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HOUSE ARMED SERVICES COMMITTEE
PROJECTION FORCES SUBCOMMITTEE

STATEMENT OF

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BEFORE THE

PROJECTION FORCES SUBCOMMITTEE

OF THE

HOUSE ARMED SERVICES COMMITTEE

ON

DD(X) SHIPBUILDING PROGRAM

JULY 19, 2005

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PROJECTION FORCES SUBCOMMITTEE

Mr. Chairman, distinguished members of the Subcommittee, thank you for this opportunity to appear before you to discuss the DD(X) shipbuilding program.

The Navy and the Nation needs DD(X) now. We need to build DD(X) now to support our Expeditionary Strike Groups and Carrier Strike Groups of the future. We need DD(X) because of its 10-fold improvement in battle-force defense, its 50-fold improvement in stealth, its 10-fold increase in operating area against shallow water mines, its three-fold increase in volume fire support for forces ashore, and its power systems and architecture needed for future high-energy weapons.

We need to build DD(X) now to counter the anticipated threat 10 years in the future and beyond.

DD(X) will serve this Nation in the 2015–2060 timeframe. We can project peer threats on the horizon which demand DD(X)'s stealth and other capabilities. Further, we must be prepared to deal with threats we do not foresee, and DD(X) provides that capability and margin.

The DD(X) program is the single largest investment ever made in surface Navy capabilities. It is appropriate to ask, "How does the Navy measure the DD(X)'s value to our overall future shipbuilding strategy?". The answer lies in the interplay of five critical factors:

- The unprecedented warfighting capabilities that DD(X) will possess immediately upon deployment.
- The cost of these ships in comparison to other acquisition programs.
- Whole-life affordability - the low total lifetime costs-procurement, manning, and operating of DD(X).
- Development of an acquisition strategy that provides these ships to our Navy at the best value for the taxpayers.
- The future warfighting capabilities that will be built on the foundation of transformational technology provided by DD(X).

When all five are taken together, the case for DD(X) becomes clear.

1. Unprecedented Warfighting Capabilities

Operating in the littorals in support of Expeditionary Strike Groups, DD(X) will, when compared to current Surface Navy capabilities, provide:

- Three-fold improvement in capability against Anti-Ship Cruise Missiles;
- 10-fold improvement in battleforce defense;
- 50-fold reduction in radar cross-section, dramatically enhancing survivability and reducing the total number of missiles required in an engagement by half; and
- 10-fold increase in operating area against mines in shallow water regions.

Figures 1-5 provide an unclassified illustration of the capabilities and survivability of the DD(X).

