

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

### Executive Summary

- The Electro-Magnetic Aircraft Launch System (EMALS) conducted successful Phase I Aircraft Compatibility Testing on F/A-18, T-45, E-2D, and C-2A aircraft.
- Advanced Arresting Gear (AAG) is a Naval Air Systems Command Acquisition Category II Program of Record that will be installed on CVN 78. It is currently undergoing system redesign for the Cable Shock Absorber (CSA) assembly. Testing is scheduled to resume in December 2011.
- The Navy has implemented a plan to re-start testing at the Wallops Island Dual Band Radar (DBR) test site in FY12 to complete DBR element-level testing to support installation in CVN 78.
- The Navy continues to work on integration deficiencies related to the F-35 Joint Strike Fighter (JSF) and its fleet of aircraft carriers, including CVN 78.
- The Navy has not funded the LFT&E program adequately. To address the funding shortfall, the Navy is proposing to defer key events to the second ship of the class. This would result in an inadequate test. DOT&E is working with Navy leadership to resolve these concerns.

### System

- The CVN 78 *Gerald R. Ford* Class Nuclear Aircraft Carrier program is designing and building the new class of nuclear powered aircraft carriers. The CVN 78 *Gerald R. Ford* Class program name replaces the previous CVN 21 program designation. It has the same hull form as the CVN 68 *Nimitz* Class, but many ship systems inside the hull are new, including the nuclear plant and the flight deck.
- The newly designed nuclear power plant is intended to reduce reactor department manning by 50 percent and produce significantly more electricity when compared to a current CVN 68 Class ship.
- The CVN 78 will incorporate electromagnetic catapults (instead of steam-powered), and have a smaller island with a DBR (a phased array radar which replaces/combines five legacy radars used on current aircraft carriers).
- The Navy's intention is that the Integrated Warfare System will be adaptable to technology upgrades and varied missions throughout the ship's projected operating life including increased self-defense capabilities when compared to current aircraft carriers.



- The Navy redesigned weapons stowage, handling spaces, and elevators to reduce manning, increase safety, and increase throughput of weapons.
- CVN 78 is designed to increase the sortie generation capability of embarked aircraft to 160 sorties per day (12-hour fly day) and to surge to 270 sorties per day (24-hour fly day) as compared to the CVN 68 *Nimitz* Class sortie generation rate demonstration of 120 sorties per day/240 sorties for 24-hour surge.
- Initial Operational Capability for CVN 78 is planned for FY17. Full Operational Capability is planned for FY18 after the Milestone C decision.

### Mission

Carrier Strike Group Commanders will use the CVN 78 to:

- Conduct power projection and strike warfare missions using embarked aircraft.
- Provide force protection of friendly units.
- Provide a sea base as both a command and control platform and an air-capable unit.

### Major Contractor

Huntington Ingalls Industries – Newport News Shipbuilding, Newport News, Virginia

### Activity

- The Navy continues to develop plans to evaluate Sortie Generation Rate (SGR) (number of aircraft sorties per day). Discussions have focused on the specific details of live testing

(e.g., which test ranges to use, how many aircraft, which weapons). DOT&E concurs with the proposed 6 consecutive 12-hour fly days followed by 2 consecutive 24-hour fly

days. Live testing will be supplemented with modeling and simulation from the Virtual Carrier model to extrapolate results to the 30-day SGR requirement.

