Nanjing Changfeng profits doubling year-on-year between 2018 and 2020.[35] However, recent reporting reveals indications of corporate infighting, significant financial losses, and possible dissatisfaction among military customers. In 2022, Aerospace Development's board rebuked its subsidiary, Nanjing Changfeng, for unauthorized dealings with the private owners of the remaining 35 percent of Jiangsu Dayang Marine. Nanjing Changfeng sued the private owners for failing to fulfill financial performance commitments. In the suit, Nanjing Changfeng demanded monetary compensation or additional equity in Jiangsu Dayang Marine.[36] Resolution of that lawsuit is unknown. Aerospace Development's 2023 annual corporate report also indicated significant declines in revenue and profit. Some of these loses were apparently due to the fact that "multiple blue force construction tasks failed to be completed and accepted." Despite these losses and apparent shortfalls, Aerospace Development's recent corporate report remains optimistic about future profits and continued blue force investment by the PLA.[37]

Maritime Blue Force Capabilities

In 2022, the PLAN Test Base began integrating what appears to be a new generation of platforms and capabilities into its blue force inventory from CASIC subsidiaries. The newest generation of blue force systems first appeared at the 2021 China Air Show. A CASIC display featured blue force ships and aircraft offered by Nanjing Changfeng (Figure 5). Offerings included a model of an aircraft carrier-shaped target barge on rails, presumably for land-based testing of missiles targeting radar returns from aircraft carriers. Another model that attracted media attention at the time was the *Bosha* (搏鲨 – "Fighting Shark") drone carrier.[38] The *Bosha* drone carriers, built by Jiangsu Dayang Marine, may have been a failed experiment. The

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[30] "Nanjing Changfeng Aerospace Electronics Technology Co., Ltd.," accessed 5 May 2024.

[31] "Aerospace Development Organizational Chart," Aerospace Industry Development Co., Ltd, accessed 5 May 2024, http://www.casic-addsino.com/n4078332/n4078338/index.html.

[32] 第十四届中国航展"江苏元素"闪耀现场 ["'Jiangsu Elements' Shine at the 14th China Airshow"], 我苏网 [*WoSu.com*], 10 November 2022, https://www.ourjiangsu.com/a/20221110/166808030363.shtml.

[33] 这家船厂原董事长被起诉索赔 1.3 亿元 ["Former Chairman of Shipyard Sued for 130 Million Yuan"], *Sohu.com*, 29 December 2022, https://www.sohu.com/a/622343495_276266.

[34] The Jiangsu Dayang Marine shipyard is located at 32.008N, 1119.994E.

[35] 黎韬扬 [Li Taoyang] and 鲍学博 [Bao Xuebo], 业绩保持较快增长, 电子蓝军有 望持续快速发展 [*Performance Maintained Rapid Growth, Electronic Blue Army Expected to Continue Rapid Development*], Securities Research Report, Aerospace Development (Beijing: CITIC Securities Research & Development Department, 28 August 2020), p. 1.

[36] Zhao Linan, "Former Chairman of Shipyard Sued for 130 Million Yuan."

[37] Aerospace Industry Development Co., Ltd., 航天工业发展股份有限公司 2023 年年度报告摘要 ["2023 Annual Report Summary"], (Beijing: Aerospace Industry Development Co., Ltd., 30 April 2024), p. 2, https://file.finance.sina.com.cn/211.154.219.97:9494/MRGG/CNSESZ_STOCK/2024/2024-4/2024-04-30/10175298.PDF.