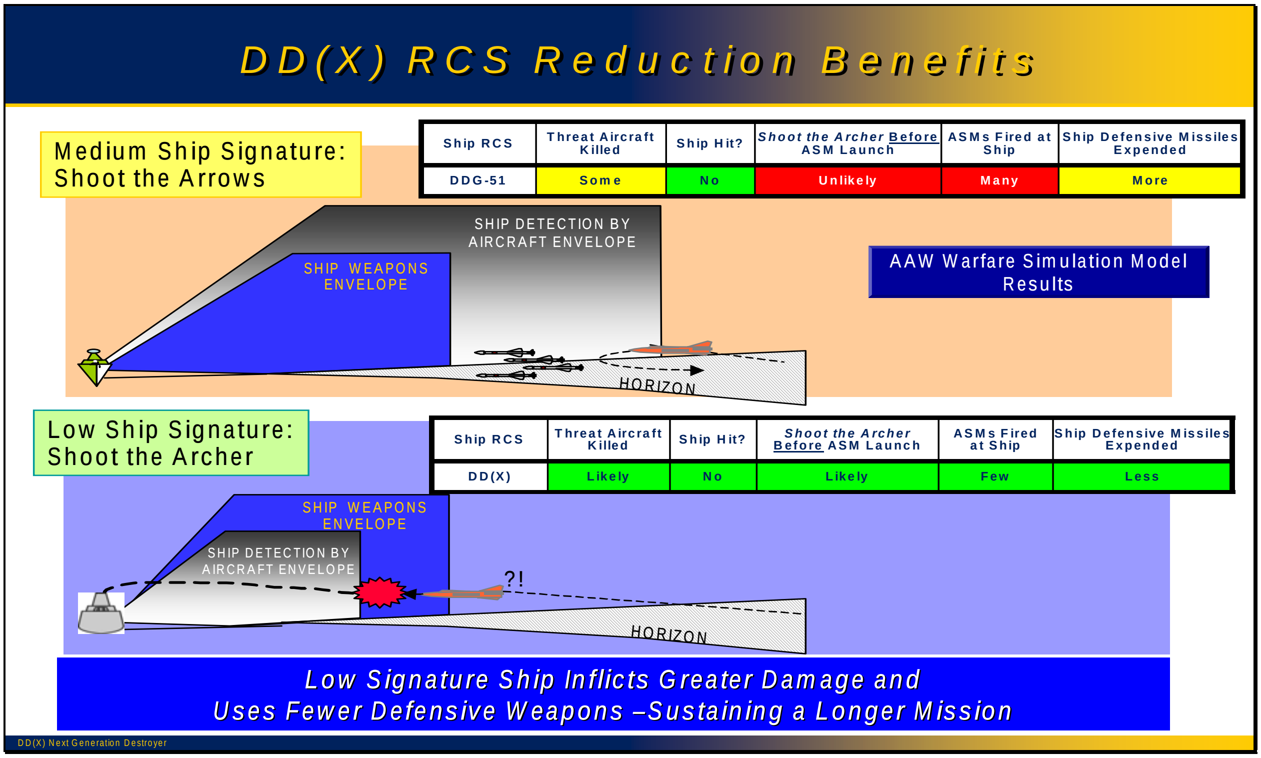


Figure 1

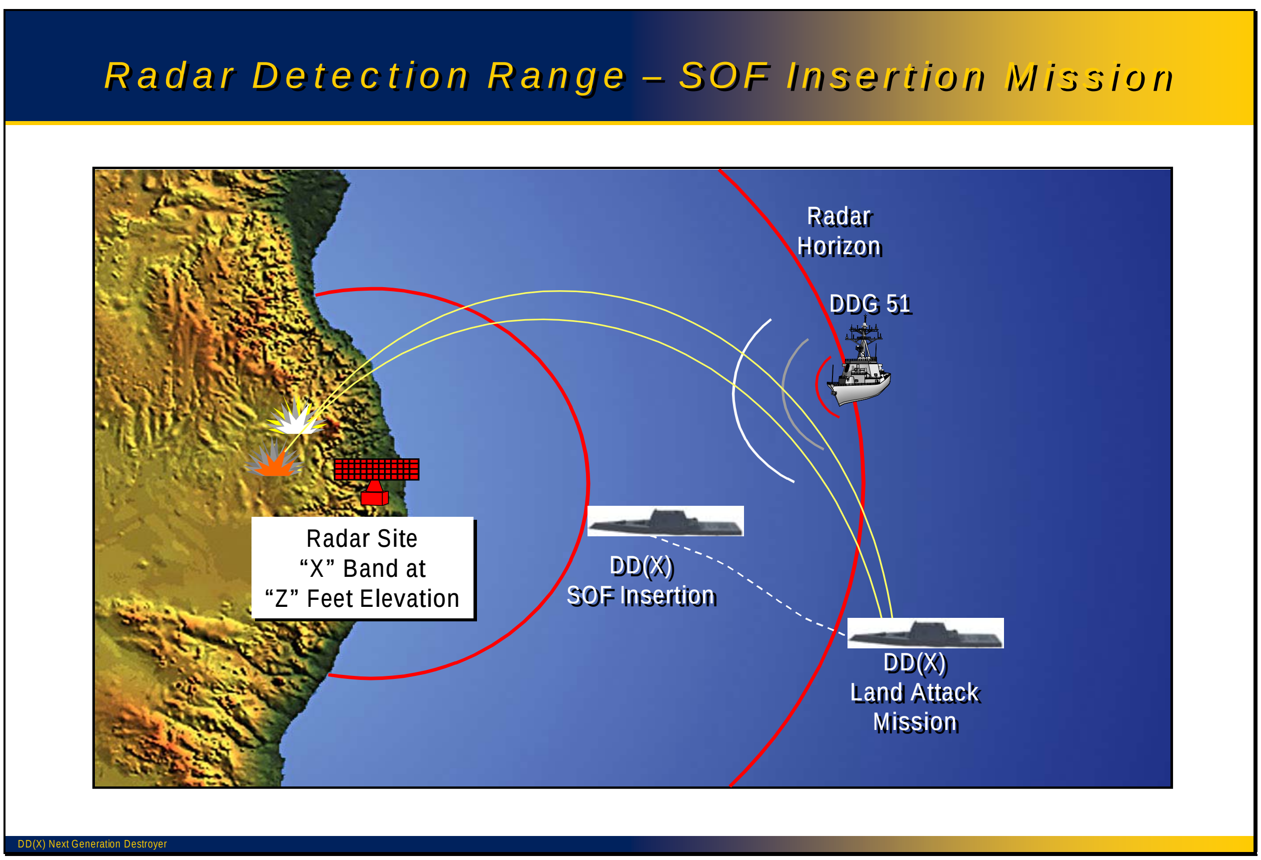
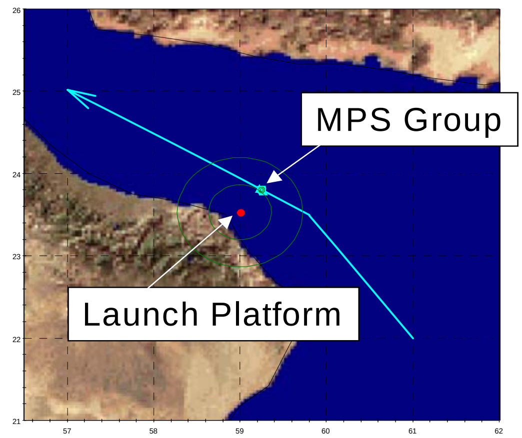
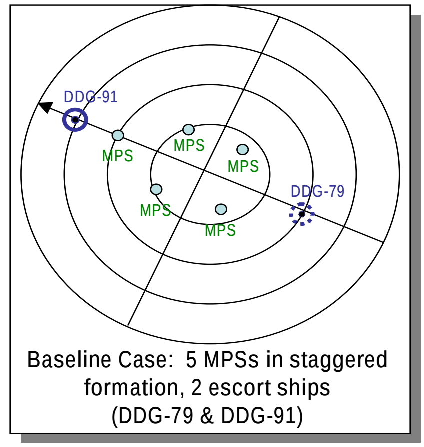


