

CVN 78 *Gerald R. Ford*-Class Nuclear Aircraft Carrier



In FY25, USS *Gerald R. Ford* (CVN 78) completed a pre-deployment workup cycle, the Total Ship Survivability Trial (TSST), and data collection in support of sortie generation rate (SGR) modeling and simulation (M&S). The January 2025 TSST demonstrated recoverability and damage control features of the *Ford*-class against simulated weapon damage and yielded numerous recommendations that would improve the survivability of the class. However, major IOT&E events remain, including the SGR live demonstration, M&S to assess the *Ford*-class SGR key performance parameter (KPP), Ship Self-Defense System (SSDS) testing, and underway cyber survivability testing. These events will be critical to evaluating the class's operational effectiveness, suitability, and survivability.

SYSTEM DESCRIPTION

The *Ford*-class is a class of nuclear-powered aircraft carriers based on the *Nimitz*-class hull, with significant design changes intended to enhance

the *Ford*-class's ability to launch, recover, and service aircraft while reducing required manning capacity by approximately 15 percent. CVN 78 includes a new nuclear power plant that increases electrical capacity to power ship systems, including new Electromagnetic Aircraft

Launch System (EMALS) catapults and electromechanical Advanced Arresting Gear (AAG). The originally planned arresting gear engine and wire positioning (consisting of four engines and three wires) was similar to the USS *Ronald Reagan* (CVN 76) and USS *George H. W. Bush* (CVN 77) flight

decks. However, the fourth AAG engine has not been installed on the *Ford*-class to date, as a cost savings measure. The *Ford*-class also incorporates a larger and more efficient flight deck layout with additional aircraft fueling stations, along with redesigned weapons elevators, weapons handling spaces, and magazine stowage to reduce manning, improve safety, and increase weapons throughput compared to *Nimitz*-class aircraft carriers. The *Ford*-class combat system incorporates the following systems:

- Dual Band Radar (DBR) that combines the phased-array SPY-4 Volume Search Radar and the SPY-3 Multi-Function Radar. CVN 78 is the only ship with DBR, but it is scheduled to be replaced with the SPY-6(V)3 Enterprise Air Surveillance Radar (EASR) fixed variant, the SPQ-9B horizon search radar, and the Mk 9 Tracker Illuminator System. These new capabilities are installed on PCU *John F. Kennedy* (CVN 79) and will be installed on follow-on *Ford*-class ships.
- SSDS Mk 2 Mod 6 with Baseline 10 combat management system, which will be upgraded to the new capability build, Baseline 12, on CVN 79 and follow-on *Ford*-class ships.
- AN/USG-2B Cooperative Engagement Capability (CEC) tracking, data fusion, and distribution system, which will be upgraded to CEC Block II on CVN 79 and follow-on *Ford*-class ships.
- AN/SLQ-32B(V)6 electronic warfare system equipped with the Surface Electronic Warfare

Improvement Program (SEWIP) Block 2.

- Rolling Airframe Missile (RAM) Block 2 and Evolved Sea Sparrow Missile (ESSM) Block 1. CVN 79 and follow-on *Ford*-class ships will be upgraded to a mix of new RAM variants Block 2A and 2B, plus a mix of ESSM Block 1 and Block 2.
- The Close-In Weapon System search and track radar, which operates in stand-alone mode on CVN 78, but will be integrated with AN/USG-2B CEC and SSDS on CVN 79 and follow-on *Ford*-class ships.

Ford-class ships also have enhanced survivability features, including improved protection for magazines and other vital spaces; shock-hardened mission systems and components; and installed and portable damage control, firefighting, and dewatering systems intended to expedite response to and recovery from fire, flooding, and battle damage.

MISSION

Carrier strike group (CSG) commanders will use *Ford*-class ships to:

- Provide credible, sustainable, independent forward presence during peacetime without access to land bases.
- Operate in a supported or supporting role with a joint and/or allied maritime expeditionary force in response to crises.
- Carry the war to the enemy, independent of forward-based land facilities, through

joint multi-mission offensive operations by:

- Operating and supporting aircraft to attack enemy forces ashore, afloat, or submerged.
- Protecting friendly forces from enemy attack through the establishment and maintenance of battlespace control.
- Engaging in sustained operations in support of the United States and its allies.

