

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

### Executive Summary

- The current Test and Evaluation Master Plan (TEMP) does not adequately address integrated platform-level developmental testing, significantly raising the likelihood that platform-level test problems will be discovered during IOT&E. The Program Office has begun to address the problem and has refined the post-delivery schedule. However, the details as to the extent of any additional integrated platform-level CVN-78 developmental tests are unclear.
- The Navy began CVN-78 construction in 2008 and plans to deliver the ship in September 2015. Current progress supports this plan; however, the Electro-Magnetic Aircraft Launch System (EMALS), Advanced Arresting Gear (AAG), Dual Band Radar (DBR), and Integrated Warfare Systems will continue to drive the timeline for successful delivery of the ship.
- 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.
- Although CVN-78 will include a new heavy underway replenishment (UNREP) system that will allow transfer of 12,000-pound cargos, the Navy's plan to install heavy UNREP systems on resupply ships has slipped eight years.
- DOT&E rescinded approval of the alternative LFT&E Management Plan pertaining to the *Gerald R. Ford* (CVN-78) class carrier program because the Navy unilaterally decided to modify the previously approved LFT&E plan. The Navy wanted to limit the scope of the Total Ship Survivability Trial (TSST) on CVN-78 to conform to the Navy budget, and to defer the Full-Ship Shock Trial (FSST) to CVN-79, a change to the previously approved LFT&E Management Plan with which DOT&E does not concur.

### System

- The CVN-78 *Gerald R. Ford* class nuclear aircraft carrier program is a new class of nuclear powered aircraft carriers that replaces the previous CVN-21 program designation. It has the same hull form as the CVN-68 *Nimitz* class, but many ship systems, including the nuclear plant and the flight deck, are new.
- 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 intends for the Integrated Warfare System to 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.
- The Navy designed CVN-78 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.
- The Consolidated Afloat Networks and Enterprise Services (CANES) program replaces five shipboard legacy network programs to provide a common computing environment for command, control, intelligence, and logistics.
- The Navy plans to declare CVN-78 Initial Operational Capability in FY17 with Full Operational Capability in 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

### Test Planning

- The Navy continues to develop the CVN-78 Sortie Generation Rate (SGR) (number of aircraft sorties per day) test concept. Discussions have focused on the specific details of live testing days (e.g., which test ranges to use, how many aircraft, which weapons). The ship's SGR requirement is based on a 30-plus-day wartime scenario. DOT&E concurs with the proposed 6 consecutive 12-hour fly days followed by 2 consecutive 24-hour fly days. This live testing will be supplemented with modeling and simulation from the Virtual Carrier model to extrapolate results to the 30-plus-day SGR requirement.
- DOT&E approved an operational assessment that began in September 2012, to assess the progress of the CVN-78 build and its ability to successfully undergo operational test and evaluation in the future. The assessment is being led by U.S. Navy's Commander, Operational Test and Evaluation Force and is a five-month series of site visits and evaluations by fleet experienced operators who will perform a detailed analysis of the carrier and all its major subcomponents. This review is expected to be completed in 2QFY13 and will be used to inform the Defense Acquisition Board decision regarding future procurement of CVN-79.
- The CVN-78 *Gerald R. Ford* class carrier program Office is revising the TEMP in an effort to align planned developmental tests with corresponding operational test phases and to identify needed platform-level developmental testing. As part of this process, the Program Office recently released a Post Delivery Test and Trials schedule.

### EMALS

- The EMALS system functional design test site at Joint Base McGuire-Dix-Lakehurst, New Jersey, continues to test the new electromagnetic catapult system.
- The Navy completed Phase I of Aircraft Compatibility Testing and installed a re-designed armature. Additionally, the system was reconfigured to enable testing of simulated shared energy storage and simulated shared power conversion to provide an early examination of multiple catapults on a carrier.

### AAG

- The Navy is testing the AAG on a jet car track at Joint Base McGuire-Dix-Lakehurst, New Jersey. Earlier testing prompted design changes for the system's Water Twisters, Cable Shock Absorbers, Inverters, and Purchase Cable Drum frames. In August 2012, the program completed two test milestones that validated system performance in the uppermost regions of the system performance envelope. AAG performance testing began in September 2012.
- As of October 2012, about one third of AAG hardware items have been delivered to the shipyard.