Figure 2

Defense of Sealift / Shipping ASCM Attack





Cases	Ships	Ingress	Egress
Baseline	DDG-79 & DDG-91		
	DD(X) for DDG-79		
Baseline	DDG-51 with SPQ 9B for DDG-79		
Baseline with Reduced Threat Launch Range	DDG-79 & DDG-91		
Baseline, Vary attack bearing - 45, 0, +45 degrees	DDG-79 & DDG-91		
Column Formation	DDG-79 & DDG-91		

DD(X) Next Generation Destroyer

Figure 3

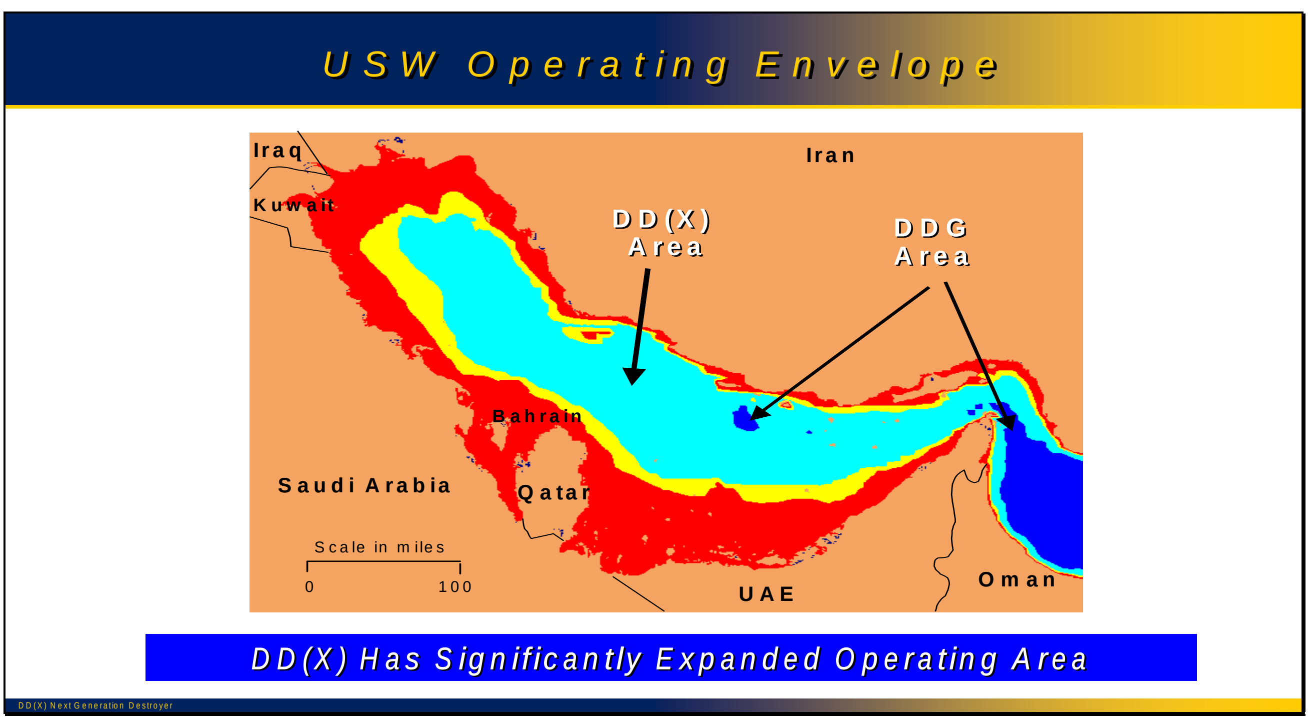


Figure 4

ASW Comparison

Capability	DD(X)	DDG 51 Class
Acoustic Environment	Littoral	Deep Water
Active	MF / HF (Littoral)	SQS-53C (Deep Water)
Ship Signature	Reduced from DDG	Reduced
In-Stride Mine Avoidance	HF / MF / EO / IR	Operational Mode of -53C
Non-Acoustic Sensor Integration	DBR - Including Periscope Detection / EO / IR	N/A (Acoustic only)
Data Fusion	Automated (Reduced Manning)	Manual (Operator Intensive)
Use of Offboard Sensors and Tactical Data	Flexible	Limited
Passive	MFTA	SQR-19 (Flt I and II only)
Torpedo Defense	Nixie / MFTA / LEADS	Nixie / Passive
Helo	MH-60R	SH-60B (Flt IIA can embark)
Weapons	VLA / Organic Torps (Helo)	VLA / Organic Torps (Tubes

DD(X) Optimized for the Littorals

DD(X) Next Generation Destroyer

Figure 5

NAVAL FIRES

In the early part of a major campaign, there is a critical fires gap stemming from a lack of capability and capacity in the current Surface Force. DD(X) will provide a three-fold increase in Naval Surface Fires coverage via:

- Long-Range Land Attack Projectiles, enabling DD(X) to provide 24-hours-a-day, seven-days-a-week fires, even in the most adverse weather conditions;
- Two Advanced Gun systems, delivering 10 rounds per minute each (i.e., 20 rounds per minute per ship);
- Two DD(X)'s can deliver essentially the same firepower as an artillery battalion;
- The ability to meet the Marine Corps' stated fire requirements, a capability otherwise unavailable in the surface fleet; and
- A ship design that allows underway replenishment, allowing an almost infinite ammunition magazine and nearly continuous fire support.