[38] Joseph Trevithick, "China Built a Mothership for Training its Forces to Defend Against Drone Swarms," *The War Zone*, 11 November 2021, https://www.twz.com/43099/china-now-has-a-mothership-to-train-its-naval-forces-against-aerial-drone-swarms.

drone carriers may have been among the "multiple blue force construction tasks [that] failed to be completed and accepted," that led to financial losses in 2022-2023. A review of commercial satellite imagery shows the two *Bosha* drone carriers have been sitting idle at the Jiangsu Dayang Marine shipyard since October 2021.[39]

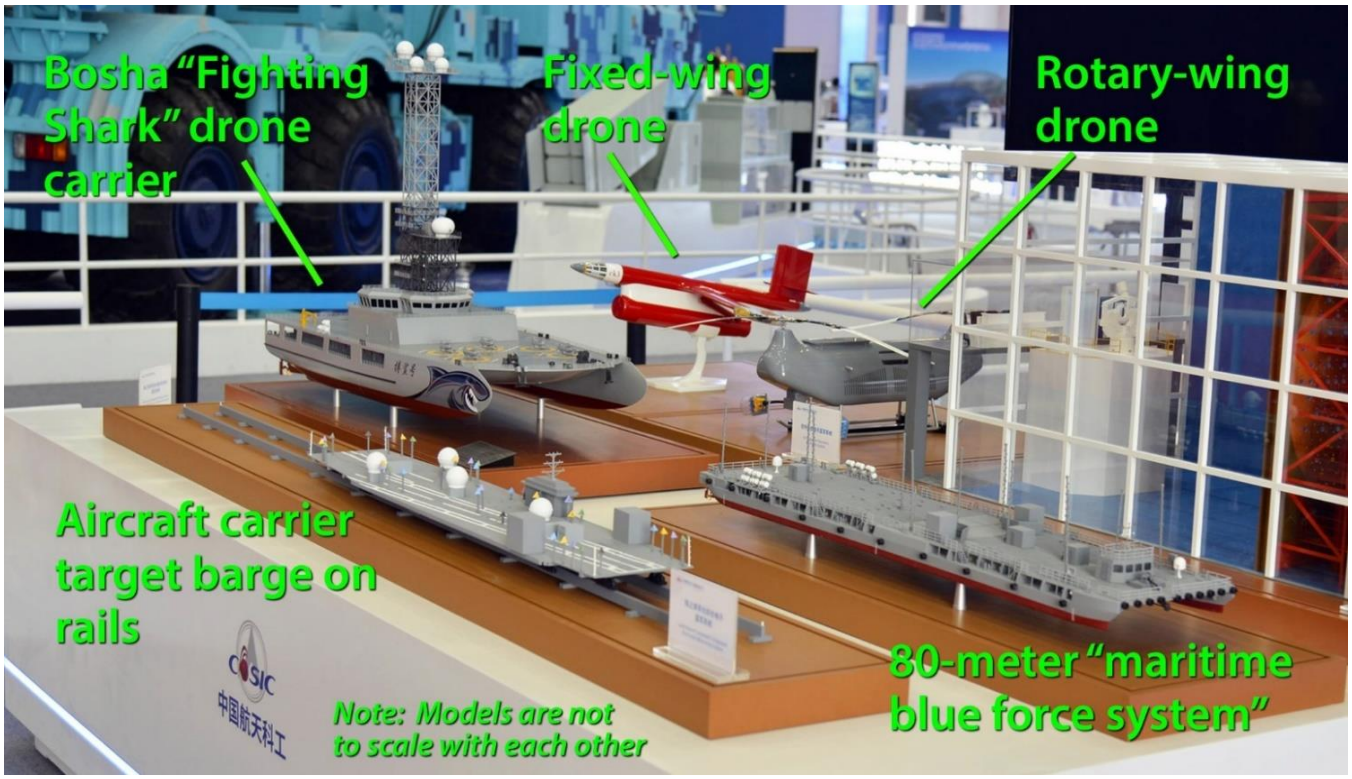

Figure 5. CASIC Blue Force System Display at 2021 China Air Show [40]

The rotary-wing drone in the CASIC display is likely the Nanjing Aerospace Intelligent Equipment GQ-320 dual-rotor drone. Both the model and the drone in the air show display shown in Figure 6 appear to be outfitted with electronic warfare antenna extending from arms at the front of the fuselage. Billed as a "shipborne unmanned helicopter," the GQ-320 can reportedly carry a 100-kilogram (220-pound) payload, with a maximum range of 500 kilometers (270 nautical miles) and endurance of 4 hours.[41]

Figure 6. (Left-to-right) GQ-320, GQ-580, GQ-680 Drones at 2022 China Air Show [42]

[39] Planet, PlanetScope, Image ID: 20211010_024400_1105, 10 October 2021, Taizhou, China, 32.007N, 1119.993E, www.planet.com.