### JSF

- The Navy completed land-based JSF testing associated with the Jet Blast Deflector (JBD). The JBD is designed to deflect engine exhaust during catapult launches.

### CANES

- The Navy conducted developmental testing on the unit-level CANES configuration used on Aegis destroyers in the lab from July 11 – 24, 2012. The Navy has scheduled developmental and follow-on testing of the force-level CANES configuration used on the *Nimitz* and *Gerald R. Ford* classes for the 4QFY14.

### DBR

- The Navy is reactivating the Engineering Development Model of the Volume Search Radar portion of the DBR at the surface Combat System Center at Wallops Island, Virginia. In addition, the Navy is installing a production Multi-Functional Radar component of DBR to establish capability by January 2013 to support CVN-78 combat system integration and test.
- The Navy plans to conduct DBR testing at Wallops Island, Virginia, to verify the radar will meet CVN-78's Air Traffic Control requirements in January 2013. The Navy will also begin CVN-78 combat system integration testing with DBR in April 2013.

### LFT&E

- DOT&E rescinded approval of the alternative LFT&E Management Plan pertaining to the *Gerald R. Ford* class carrier program because the Navy unilaterally decided to modify the previously approved LFT&E plan. The Navy informed DOT&E of its intent to limit the scope of the TSST on CVN-78 to conform to the Navy budget. While progress has been made toward reaching consensus on the scope of the TSST, the budget has not been adjusted accordingly. The Navy also deferred the FSST to CVN-79, a change to the previously approved LFT&E Management Plan with which DOT&E does not concur. Though the change is motivated by the desire to reduce the gap in available carriers caused by the retirement of the USS *Enterprise*, the delay due to the FSST is minimal, and only a small portion of the already substantial delay caused by other factors. The benefit of having test data to affect the design of future carriers in the class outweighs the delay.

## Assessment

### Test Planning

- 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 continues in order to ensure that the required fidelity will be available to support the SGR assessment during IOT&E.
- The current TEMP does not adequately address whole platform-level developmental testing. The Program Office has begun to address the problem and has refined the Post Delivery Test and Trials schedule. The details are unclear on the extent of any additional integrated platform-level CVN-78 developmental tests. Lack of platform-level

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developmental testing significantly raises the likelihood of the discovery of platform-level problems during IOT&E.

- The Navy plans to deliver CVN-78 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.

## EMALS

- 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 concern is partially mitigated by the current phase of test using a simulated shared electrical storage and shared power conversion at the EMALS system functional design test site in Joint Base McGuire-Dix-Lakehurst, New Jersey.

## AAG

- Significant redesign of multiple components has slowed development of AAG development. The program will begin performance testing in FY13.

## JSF

- JBD testing identified no deficiencies for catapult launch operations of JSF at military rated thrust. The tests did, however, determine that additional JBD side panel cooling (SPC) and other adjustments are required for operations at combat rated thrust, i.e., with afterburner. The existing JBD panels will need to be replaced with new panels with SPC to be fully JSF-compatible. JBD panels with SPC are form, fit, and function replacements and will be installed after CVN-78 delivers.
  - JSF data flow aboard ship via the Autonomic Logistics Information System (ALIS) is critical to proper F-35 maintenance. Currently, the ALIS system has provided all required parametric information to interface properly with CANES, but CANES is not fully developed yet, as the contract was awarded in August 2012. ALIS is expected to undergo Application Integration Process testing in FY13 to ensure proper interface with CANES. DOT&E will be able to better assess the impact on JSF operations aboard CVN-78 after the test. Currently, data are planned to be exchanged manually until ALIS and CANES properly interface.
  - In 2007, the Program Office identified discrepancies with the integration of the JSF's F135 engine onto aircraft carriers. The weight of the F135 power module, approximately 10,000 pounds, exceeds the limit of current underway replenishment (UNREP) systems. Although CVN-78 will include a heavy UNREP system that will allow transfer of 12,000 pounds, supply ships must include the new system for power module transfer to occur. The Navy's plan to install heavy UNREP systems on resupply ships has slipped eight years.
- Navy Fleet Force's JSF "day-in-the-life" analysis identified a significant number of aircraft-ship interface deficiencies that must be accomplished by the Navy in post-delivery ship modification. They include the following:

- JSF battle damage assessment and non-traditional Intelligence, Surveillance, and Reconnaissance information captured on the Portable Memory Device or cockpit video recorder cannot be shared real-time with the Distributed Common Ground System-Navy (DCGS-N). This prevents assessment by shipboard intelligence analysts for inclusion in mission reports.
- Ships are unable to receive and display Link 16 imagery; this problem is not unique to JSF. The Combatant Commanders have stated a need to display imagery to intelligence analysts and operations command and control nodes to enhance engagement decisions.
- Limited shipboard capabilities exist with expeditionary Link 16. The Navy is considering a program of record to distribute imagery to analysts and maritime operations command and control nodes (e.g., carriers and amphibious ships). This would be a temporary workaround for the DCGS-N post-flight data gap.
- The JSF Prognostic Health Maintenance (PHM) downlink design for ships is not mature. The uncertainty in the technical characteristics of the final design means that there are potential challenges to integrating PHM into current shipboard communications suites and networks. These challenges include unidentified Information Assurance considerations and unidentified waveform hosting and interfacing.
- The JSF wheel supplier's recent rim inspection requirement may force a significant increase in shipboard tire and wheel storage requirements. The JSF Program Office is currently working to determine the effect of this deficiency and the need for inspection by the wheel supplier.

## DBR

- Previous testing of Navy combat systems similar to CVN-78's revealed numerous integration problems that degrade the performance of the combat system. The previous results emphasize the necessity of maintaining a DBR/CVN-78 combat system asset at Wallops Island. The Navy is considering long-term plans (i.e., beyond FY15) for testing DBR at Wallops Island, Virginia, but it is not clear if a Multi-Functional Radar and funding will be available. Such plans are critical to delivering a fully capable combat system and ensuring lifecycle support after CVN-78 delivery in 2015.

## LFT&E

- While the Navy has made substantial effort in component and surrogate testing, this work does not obviate the need to conduct the FSST to gain the critical empirical data that past testing has repeatedly demonstrated are required to rigorously evaluate the ship's ability to withstand shock and survive in combat. Shock Trials conducted on both the *Nimitz* class aircraft carrier and the *San Antonio* class Amphibious Transport Dock demonstrated the need for and substantial value of conducting the FSST. Postponing the FSST until CVN-79 would cause a five- to seven-year delay

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in obtaining the data critical to evaluating the survivability of the CVN-78 and would preclude timely modification of subsequent ships of this class to assure their survivability.

- The Navy proposes delaying the shock trial by five to seven years because of the approximately four- to six-month delay required to perform the FSST. The delay is not a sufficient reason to postpone the shock trial, since the shock trial could reveal valuable lessons, including previously unknown vulnerabilities.
- DOT&E has requested the Navy adequately fund and complete the actions necessary to conduct the TSST on the CVN-78. This includes updating the Damage Scenario Based Engineering Analyses (DSBEA) from prior Vulnerability Assessment Reports and enough new DSBEAs, including machinery spaces, to conduct an adequately scoped TSST. DOT&E expects this will require five or six TSST drills. While progress has been made toward reaching consensus on the scope of the TSST, there is still work to be done, mainly to include the machinery spaces, and the budget has not been adjusted to adequately support the TSST.

## Recommendations

- Status of Previous Recommendations. The Navy addressed one of eight previous recommendations but the following seven remain valid:

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 required to JBDS, changes (due to heat and or noise) to flight deck procedures, and ALIS integration.
  2. Finalize plans that address CVN-78 integrated warfare system engineering and ship's self-defense system discrepancies prior to the start of IOT&E.
  3. Continue aggressive EMALS and AAG risk-reduction efforts to maximize opportunity for successful system design and test completion in time to meet required in-yard dates for shipboard installation of components.
  4. Continue development of a realistic model for determining CVN-78's SGR, while utilizing realistic assumptions regarding equipment availability, manning, and weather conditions for use in the IOT&E.
  5. Provide scheduling, funding, and execution plans to DOT&E for the live SGR test event during the IOT&E.
  6. Continue to work with the Navy's Bureau of Personnel to ensure adequate depth and breadth of required personnel to ensure that the 100 percent Navy Enlisted Classification fit/fill manning requirements of CVN-78 are met.
  7. Conduct system-of-systems developmental testing to preclude discovery of deficiencies during IOT&E.
- FY12 Recommendations. None.