DUAL-BAND RADAR SUITE: MULTI-FUNCTION RADAR (MFR) AND VOLUME SEARCH RADAR (VSR)

The AN/SPY-3 Multi-Function Radar (MFR) is an X-band active phased-array radar designed to:

- Provides X-band capability allowing the ship to operate and target enemies in the high clutter environment of coastal and over land areas;
- Meet all horizon search and fire control requirements for the 21st Century Fleet;
- Detect the most advanced low-observable Anti-Ship Cruise Missile threats;
- Support fire-control illumination requirements for the Evolved Sea Sparrow Missile; and
- Support new ship-design requirements for reduced cross-section, significantly reduced manning (no operators) and total ownership costs.

The S-band Volume Search Radar (S-VSR) is an S-band active phased array radar designed to:

- Meet above-horizon detection requirements for the 21st Century ships including CVN-21 and amphibious ships as well as DD(X);
- Provide long-range situational awareness with above-horizon detection and air-control functionality;
- Provides capability that meets or exceeds current DDG S-Band and Aegis radar performance; and
- Combined S and X capability far exceeds current US Navy radar search and fire control capability.

TUMBLEHOME HULL

DD(X) will incorporate a wave piercing tumblehome hull that will provide low radar cross section and reduced seaway resistance, thereby resulting in a profound detection range advantage against adversary aircraft, missiles, and ships. The DD(X) hull is necessary to deliver stealth and survivability in the littorals. DD(X)'s stealth makes it significantly harder for an adversary to detect, track and target the ship. Thus DD(X)'s stealth provides the Navy with greater operational flexibility and survivability against evolving threats.

SURVIVABILITY IMPROVEMENTS

DD(X) will incorporate a total ship approach to survivability that addresses susceptibility, vulnerability, and recoverability. Featured are:

- The Autonomic Fire Suppression System to safely reduce damage control requirements for a broad range of shipboard fire scenarios, including the highly stressful combat damage environment.
- The Peripheral Vertical Launch System to isolate each MK 57 VLS four-cell module to achieve maximum survivability in the event of enemy engagement.

- The combination of the Integrated Power System with the Integrated Fight-Through Power System, which will enable DD(X) to automatically reconfigure its power distribution system following damage.

Simply said, DD(X) will be able to take a hit and continue to fight.

Future Warfighting Capbilities/Transformational Technology

DD(X) is the engine of the technology train that is pulling the surface Navy into the 21st Century. DD(X) development is directly applicable to our existing and future fleet: the Littoral Combat Ship, CVN-21, LHA(R), and CG(X). Open Architecture is what makes this kind of cross-pollination of technology possible, and Navy Standard Command and Control (NSC2) depends on DD(X) delivery. The NSC2 in DD(X) is intended for direct transplant into all appropriate Navy platforms; they depend on DD(X) development of the dual band radar suite as well as the Total Ship Computing Environment.

2. Cost

DD(X) is being designed to be the Nation's destroyer and future cruiser sea frame. DD(X) and CG(X) will project power and protect the sea lanes in the 2015-2060 time frame. Navy analyses makes it clear that the service will need improved capabilities in the 2015 and beyond timeframe that the DDG-51s do not possess to defend against evolving peer threats.

If we were only worried about the next 10 years, we could possibly buy more DDG-51 Class destroyers. While we welcome debate on the requirement for DD(X), it is dangerous to look only at short-term goals.

It takes five to seven years or more to design and build a ship. Discussions about ship cost must consider the time value of money. For example, the lead DDG-51 was purchased in 1985 for $1.2 billion. Accounting for realistic inflation in the industries that that make up shipbuilding, that ship would cost $2.4 billion in Fiscal Year 2007 dollars.

DD(X) is 50 percent larger in tonnage, built with a substantially lower radar and acoustic signature, is automated to reduce crew size from 360 to 114, and includes vastly improved X- and S-band radar (vs. S-band only on DDG-51), two large caliber guns (vs. one medium caliber), and enhanced vertical launchers. The Navy will continually work to lower the cost of DD(X), but $3.3 billion for this lead ship vs. the $2.4 billion lead DDG is a good value. The Navy expects the fifth DD(X) to cost $2.2B in FY 2011 dollars at a procurement rate of one per year. Higher procurement rates could further lower the cost of DD(X)'s.

Additionally, the Navy has confidence in the $3.3 billion lead ship estimate. This estimate assumes baseline shipyard efficiency similar to what has been achieved on recent DDGs, with historical adjustments for the challenges of a first ship of a Class. It assumes efficiency among the combat system providers similar to recent complex weapon systems. It assumes design efficiency similar to what was recently achieved in the VIRGINIA Class submarine program. A detailed list of the components of the first ship costs is provided in Table 1.