- The EMALS system functional design test site at Joint Base McGuire-Dix-Lakehurst, New Jersey, continues to test the new electromagnetic catapult system. This year, testing has focused on Phase I of Aircraft Compatibility Testing and included successful launches of the Navy's F/A-18 (with and without external stores), T-45, E-2D, and C-2 aircraft. The EMALS program conducted a total of 133 aircraft launches in FY11.
- The Navy is performing testing of the AAG on a jet car track at Joint Base McGuire-Dix-Lakehurst, New Jersey. The Navy conducted 12 dead-load arrestments out of several hundred scheduled prior to suspending test. The site is currently undergoing system design modifications to the CSA following discovery of significant metal-metal scoring on several components during dead-load testing. Initial component redesign is complete and installation of redesigned components is expected for completion in December 2011.
- The Navy initiated land-based JSF testing associated with the Jet Blast Deflector (JBD). The JBD is designed to deflect engine exhaust during engine runs and catapult launches. The testing is examining cooling of the JBD, noise for flight deck personnel, and the exhaust effects from JSF on nearby aircraft on the flight deck.
- The Navy has a plan to re-start DBR element testing at the Surface Combat Systems Center in Wallops Island, Virginia, in FY12; this test site is required for critical testing of the carrier's radar to mitigate risk before installation and testing in CVN 78.
- The Preliminary Ship's Manning Document (PSMD) was partially validated during Naval Aviation Enterprise Manning Wargame II in September 2011. The preliminary war game assessment revealed that for the seven departments analyzed, the ship can perform its operational mission when operated at 100 percent manning. Reductions below 85 percent Navy Enlisted Classification (NEC) fit/fill requirements and/or surge operations may be problematic with respect to operational effectiveness.
- The CVN 78 *Gerald R. Ford* Class Carrier program office is revising the Test and Evaluation Master Plan in an effort to align planned developmental tests with corresponding operational test phases.
- The Navy conducted tests related to the detection and suppression of fires in the weapons magazines. Magazine sprinkling systems are required to perform two functions: (1) to prevent ordnance cook-off in the event of an adjacent space fire; and (2) to extinguish incipient fires within the magazine. The fire detection system must provide sufficient warning of a fire for actions to be taken to avoid ordnance cook-off. The objectives of the two test series were to evaluate the performance characteristics of the new detector system, and to quantify the fire suppression and boundary cooling capabilities of the two water delivery systems installed in the magazines on

the CVN 78. The analyses of the test results and development of the test reports are in progress.

- The Navy began the damage scenario-based engineering analysis for one threat scenario to support a vulnerability assessment report planned for completion in FY14. The Navy has indicated that funding limitations will permit only one additional scenario to be examined for this assessment.

## Assessment

- The Navy began CVN 78 construction in 2008 and plans to deliver the ship in September 2015. Current progress supports this plan; however the EMALS, AAG, DBR, and Integrated Warfare Systems remain pacing items for successful delivery of the ship.
- The CVN 78 program (similar to the CVN 68 class program) continues to work through challenges with F-35 JSF aircraft/ship integration. These challenges have the Naval Sea Systems Command's and Naval Air Systems Command's significant attention and priority. The Navy has not completed its analysis of the test data to determine whether design changes are required for the jet blast deflectors and/or flight deck. Problems remain outstanding regarding JSF data flow aboard ship via the Autonomic Logistics Information System; JSF engine replacement logistics; lithium-ion battery stowage and operations; and low observable material maintenance procedures.
- EMALS developmental testing continues within timelines required to meet shipyard Required in Yard Dates (RIYD) for various EMALS components. Developmental test progress continues, although continued discovery of deficiencies (necessitating a re-design of the launch armature and rough acceleration characteristics on initial Aircraft Compatibility Testing aircraft launches) indicates a still maturing system. DOT&E holds moderate concern regarding the performance risk generated by the inability to test the full, four catapult electrical distribution system prior to initial trials aboard ship. This is mitigated somewhat by the conduct of system electrical fault testing during FY12, which will replicate some level of the electrical distribution fault tree.
- AAG testing was halted following the discovery of metal scoring of the CSA during initial dead-load testing requiring component redesign and software modifications. Testing should resume in December 2011 and still supports RIYD for AAG components barring significant additional redesign.
- The Navy will re-start DBR testing at Wallops Island in FY12. Based on these tests, if additional DBR testing is required, there will likely be cost growth in software development and required testing and a slip in completion of the post-delivery testing and trials of the DBR. Numerous integrated warfare system items are of concern, including:
  - Historically the ship self-defense combat systems on aircraft carriers have had reliability, weapon, and radar system integration shortcomings. While the Navy has made efforts, it has not yet developed a detailed plan to address these concerns on CVN 78.