PROGRAM

The CVN 78 *Gerald R. Ford*-class is an Acquisition Category IC program. DOT&E approved Revision E of the TEMP in September 2022 and Revision B of the LFT&E Management Plan in September 2023. The first ship in the *Ford*-class, CVN 78, was delivered to the Navy in 2017. It completed Post Delivery Test and Trials in April 2021 to demonstrate the basic functionality of the carrier, certify the flight deck, and embark an air wing. CVN 78 also completed Full Ship Shock Trials (FSST) in August 2021 and a Planned Incremental Availability in February 2022. DOT&E approved the first of two planned phases of the IOT&E test plan, and IOT&E began in September 2022. IOT&E is expected to complete in FY27.

The Navy deployed CVN 78 in May 2023, which was earlier than the scheduled timeline for first deployment in TEMP Revision E. In preparation for the first deployment, CVN 78 completed its first Composite Training Unit Exercise (COMPTUEX) in April 2023. DOT&E

approved Revision 1 to the IOT&E test plan in March 2023, and in July 2024 the Navy delivered to DOT&E a revised test plan, labeled IOT&E Test Plan Update 1, which replaced the IOT&E's original two-phase structure with a more incremental approach. DOT&E initially withheld full test plan approval due to an insufficiently articulated reliability, maintainability, logistics supportability, and availability (RMLA) data collection strategy, but in February 2025, the Navy submitted to DOT&E an updated test plan revision that contained an improved RMLA data collection strategy. DOT&E then approved the revised IOT&E test plan. In May 2025, DOT&E approved an IOT&E test card detailing the process by which the Navy would execute the sustained SGR live demonstration, which was scheduled for June 2025.

CVN 79 delivery is now scheduled for FY27, two years later than reported in the FY24 Annual Report. A combination of supply chain impediments, difficulties with AAG installation and certification, and Advanced Weapons Elevator (AWE) installation progressing slower than forecasted all contributed to this delay. *Enterprise* (CVN 80) construction began in August 2017 and is now expected for delivery to the Navy in FY30, one year later than reported in the FY24 Annual Report. *Doris Miller* (CVN 81) construction began in August 2021 and is expected for delivery to the Navy in FY32. The most significant changes to CVN 79 and beyond are related to the combat system and design changes to support F-35. The Navy is updating the Platform TEMP 1610 to include operational testing of the *Ford*-class's

capability to support F-35 and CMV-22. Enterprise TEMP 1910 will document operational testing of the self-defense capabilities of CVN 79 and follow-on *Ford*-class carriers. The Navy now expects to submit the updated TEMP 1610 for DOT&E approval in FY26.

» **MAJOR CONTRACTOR**

- Newport News Shipbuilding, a division of HII – Newport News, Virginia

TEST ADEQUACY

The Navy began *Ford*-class IOT&E in September 2022 and is conducting it in accordance with TEMP Revision E and the DOT&E-approved IOT&E Test Plan Update 1.

In March 2024, the Navy conducted *Ford*-class pierside shipboard cyber survivability tests, which included some testing of the ship's industrial control systems. The Navy conducted cyber survivability testing of the SSDS integrated combat systems at a land-based test site which was not accredited for the specific use of cyber survivability testing. The Navy conducted the test in accordance with a DOT&E-approved test plan and with observation by DOT&E. However, the Navy and DOT&E do not concur on the path forward for *Ford*-class underway cyber testing. The Navy believes they have collected sufficient data to evaluate cyber survivability for the class, but DOT&E assesses that the Navy has insufficient data to support their current cyber survivability assessment.