TABLE 1

Item	Cost – 1st Ship (TY07$M)	Cost - 5th Ship (TY07$M)	Cost – 5th Ship (TY11$M)
Total Design	$558M	$43M	$47M
Ship Construction and Material	$1,248M	$1,098M	$1,192M
Communications and Intelligence Equipment	$289M	$193M	$209M
Radar	$323M	$174M	$189M
Underwater sensors including sonar	$52M	$34M	$37M
Total Ship Computing Environment	$86M	$47M	$51M
Other Electronics	$37M	$47M	$52M
Advanced Gun System	$286M	$149M	$162M
Vertical launch System	$127M	$65M	$71M
Other Guns and Launchers	$25M	$19M	$21M
Change Orders	$125M	$55M	$60M
Other costs	$135M	$134M	$146M
Total	$3,291M	$2,058M	$2,237M

Note: The fifth ship Other Electronics numbers contains Electronic Warfare (EW) funding (lead ship EW system will be funded for post delivery install and is not in the ship end cost), hence the higher Other Electronics cost for the fifth ship.

DD(X) has automation that allows it to operate with a crew of just 114 Sailors compared to the 360 currently onboard an ARLEIGH BURKE destroyer. This saves millions of dollars over the life cycle of the ship and puts fewer sailors at risk. Finally, the ship will also have an integrated power system moving the Navy to the quiet, efficient and reliable electric drive propulsion being adopted by commercial shipbuilders and enabling greater design flexibility and rapid reconfiguration of power in combat situations. Most importantly, the electric drive design reduces the ship's acoustic signature, providing greater freedom of operation in potentially mined waters.

Accurate comparisons would also note that a single DDG per year is estimated to cost $1.65 billion to $1.8 billion. Building DD(X)s at one per year for $2.2 billion, the estimate for the fifth ship in production, with far more capability, represents exceptional value. To produce a DDG-51 with DD(X)'s capability in firepower, radar and crew reduction would require radical design changes that would increase its cost to DD(X) levels. Heavily modified DDGs are not a good deal for the taxpayer, future Sailors, or the Nation.

Finally, the Navy has an adequate and robust supply of current-generation cruisers and destroyers. With DDG deliveries through 2010, the surface fleet will grow from today's 102 ships to 110. During the years that follow, the Navy will shift mine-hunting, maritime interdiction and other littoral missions to the Littoral Combat Ship (LCS), reserving highly capable CGs and DDGs for air defense, missile defense and strike missions.

In 2020, the Navy is projected to have 145 surface combatants, including 52 LCS's. The Navy must use this time to move to the next generation of ships equipped with advanced weapon systems and critical new design features in order to meet projected and unexpected future threats.

The best deal for the taxpayer would be to compete for the DD(X) Class now and control cost in low-rate production. The Navy believes that the combined savings of facilitizing a single shipyard and achieving a single learning curve would save up to $3 billion over a 10 ship Class. Congress rejected competition, forcing the Navy to return to the previous DD(X) acquisition strategy. Simply alternating ship allocations provides no government leverage, no cost control, no competitive pressures and no motivation to design the ship with urgency and collaboration.

Further, the current DD(X) quantities do not support current steady employment levels at two shipyards - the yards will face unmanageable peaks and valleys as they deliver a ship, live through a one-year gap, and then build the next ship. Building DDGs at low rate into the future would also do little to help maintain our current production industrial base. Building DDG's at one per year, the Navy requirement, will not sustain a stable workforce at either of the current DDG production shipyards. A shipyard that built only a single DDG a year would reach a level where the low rate production could not support affordable ship construction. Building a DD(X) every other year in two yards, or building one DDG a year at a single yard is unaffordable and unexecutable for the Navy and the taxpayer. Further, building DDG's that the Navy does not require is a poor use of tax dollars and denies warfighters needed capabilities that could be purchased with those funds. The Navy will struggle to control cost, as we have on the VIRGINIA Class program, if we have directed acquisition and industrial strategies.

The value of DD(X) extends beyond a single ship type. Its combat system investment leads to an open architecture system that is integral to DDG-51 modernization and long-term supportability, is the core of the CVN-21 carrier and the LHA(R) amphibious assault ship, and is closely coupled to the LPD-17 amphibious transport dock ships. The Raytheon Corporation is building SSDS, the LPD-17 combat system, and is the prime for the DD(X) combat system. DD(X) will further open the SSDS design, and that design will be used in DD(X), future LPD's, and backfit eventually to current LPD's. Without DD(X), substantial additional funds will have to be added to each of these individual programs to develop and modernize their combat systems.

DD(X) provides the Navy with a low acoustic- and magnetic-signature ship, which is fundamental to future survivability. Finally, DD(X)'s electric drive and automation enables future growth, reduces crew size and lowers maintenance costs.