[40] Rick Joe (@RickJoe_PLA), "The moving target is probably the most interesting part," X (Twitter), 8 November 2021, 12:00 a.m., https://x.com/RickJoe_PLA/status/1457573642401824770/photo/1.

[41] "GQ-320 Shipborne Unmanned Helicopter," *China Defence*, accessed 6 August 2024, https://www.militarydrones.org.cn/gq-320-shipborne-unmanned-helicopter-p00609p1.html.

[42] "'Jiangsu Elements' Shine at the 14th China Airshow."

In mid-2022, the PLAN Test Base apparently accepted what the CASIC display identified as a "Maritime Systemized Multifunctional Integrated Electronic Blue Force System" (海上体系化多功能统合电子蓝军系统) built by Jiangsu Dayang Marine.[43] It is a self-propelled 80-meter catamaran barge outfitted with radar and communication gear to simulate blue signals of interest. This includes jammers, chaff, and radar reflectors to make the barge look like a much larger vessel (Figure 7). As of April 2024, five of the Blue Force System barges were located at the Huludao Naval Base (Figures 8-9).

Figure 7. 80-meter Blue Force System Barge with Tug (note the catamaran hull)[44]

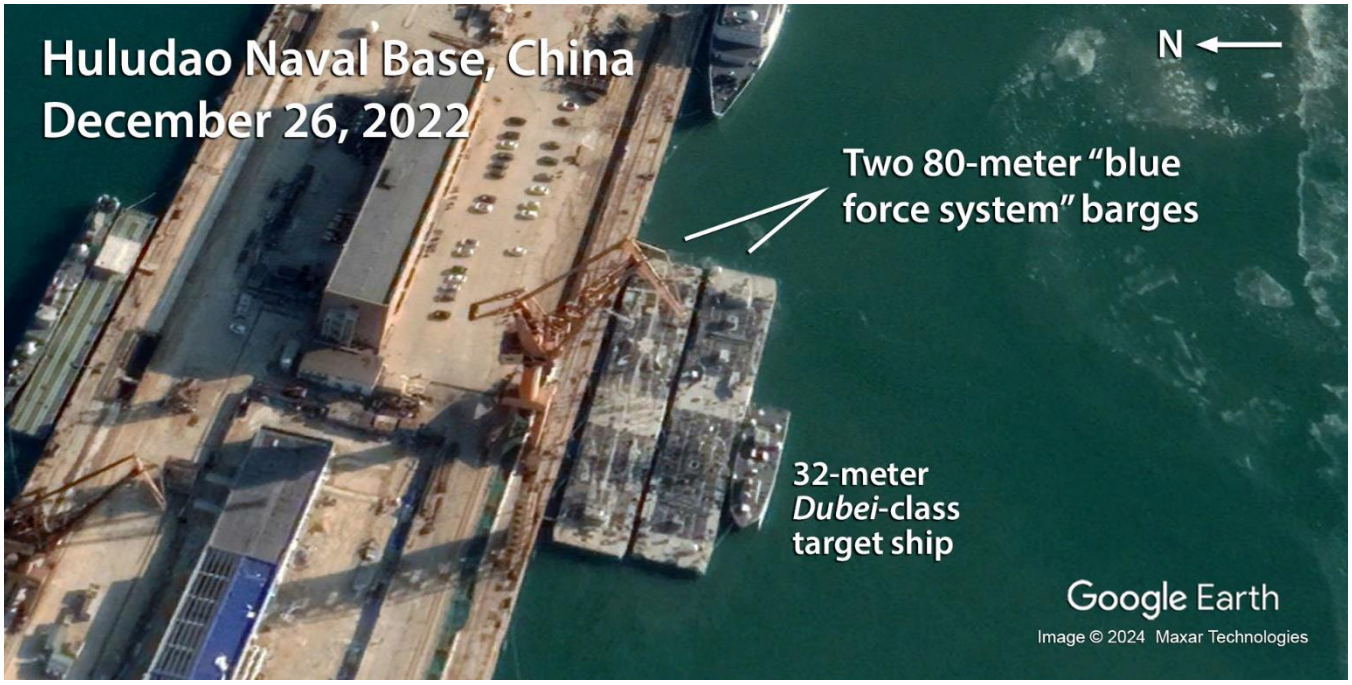

Figure 8. Blue Force System Barges at Huludao Naval Base (Google Earth/Maxar Technologies) [45]