The Navy conducted the TSST aboard USS *Gerald R. Ford* in

January 2025. This test was conducted in accordance with the DOT&E-approved test plan and was observed by DOT&E personnel. TSST simulated four weapon damage events against the ship and was adequate to evaluate many recoverability features and damage control systems. However, concerns of possible damage to vital equipment limited the ability to simulate power interruption and restoration to mission systems and the associated recovery timeline of these systems. Similarly, a previously undiscovered interdependency between auxiliary systems identified during pre-trial system checks limited the ability to simulate damage and recovery of selected distributed systems.

Evaluation of the *Ford*-class's anti-air warfare capability was coordinated between the CVN 78 TEMP Revision E and the Capstone Enterprise Air Warfare Ship Self-Defense (AW SSD) TEMP 1714 of March 2008. In 2QFY25, unplanned maintenance requirements prevented the execution of a series of live missile fire events aboard CVN 78 against a variety of anti-ship cruise missile (ASCM) threat surrogates, which were designed to demonstrate the ship self-defense capability of CVN 78's current combat system configuration (SSDS Baseline 10 and DBR) and are required to validate M&S used to predict CVN 78 performance across the spectrum of threat ASCMs. The Navy has not yet rescheduled these tests.

The *Ford*-class SGR evaluation comprises M&S (for both *Ford*- and *Nimitz*-class), a four-day live demonstration that includes flight operations executed at sustained SGRs, a one-day live demonstration

of flight operations executed at the surge SGR, and observation of flight operations on a *Nimitz*-class carrier. Development of the M&S suite intended to evaluate the SGR, the Sea Strike/Sea Basing Aviation Model (SSAM), is still ongoing. Due to the complexity of SSAM, the Navy coordinated the use of high-power computing (HPC) facilities to expedite the model's validation and verification (V&V). However, difficulties porting SSAM to the HPC network, the nature of data processing within the model, and the need to collect data during the sustained SGR live demonstration persist, contributing to delays with SSAM V&V as well as assessing the SGR KPP. The Navy has not determined when SSAM V&V will be complete. Once finished with SSAM V&V, the Navy estimates that completing SGR runs for the record may take between 6 – 12 months. This timeline depends on the variance of the model and the Navy's ability to overcome challenges such as running the model in the HPC environment, extracting and converting outputs to a database format, and generating reports.

The Navy had planned to execute the sustained SGR live demonstration in 3QFY25, but unplanned aviation launch and recovery equipment maintenance coupled with a constrained operational schedule prevented the execution of the event. The Navy intends to execute the SGR live demonstration in FY26, and this event remains critical for SSAM V&V and evaluating the class's SGR KPP. Additionally, the Navy plans to apply lessons from the sustained SGR live demonstration to the surge SGR test, which is also currently unscheduled.

The Navy can mitigate the risk to SSAM V&V and evaluating the SGR KPP by scheduling and adequately resourcing the two SGR demonstrations, maximizing data collection during these events, and characterizing model performance to focus on the most critical live data needs.

The Navy remains in development of an enterprise test strategy that will coordinate ship self-defense evaluation of multiple ship classes, including the *Ford*-class, as modified in CVN 79 and follow-on carriers. The new enterprise test strategy for the CVN 79 and follow-on ships will be coordinated between the yet-to-be-approved CVN 78 TEMP Revision F and the SSDS Enterprise TEMP. CVN 79 includes an updated combat system, SSDS Baseline 12, and the new SPY-6(V)3 radar system. The Navy has yet to finalize the replacement self-defense test capability for ship self-defense against threat ASCMs following the deactivation of the current self-defense test ship, ex-USS *Paul F. Foster*, now expected in FY29. To avoid delays in determining *Ford*-class capability and survivability, the Navy should finalize enduring test capabilities, similar to those provided by ex-USS *Paul F. Foster*, as soon as possible.

PERFORMANCE

» EFFECTIVENESS

Insufficient data are available to determine the *Ford*-class's operational effectiveness due to IOT&E being incomplete. Observations based on testing to date are below.

Combat System

Self-defense testing against unmanned aerial vehicles and high-speed maneuvering surface targets (small boats) was conducted in July 2022. Details can be found in DOT&E's classified early fielding report (EFR) dated April 2023. The Navy continues to develop fixes to combat system deficiencies identified in DOT&E's classified interim assessment report dated April 2022, but as discussed in the FY24 Annual Report, the fixes still remain largely unfunded.