A factual debate on the Navy's plans will conclude that we have defined an effective alternate path forward. The Navy has realistically budgeted the first DD(X) at roughly eight million shipyard production hours and follow-on DD(X)s are projected at six million production hours. DDGs today are built with roughly three million production hours at the final stages of a mature program. The Navy has done nothing but lower requirements on DD(X) in the last three years, reducing the ship from 18,000 tons to 14,500 tons; lowering the gun firing rate from 12 to 10 rounds per minute; and defining a resupply concept to reduce the gun magazine size. Each of these steps has lowered cost. The Navy has also made design decisions, such as delivering the Advanced Gun System to the shipbuilders in modular pieces, which will enhance producibility and drive down cost. The Navy has and will work to control expenses associated with the

DD(X) program. However, the Nation expects the Navy to provide the best available capability and technology for the men and women who are prepared to make personal sacrifices to protect our Nation's future interests.

Some have argued for Congressionally imposed cost caps as a way to induce cost performance on this, and other, acquisition programs. Cost caps do not recognize the significant amount of non-recurring costs required on any lead ship of a Class nor is there any detailed analytical basis behind any current cost cap number. The DD(X) acquisition program encompasses development, test, and production of numerous new technologies necessary to meet Joint Staff validated operational requirements, while enhancing survivability and reducing life-cycle costs over current platforms. DD(X) fields significantly enhanced war-fighting capabilities over current DDGs. These technologies are critical to an effective DD(X) as well as development of a CG(X) with the power and radar capabilities we need for missile defense to counter the challenging ballistic, cruise and hypersonic missile threats of the near future. Should we lose DD(X), this would also significantly drive up combat system development costs for current Aegis equipped cruiser and destroyer modernization programs, and likely delay the scheduled delivery of CVN-21, since the development of the Dual Band Radar and Total Ship Computing Environment are being tailored to meet both DD(X) and CVN-21 requirements. The liability to the CVN 21 program alone is estimated to be $1.3B, not including the cost of schedule delay.

In the case of the recent HASC language, a $1.7B cost cap would not be sufficient to purchase a single DDG 51 Class ship today. For example, the first DDG 51 Class ship, USS ARLEIGH BURKE, would cost approximately $2.4B when escalated to current year dollars. Additionally, the estimated cost of a single DDG 51 ship in FY 2006 is approximately $1.65B to $1.8B as is, with no improvements and as a very mature production program.

It does not appear this proposed cost cap reflects any consideration of the return on investment offered by the early investment in technology in terms of resultant savings in operations and support costs over the life of the Class, or the opportunity to amortize these developmental costs over a wide range of ship Classes. Without DD(X), an entire generation of technological progress may be sacrificed, an investment of over $4.5B in non-recurring engineering. Finally, an arbitrary cost cap, if implemented, poses the very real prospect that we will ask Marines and Sailors to deploy with equipment which cannot match the capability of our evolving and future adversaries.

3. Whole-Life Affordability

To have a clear picture of the affordability of DD(X), all program lifetime cost components should be viewed together: development, procurement, and operation. These cost categories are not independent; when one is capped or controlled, there is a tendency for growth in at least one of the other categories.

In the case of DD(X), development is less than what it cost the surface Navy to develop the Aegis Weapon System fielded aboard the TICONDEROGA Class cruiser. While the TICONDEROGA Class lead ship fielded a hull and propulsion plant recycled from its predecessor (the SPRUANCE Class), DD(X) will be fielding a new combat system, a new propulsion plant, and a new hull.

Also, the design of DD(X) will allow the Navy to achieve optimal manning goals, with a reduction of manpower of over 60% from DDG 51, as well as annual operating cost savings of almost 30% when compared to DDG 51.

4. Acquisition Strategy

On March 23, 2005, the Secretary of the Navy signed an interim report to Congress on the Long Range Plan for the Construction of Naval Vessels. This report identified a range between eight and 12 for the required number of DD(X) Class ships. This DD(X) procurement profile represents a build rate of one ship per year versus the two to three ships per year previously programmed. Navy assessment of the impact of the reduced number of DD(X) Class ships in the Future Years Defense Program on the surface combatant workload indicates that there may not be sufficient workload to support two shipyards.

Earlier this year, the Navy recommended a revision to the DD(X) Phase IV acquisition strategy that would competitively award DD(X) detail design and ship construction to one shipbuilder, rather than directing the lead ship contract award to the DD(X) Design Agent. The contract awarded under this strategy would include detail design and construction of the lead ship, and options for the next four ships of the Class. The Navy's revised DD(X) acquisition strategy was intended to reduce ship unit cost and thus save taxpayers' dollars by concentrating the workload associated with the lower build rate at a single shipyard. This competitive strategy was not formally reviewed and approved by OSD or OMB.

The FY 2005 Emergency Supplemental Defense Appropriations Act prohibited the Navy from conducting a "winner take all" competition for the DD(X) destroyer program. The Navy strongly believed that this strategy would have resulted in the lowest possible costs to acquire the needed number of ships. However, since the passage of the Supplemental, we have again consulted with industry, the Defense Department, and Congress to chart our way forward for the DD(X) program. The key objectives of any path forward are:

- Acquire eight -12 DD(X) Class destroyers in as cost effective a manner as possible;
- Create pressures to control and reduce cost;
- Acquire these ships on a timeline that meets the warfighters requirements;
- Lower overall risk in the program;
- Treat each of our industry partners fairly; and
- Preserve a viable industrial capability for complex surface combatants.