[43] See the image of a blue force system barge under construction at 肇庆市国联投资控股有限公司 [Jiangsu Dayang Marine shipyard – Zhaoqing State-Owned Investment Holding Co., Ltd.], 对标先进促提升 ["Benchmarking Advanced, Rapid Improvement"], *The Paper*, 12 June 2023, archived on 6 August 2024, https://web.archive.org/web/20240806171817/https://m.thepaper.cn/newsDetail_forward_23451346.

[44] Ryan Chan (@ryankakluchan), "Interesting Chinese naval equipment for testing," X (Twitter), 22 September 2022, 11:22 a.m., https://x.com/ryankakiuchan/status/1572969585330262022/photo/4.

[45] Google Earth Pro 7.3.6.9796, Huludao Naval Base, China, 40.712N, 120.995E, 26 December 2022, Maxar Technologies 2024.

Commercial synthetic aperture radar (SAR) satellite imagery of Blue Force System barges demonstrates how the barges mimic a larger ship's radar return. Figure 9 shows the five barges as bright and dense objects, representing a greater return of reflected X-band radar energy to the *Capella Space* SAR imagery satellite.

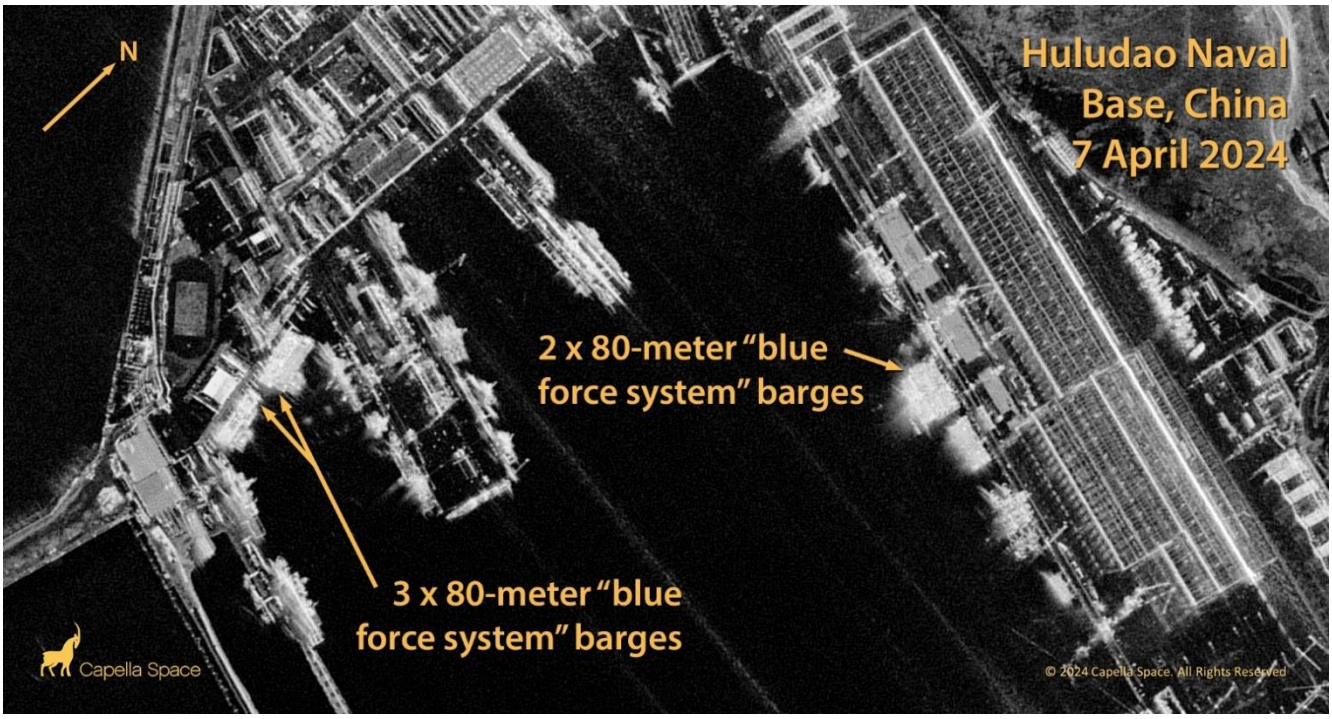

Figure 9. SAR Image of Blue Force System Barges at Huludao Naval Base (© 2024 Capella Space) [46]

In December 2022, the Jiangsu Dayang Marine Equipment shipyard launched what appears to be a new-type drone carrier that may eventually join the PLAN maritime blue force.[47] However, eighteen months after leaving the graving dock, the carrier was still located at the shipyard's basin (Figure 10). Analysis of the vessel by noted PLA analyst H.I. Sutton indicates that the drone carrier has a catamaran design similar to the *Bosha* drone carriers, set low to the water. This leaves little-to-no space for a hanger below the flight deck.