SGR

During the FY25 operational deployment, USS *Gerald R. Ford*'s crew reported that the ship and its embarked air wing maintained an SGR sufficient to meet combatant commander operational taskings. Although the SGRs sustained during evolutions such as Carrier Qualification have numerically approached those required by the KPP, the aircraft configuration and tempo of these operations did not match the Design Reference Mission and were therefore not representative of the KPP requirement. The reliability and maintainability of CVN 78's EMALS and AAG continue to adversely affect sortie generation and flight operations, which remains the greatest risk to demonstrating operational effectiveness and suitability in IOT&E.

Electromagnetic Spectrum Compatibility

Developmental testing identified significant electromagnetic radiation hazard and interference problems. The Navy implemented some mitigation measures

and conducted follow-on characterization testing during independent steaming events in developmental test, but some operational limitations and restrictions are expected to persist. The Navy should verify electromagnetic spectrum compatibility during operational test, particularly when integrated with CSG operations in an advanced electronic attack environment. This will enable capability assessments at differing levels of system use to inform decisions on system employment. The Navy should apply lessons learned from CVN 78 to the future EASR configuration.

» **SUITABILITY**

Insufficient data are available to determine the *Ford*-class's operational suitability. However, the following five CVN 78 systems are new to the class, have shown low or unproven reliability, or are highlighted as the most significant challenges to flight operations.

AAG

The Navy has not scored any AAG RMLA data for operational test since the beginning of IOT&E in 2022; therefore DOT&E has not received sufficient data to update the reliability metrics reported in the FY23 Annual Report with operational test data. Naval Air Systems Command (NAVAIR) continues to work on short- and long-term improvements to address AAG reliability degraders. However, difficulties such as obtaining replacement parts and the reliance on off-ship technical support remain a challenge. The Navy has allocated FY26 funding to support a fourth engine alternative,

with installation of the new system targeted for FY29. The fourth engine alternative would improve the reliability and availability of AAG, improve the pilot boarding rate, and restore a redundant capability to rig the barricade in the event of AAG engine failure, which the current configuration does not support.

EMALS

Data collected during CVN 78's FY25 pre-deployment workup cycle indicate that EMALS reliability remains consistent with developmental and operational test data collected in FY23 and FY24. Engineering upgrades to hardware and software have produced gradual improvements in cumulative reliability and availability. Reliance on off-ship technical support remains a challenge. NAVAIR is continuing development on improvements.

AWEs

The *Ford*-class has yet to build and transfer ordnance to the flight deck at rates reflective of the Design Reference Mission. DOT&E expects the sustained SGR live demonstration to be the first operationally representative demonstration of high ordnance throughput. Of note, the crew is still reliant on off-ship technical support for correction of AWE hardware and software failures.

DBR

Details on DBR suitability can be found in DOT&E's classified EFR from April 2023. Due to the one-of-a-kind nature of the DBR, its availability will depend on the Navy's access to replacement

parts and embarked contract maintenance support throughout the remaining life of the system. The Navy should acquire sufficient DBR replacement parts for the interim period prior to the scheduled replacement of DBR with EASR.

Manning and Berthing

Per the Navy's Shipboard Habitability Program, all new ships are required to have a growth allowance of 10 percent of ship's company when the ship delivers. This Service Life Allowance provides both empty bunks to allow for changes in the crew composition over the ship's life and berthing to support crew turnover, visitors, and personnel temporarily assigned to the ship for repairs, inspections, test, and training. However, sufficient berthing is not installed for the *Ford*-class to conduct combat operations with all hands assigned a bed, due to a lack of berthing capacity for embarked units. If the ship and its embarked units were each at 100 percent manning, the ship would have a shortfall of 159 beds. These berthing shortfalls will affect quality of life onboard and could reduce the Navy's operational flexibility in employing the ship across its full spectrum of missions and logistical support roles for the CSG. Furthermore, there is potential that the berthing shortfalls could increase as the air wing diversifies to include CMV-22, F-35, and MQ-25, none of which are embarked on the *Ford*-class today.