In order to accomplish these objectives, the Navy has creatively defined a new way ahead: "Dual Lead Ships". This effort tries to create a strong, mutually dependent partnership between the shipyards and the Navy to reduce cost and improve collaboration. Importantly, the Navy's new strategy fully addresses industry's key issues and responds to Congressional concerns. The Dual Lead Ship Strategy has not been fully reviewed by OSD or OMB. Neither OSD or OMB have approved the the Dual Lead Ship Strategy, and these offices are currently reviewing and evaluating the Dual Lead Ship strategies benefits and drawbacks.

The key features are:

➢ Sole source lead ship detail design and construction contracts with the shipbuilders;

- Equal split of common detail design with each yard doing their respective production design;
- Shipyards procure electronics, ordnance, and Integrated Power System from system developers as Contractor Furnished Equipment;
- Funding phased to synchronize Start of Fabrication dates in both shipyards; and
- Importantly, the shipyards are mutually dependent on each other to urgently and cooperatively complete the DD(X) detail design.

➢ Sole source contracts to software and system developers
  - Transition to production of systems culminating in Production Readiness Reviews;
  - Complete software releases and provide to shipyards as Government Furnished Information; and
  - Importantly, this approach lowers the cost to the Navy by avoiding incremental pass through fee costs.

➢ Keep open the option for allocated procurement or various competition strategies in FY 2009 and follow.

The Navy is confident that the Dual Lead Ship Strategy is a viable acquisition approach which motivates cooperative and collaborative completion of detail design. Further, being able to benchmark the lead ships against each other provides an unprecedented pressure and opportunity to control cost on the lead ships. Finally, because each builder will have completed significant construction on sections of the ships and will have completed detail design, the Navy will have information and options for future acquisition strategy decisions.

The Navy has made no acquisition strategy decisions about the DD(X) program in 2009 and beyond. Successful construction of lead DD(X)'s by both of the current destroyer shipbuilding yards provides the Navy and DoD with a full range of options and a robust industrial capacity. The Navy will work with OSD and OMB to frame DD(X) acquisition strategies for 2009 and beyond.

5. Transformational Technology – DDX Engineering Development Models (EDMs)

The Navy has made significant progress in fielding the EDMs required for DD(X) production. These EDMs are essential and provide high confidence in our ability to build the lead DD(X). While requiring an investment in RDT&E, the use of EDMs reflects a DoD best practice for the development of complex systems with technical risk. The DD(X) program has been carefully planned and well executed.

Since the award of the DD(X) Design Agent contract in April 2002, the DD(X) program has conducted extensive land-based and/or at-sea testing of the 10 EDMs. The knowledge gained from these efforts has served to mature the ship and system designs.

As a result of Phase III efforts, the DD(X) program has demonstrated fundamental capabilities prior to ship construction contract award at Milestone B, is completing necessary testing in support of ship Critical Design Review (CDR) this summer, and is on track to mature systems in time for ship installation. As a reminder, successful completion of CDR generally leads to the start of detail design and initial hardware fabrication efforts.

A challenging set of Milestone B exit criteria was established by the April 2002, Acquisition Decision Memorandum and updated by the August 2004, Acquisition Decision Memorandum. These exit criteria for DD(X) Milestone B were chosen to provide assessments of critical technologies prior to the contract award. The DD(X) program has accomplished the stated exit criteria.

- Completion of DD(X) Preliminary Design Review (PDR) and Early Operational Assessment (EOA)
  Status: Complete
- Completion of Advanced Gun System (AGS) PDR and successful testing of gun hardware and flight testing of guided projectiles
  Status: Complete
- Completion of Dual Band Radar (DBR) CDR and land-based testing of Multi-Function Radar (MFR)
  Status: Complete
- Completion of Main Propulsion System PDR and factory testing of major components
  Status: PDR and factory testing of the Advanced Induction Motor (AIM) and gas turbine generators are complete. Permanent Magnet Motor (PMM) factory testing has highlighted problems with the stator insulation system. The baseline ship design has been shifted to an AIM based system.

Also, in preparation for Milestone B, the DD(X) program has successfully completed an independent Technology Readiness Level Assessment (TRA). The TRA was conducted by the Office of Naval Research and validated by an Independent Expert Review. The Deputy Under-Secretary of Defense (Science and Technology) concurred with the report of successful TRA on April 19, 2005. The TRA noted satisfactory progress in all key technology areas, particularly those associated with the EDM's, to demonstrate technology readiness at Milestone B.

Over the course of Phase III, the DD(X) Program has conducted extensive land-based and/or at-sea testing of the following 10 EDMs:

- Integrated Power System
- Integrated Undersea Warfare System
- Infrared Mock-up Signatures
- Vertical Launch System
- Advanced Gun System and Long Range Land Attack Projectile
- Integrated Deckhouse and Apertures
- Dual Band Radar Suite, which includes the Multi-Function Radar and Volume Search Radar
- Hull Form Scale Model
- Total Ship Computing Environment

- Autonomic Fire Suppression System

The knowledge gained from these efforts are maturing the ship and system designs transitioning into DD(X) detail design and construction. The DD(X) risk mitigation approach represents the management of finite resources to achieve innovation and to implement a cost effective test plan designed to address those risks with the greatest potential to impact the ship's ability to conduct its mission.