[48] The carrier's deck measures 100 x 25 meters (328 x 82 feet) with an island on the starboard side. The solid deck lines on either side of the dashed launch line are approximately 17 meters (56 feet) apart, indicating that any fixed-wing drones launched from the carrier would likely have a slightly smaller wingspan. The new-type drone carrier may join the PLAN blue force, engage in uncrewed aerial vehicle experimentation, or support some other operational end.

Jiangsu Dayang Marine shipyard also produces what may be a previously unknown class of "comprehensive electronic test ship" (综合电子试验舰). The shipyard launched its most recent electronic test ship in September 2021 (Figure 11).[49] The ship is approximately 120-meters long and 16-meters wide. Concurrent with the ship's disappearance from satellite imagery, AIS tracking data indicated that a ship with identical dimensions called the CHANGYINHAO departed the shipyard, possibly revealing the new ship's name.[50]

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[46] Capella Space, C10, Image ID: 16b0d8fb-4d8e-4e65-9b9e-a883597aa02a, 7 April 2024, Huludao, China, 40.710 N, 121.000 E, https://www.capellaspace.com/.

[47] Planet, PlanetScope, Image ID: 20221225_014038_87_2455, 25 December 2022, Taizhou, China, 32.007N, 1119.993E, www.planet.com.

[48] H.I. Sutton, "China Builds World's First Dedicated Drone Carrier," *Naval News*, 15 May 2024, https://www.navalnews.com/naval-news/2024/05/china-builds-worlds-first-dedicated-drone-carrier/.

[49] Nanjing Changfeng, "南京长峰又一艘综合电子试验舰顺利下水" [Another Nanjing Changfeng Comprehensive Electronic Test Ship Successfully Launched], *Sohu*, 10 September 2021, https://www.sohu.com/a/488962756_121124371.

[50] AIS position data: CHANGYINHAO (MMSI 413888885), 4-6 May 2024, www.marinetraffic.com.

Figure 10. New-Type Drone Carrier at Jiangsu Dayang Marine Equipment Shipyard (© 2024 Airbus DS) [51]