» **SURVIVABILITY**

The survivability assessment of the *Ford*-class against kinetic threats is based on a combination of FSST,

TSST, and related modeling of the class supported by component and surrogate testing. To date, the Navy has completed all planned LFT&E, except for the Final Survivability Assessment Report (FSAR). The Navy has yet to issue a Shock Deficiency Correction Plan that will detail the corrective actions planned to rectify adverse findings from the FSST.

Through the TSST, the Navy was able to evaluate how well the ship's systems supported the crew in detecting, responding to, containing, and restoring operations after combat damage. The trial showed that the ship's design supports a robust damage control capability that is somewhat hindered by shortcomings in supporting systems. The TSST also highlighted previously undetected interdependencies in vital distributed systems that impacted the ship's mission capability. Additional details regarding the performance of CVN 78 during TSST will be included in a classified DOT&E report in FY26. The CVN 78 LFT&E program is nearing completion and now expects to issue a FSAR for the class in early FY26. The FSAR is a summation report that will include findings for the class gathered from all previous LFT&E activities, including recent findings from the TSST and updates to vulnerability M&S. The program office is in the process of updating the vulnerability M&S, as recommended in the FY24 Annual Report, and expects to provide updated results for the predicted vulnerability of the class to threat weapons in the FSAR package.

The survivability of the *Ford*-class in a cyber-contested environment was evaluated in March 2024

testing, and earlier land-based testing for EMALS and AAG. DOT&E's full cyber survivability assessment will be published following the underway test. The survivability of the *Ford*-class in contested and congested electromagnetic spectrum environments has not been evaluated. Discussions on how to evaluate CVN 78 survivability in these environments are ongoing with the Navy.

RECOMMENDATIONS

The following recommendations remain as stated in the FY23 and FY24 Annual Reports. The Navy should:

1. Improve the suitability of AAG, EMALS, AWE, and DBR while minimizing the requirement for off-ship and/or contractor technical support.
2. Resource and execute the testing per Enterprise AW SSD TEMP 1714 and CVN 78 TEMP 1610, including the planned SGR testing, along with completing, verifying, validating, and accrediting the SGR M&S suite; underway cyber survivability testing; and self-defense tests and P_{RA} modeling.
3. Re-examine manning and berthing for future ships of the class to ensure sufficient berthing is available and that 10 percent Service Life Allowance is allocated for future growth.
4. Prioritize and correct deficiencies identified in DOT&E's classified FSST report of December 2022.

5. Verify electromagnetic spectrum compatibility during operational test to better inform effectiveness and survivability, particularly when integrated with CSG operations in an advanced electronic attack environment.
6. Continue to address the recommendations in DOT&E's classified self-defense interim assessment report from April 2022, and the additional recommendations in DOT&E's classified EFR from April 2023.
7. Continue to fully fund the scheduled replacement of DBR on CVN 78 with the EASR configuration.
8. Continue to develop more robust capabilities to test the cyber survivability of shipboard industrial control systems, similar to those capabilities demonstrated during the March 2024 cyber survivability testing.
9. Identify, fund, and deliver a replacement capability for the Navy's self-defense test ship, *ex-USS Paul F. Foster*, to support planned testing of CVN 79 capability.
10. Characterize and validate performance of the SSAM model for SGR.

The following recommendation from the FY24 Annual Report has been updated. The Navy should:

1. Submit an update of the *Ford*-class TEMP for DOT&E approval in FY26 that is aligned with the new Enterprise TEMP 1910 and provides the test strategy and test resources to determine operational effectiveness of new and/or upgraded capabilities on CVN 79.

The Navy should address the following recommendations, which are new:

1. Review findings from the CVN 78 TSST and implement recommendations as soon as possible to improve the recoverability and damage control capabilities of the class.
2. Complete evaluation of system interdependencies identified during TSST and identify potential design improvements.