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- Navy development of a new anti-ship ballistic missile target and obtainment of a capability to launch multiple simultaneous supersonic sea-skimming targets lags behind CVN 78 testing need dates. Both are required to fully assess the effectiveness of the ship self-defense systems.
  - CVN 78 will use DBR continuously and simultaneously for both air traffic control and to support other warfare areas including ship self-defense, whereas separate legacy systems perform these missions individually. Merging these previously separate missions into a single system requires significant testing and integration. Portions of this testing are currently scheduled shipboard, instead of making more complete use of the land-based Wallops Island facility; this complicates the test-fix-test timeline. RIYD for these systems continues to drive the development schedule; however, to date, development and testing remains on track.
  - The PSMD was partially validated during Naval Aviation Enterprise Manning War-game II in September 2011. In order to reduce Total Ownership Costs (TOC) the ship's overall manning (not including embarked air wing and staffs) was reduced by 663 billets from current aircraft carrier requirements. In light of these forced manning reductions, the Navy specifically designed CVN 78 to operate at 100 percent manning on a continual basis, a level which the current manning construct and personnel policies of the Navy do not support. The war-game validated the CVN 78 manning requirements for operating during normal peacetime conditions; however during surge operations or at less than 85 percent NEC fit/fill requirements there is risk as to whether the ship can operate effectively. In order to ensure the ship's operational effectiveness the Navy will have to develop a manning construct which supports the 100 percent NEC fit/fill manning requirement for CVN 78.
  - The current state of the Virtual Carrier model does not fully provide for an accurate accounting of SGR due to a lack of fidelity regarding manning and equipment/aircraft availability. Spiral development of the Virtual Carrier model is continuing in order to ensure that the required fidelity will be available to support SGR testing during IOT&E.
  - DOT&E has requested the Navy adequately fund and complete the actions necessary to conduct the TSST and the FSST on the CVN 78. This includes updating the Damage Scenario Based Engineering Analyses (DSBEA) from prior Vulnerability Assessment Reports (VARs) and enough new DSBEAs, including machinery spaces, to conduct an adequately scoped TSST. DOT&E expects this will require five or six TSST drills.
  - Because of the two-month delay required to perform the FSST, the Navy proposes delaying the shock trial by 5-7 years in order to complete it on CVN 79 (instead of CVN 78). The two-month delay is not sufficient reason to postpone the shock trial for so long, as it could reveal valuable lessons, including previously unknown vulnerabilities.
  - The current TEMP and proposed revisions do not adequately address whole-platform level developmental testing. The strategy leverages the testing being conducted by contracted organizations on their associated systems and sub-systems but does not stipulate any additional integrated platform-level CVN 78 class specific developmental tests. Lack of platform-level developmental testing significantly raises the likelihood of platform-level discovery during operational test.
- ## Recommendations
- Status of Previous Recommendations. All FY10 recommendations remain valid and are updated below. The Navy should:
    1. Adequately test and address integration challenges with JSF; specifically logistics (storage of spare parts and engines, transport of support equipment and spares to/from the carrier), changes (if any) required to JBD's, changes (due to heat and or noise) to flight deck procedures, and Autonomic Logistics Information System integration.
    2. Finalize plans that address CVN 78 integrated warfare system engineering and ship's self-defense system discrepancies.
    3. Develop and procure an anti-ship ballistic missile target that adequately emulates the self-defense portions of the threat trajectory, and pursue test range upgrades to allow up to four supersonic sea-skimming targets to be launched simultaneously.
    4. Continue aggressive EMALS and AAG risk-reduction efforts to maximize opportunity for successful system design and test completion in time to meet RIYD for ship-board installation of components.
    5. Continue development of a realistic model for determining the sortie generation rate, while utilizing realistic assumptions regarding equipment availability, manning, and weather conditions. Obtain acknowledgement and concurrence from Navy leadership on scheduling, funding, and execution plan for conducting a live SGR test event.
  - FY11 Recommendations.
    1. Develop and codify a formal manning construct through the Navy's Bureau of Personnel to ensure adequate depth and breadth of required personnel to ensure that the 100 percent NEC fit/fill manning requirements of CVN 78 are met.
    2. Conduct platform-level developmental testing to preclude discovery of operational effectiveness deficiencies during IOT&E.
    3. Plan and budget for an adequate Full-Ship Shock Trial and Total Ship Survivability Trial on CVN 78.

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