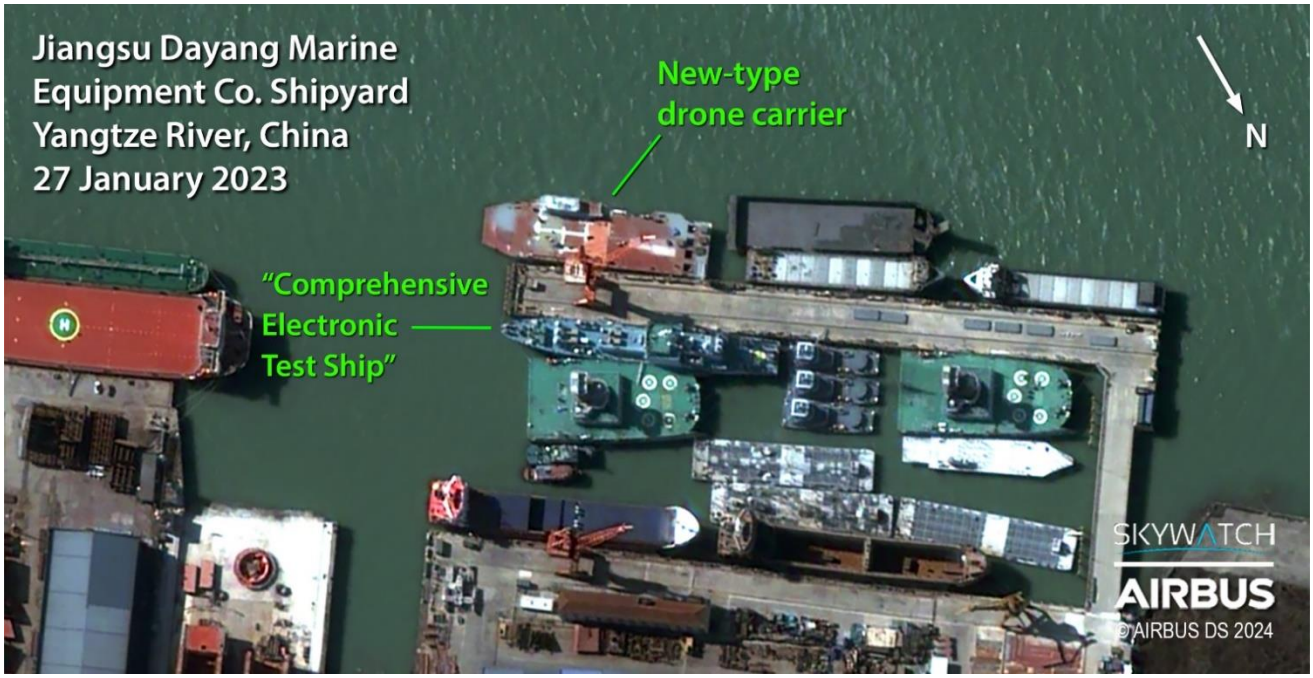

Figure 11. "Comprehensive Electronic Test Ship at Jiangsu Dayang Marine Equipment Shipyard (© 2024 Airbus DS) [52]

[51] Airbus, Pléiades NEO, Image ID: PNEO3_04317411655993, 6 May 2024, Taizhou, China, 32.007N, 119.993E, SkyWatch EarthCache, www.skywatch.com.

[52] Airbus, Pléiades, Image ID: PHR PS 20230127T0249, 17 January 2024, Taizhou, China, 32.007N, 119.993E, SkyWatch EarthCache, www.skywatch.com.

What may be more significant than the fielding of physical blue force equipment is the development of blue force virtual and electromagnetic simulation systems. CASIC's Aerospace Development company has reportedly been involved in over 30 microwave anechoic chamber shielding projects and claims to have built the only "extra-large microwave anechoic chamber in China."[53] Anechoic chambers are large isolation rooms that prevent reflections or echoes of electromagnetic waves to test weapons and equipment in controlled, simulated environments. A model of an anechoic chamber appeared at CASIC's 2021 China Airshow display. Identified as "interior electronic blue force equipment" (内场电子蓝军设备), the accompanying slide projected behind the chamber called it an "interior radiation-/injection-type radio frequency simulation system based on a synthetic signal environment" (综合信号环境为主的内场辐射式/注入式射频仿真系统) (Figure 12).

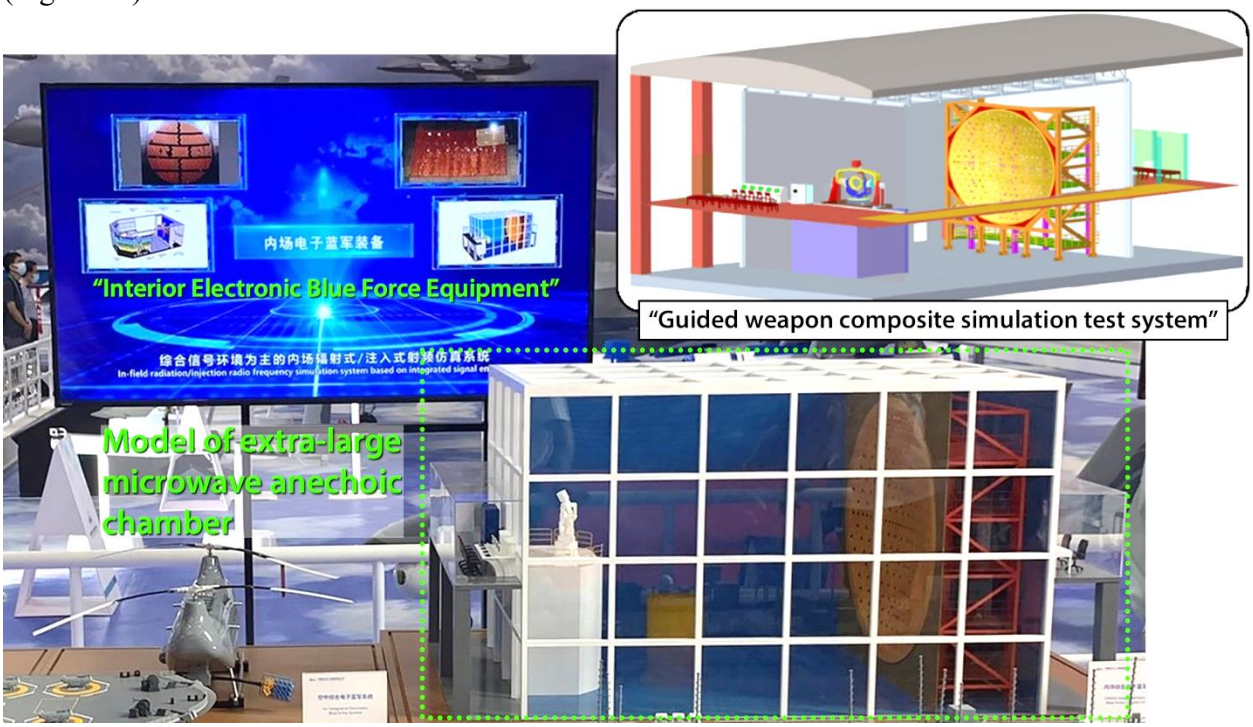

Figure 12. Model of Extra-Large Microwave Anechoic Chamber at 2021 China Air Show
(Inset: Figure Accompanying Analysis of CASIC Composite Simulation Test System) [54]

Advances in data collection and analysis may also offer significant contributions to blue force training, equipment research, and weapon development. These capabilities presumably combine data from actual maneuver forces, real and simulated electromagnetic signals, and virtual forces. A 2023 *PLA Daily* article reported on the exploits of the "Maritime Blue Force Combat Test Research Team" (海上蓝军作战试验研究团队) at what is almost certainly the Huludao PLAN Test Base. The team's chief engineer invoked an increasingly common PLA saying, "data is combat power" (数据就是战斗力). She introduced reporters to a prototype data system designed to collect, process, and feedback combat data into training and testing models. According to the article, "data is the key to clearing away the fog of war and understanding future wars."[55]

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[53] Board of Directors, *2023 Annual Board of Directors Work Report*, Aerospace Industry Development Co., Ltd, 30 April 2024, https://pdf.dfcfw.com/pdf/H2_AN202404301631696532_1.pdf.

[54] Main image: Joe, "The moving target is probably the most interesting part." Inset: 资讯 AD 知识分享 [Information AD Knowledge Sharing], 航天发展蓝军装备之射频/光电复合仿真系统 ["Aerospace Development Blue Force Equipment Radio Frequency/Photo-electronic Composite Simulation System"], *Sohu.com*, 3 October 2021, archived 7 August 2024, https://web.archive.org/web/20240807114030/https://www.sohu.com/a/493391809_121124371.

[55] 钱晓虎 [Qian Xiaohu], 奉云鹤 [Feng Yunhe], and 陈海涛 [Chen Haitao], "海上蓝军"搅动"未来战场" ["'Maritime Blue Force' Stirs Up 'Future Battlefield'"], 解放军报 [*PLA Daily*], 7 January 2023, http://www.mod.gov.cn/gfbw/wzll/hj/16198411.html.

Conclusion and Implications

PLAN scholars have depicted the establishment of a maritime blue force as inevitable, citing the presence of professional OPFOR in developed militaries like those of the United States, Soviet Union, Israel, and Japan. In its efforts to become a "world-class navy," the PLAN understands the importance of a dedicated blue force to improve its training and operational concepts and contribute to weapons testing and development.[56] However, progress toward a PLAN maritime blue force has been relatively slow, lagging behind PLAAF and PLAA blue force development. The PLAN Test Base in Huludao does appear to have made significant progress in blue force design and training application since 2022.

Despite this recent progress, however, the PLAN likely has far to go before it achieves world-class maritime OPFOR capabilities to support fleet training, tactics development, and operational planning. In 2023, two authors assigned to the PLAN Test Base wrote an article advocating for the construction of a maritime unmanned test and training system (海上无人化试验训练体系). Chief among the blue force challenges they described relates to the mindset of PLAN trainers and operators. While there have been breakthroughs in technology, the process of applying tactical concepts has been slow as has the integration of operators with blue force equipment. Specific to uncrewed and autonomous capabilities, the authors note that most PLAN progress has been limited to airborne systems while research on uncrewed boats and underwater vehicles for training has apparently lagged behind.[57]

For all that can be gleaned from commercial satellite imagery and open sources about PLAN blue force development, gauging actual progress in the PLAN's efforts to simulate modern combat presents significant challenges. According to most writings by PLAN Test Base authors, the blue force operations and simulations that offer the PLAN fleet the greatest training benefit may be in the electromagnetic spectrum, hidden from public examination. The PLAN is also keenly aware that U.S. and other intelligence services are watching, probably driving combat training into live-virtual-constructive environments or wholly simulated, virtual battlefields.

Maritime blue force equipment and capabilities will likely afford the PLAN increasingly realistic training environments to develop combat skills against potential adversaries like the United States and its allies. "Leap frog development" has allowed the PLAN to leverage Russian and Western technology to rapidly advance the capabilities of its weapons and combat platforms. Blue OPFOR is not another shortcut, but the next step in the evolution of China's navy—leveraging the experience and concepts of a realistic blue force to sharpen the PLAN into an effective combat force. Training against a realistic blue OPFOR may allow the PLAN to generate near-real world experience, develop more effective tactics, and gain confidence against potential adversaries. These advances may increase threats to U.S. and allied military forces and ultimately undermine deterrence.

[56] Yang, Zhang, Chang, and Zhou, "Navy Trial Training Blue Force System Construction and Application Research," p. 23.

[57] Wang and Cui, "Research on the Construction of Maritime Unmanned Test and Training System," p. 18.

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This report reflects the analysis and opinions of the author alone. The author is responsible for any errors or omissions in this report.

Sources and Methods

This report features commercial satellite imagery from Capella Space and Airbus Intelligence. Synthetic aperture radar (SAR) imagery (ground sample distance (GSD) ~0.5 meters) was provided courtesy of Capella Space. The author purchased Airbus' Pleiades NEO constellation (GSD ~0.3 meters) and Pleiades constellation (GSD ~0.5 meters) images through SkyWatch Space Applications Inc. The author is responsible for all annotations of satellite images contained in this report. Capella Space and Airbus retain copyrights to the underlying satellite images. Copyrighted satellite images in this report should not be reproduced without the expressed permission of Capella Space or Airbus. Google Earth images are attributed to the commercial satellite provider and published under the Google Earth terms of service.