The DD(X) development schedule supports readiness of DD(X) technologies in time for ship installation, which for shipbuilding programs, is the most relevant point of reference for technology maturity. In the case of DD(X), the completion of EDM testing precedes scheduled system in-yard need dates by up to four years, allowing sufficient time to incorporate lessons learned.

Given the long production lead time in shipbuilding, the Navy believes it is appropriate to undertake a reasonable amount of risk in the DD(X) lead ship, in order to deliver technological benefits to the rest of the class. The ability of DD(X) to deliver revolutionary capabilities to the fleet with reduced crew necessitates some element of development and production risk.

The following is a status of each of the DD(X) EDM's:

<u>Integrated Power System (IPS)</u>

IPS provides total ship electric power, including propulsion (electric drive), allowing improvements in ship survivability, reduced signatures, and reduced operating and support costs. IPS architecture will facilitate the incorporation of future weapons systems, which will require larger quantities of electric power than historical ship design margins will accommodate.

The IPS EDM has conducted a great deal of risk mitigation through testing to demonstrate design compliance. Major IPS EDM tests and events already completed include:

- IPS EDM Critical Design Review;
- Factory testing of main and auxiliary gas turbine generators; and
- Advanced induction motor (AIM) factory acceptance testing.

Extensive factory testing has significantly reduced risk. The GE Auxiliary Turbine Generator (ATG) produced the required power at rated generator speed, voltage and current during land based testing in Houston, TX. The Rolls Royce ATG also produced similar results during its land based testing in Cleveland, OH. The Rolls Royce Main Turbine Generator (MTG) ran in factory testing in Cheswick, PA, successfully producing required voltage, current, and power.

Installation and check-out of IPS components is underway at NSWC Philadelphia Land Based Test Site (LBTS) in preparation for land-based system testing this summer. System readiness for lead ship installation will be verified by factory acceptance testing of the production unit including future "back-to-back" testing.

The PDR baseline propulsion motor for DD(X) was a Permanent Magnet Motor (PMM) with AIM as the fallback design. The first propulsion-sized PMM, in January 2005, experienced failures with its stator insulation system during factory testing. Consequently, the baseline for the ship was shifted to the AIM system in February 2005, thereby reducing program risk. The AIM was initially developed by the U.S. Navy in 2001 and is currently being manufactured for the United Kingdom Type 45 Frigate program. In addition, an AIM was procured as a load machine for the PMM, and will now be tested as a propulsion motor at the LBTS. It represents one of two motors that form a tandem pair of motors for the fallback motors for the DD(X) design. The AIM has completed factory testing and is being installed at the LBTS. Land based testing of the full scale AIM motor will begin in July 2005. During factory testing to verify the AIM will meet propulsion performance, the motor achieved rated speed at the rated voltage .

The insulation system for the PMM has been redesigned for the fourth time in five years and 12 of 24 stator segments have been rebuilt. Factory testing of the rebuilt motor was conducted in June, but the insulation system has not been qualified and the requisite critical parameter testing has not been conducted at a land-based test site. While the technology remains an option for insertion in future hulls, PMM represents too much risk for the lead ships.

Infra-Red (IR) Signature Mockups

DD(X) is the first low observable surface combatant designed by the Navy to meet multi-spectral signature requirements. Operationally, the reduced signatures exhibited by DD(X) will allow the ship to stay and fight in the littorals. The IR Signature Mockups EDM applies a disciplined engineering approach to resolve IR signature challenges including deckhouse and aperture treatments, as well as development testing of an exhaust suppressor.

The IR Signature Mockups EDM has conducted significant risk mitigation through testing. Major IR Signature Mockups EDM tests or events already completed include:

- IR Signature Mockups EDM CDR, allowing the design to be final and ready for production;
- Initial materials characterization testing;
- Suppressor test at Great Lakes Training Facility; and
- At-sea testing of mockups.

Integrated Undersea Warfare (IUSW) System

The DD(X) IUSW system is composed of medium and high frequency bow arrays and towed arrays. The IUSW system will provide anti-submarine warfare and in-stride mine avoidance capabilities. The IUSW EDM has conducted significant risk mitigation through testing as well as reducing manpower required to conduct USW operations. Major IUSW EDM tests or events already completed include:

- IUSW EDM CDR;
- Seneca Lake testing of medium and high frequency bow arrays;
- Completed at-sea mine avoidance testing on a commercial test ship; and
- Completed automated mine-avoidance testing at land base test site.

Advanced Gun System (AGS) /Long Range Land Attack Projectile (LRLAP)

AGS is a fully automated, single barrel, 155mm, vertically loaded gun. The primary AGS mission is precision and volume fires in support of ground and expeditionary forces ashore beyond line of sight in the littoral engagement area. With AGS, DD(X) will have the ability to deploy a high volume of affordable, precision-guided munitions with significantly improved ranges, accuracy, volume, firing rates and response times in support of forces ashore. AGS will fire LRLAP, a Global Positioning System (GPS) guided projectile, delivering a unitary high explosive payload to ranges of up to 83 nautical miles.

The AGS EDM has conducted significant risk mitigation through testing to ensure that AGS meets response time and rate of fire requirements. Major AGS EDM tests and events already completed include:

- AGS EDM CDR for the gun and magazine and
- Completed factory testing of AGS components.

In the factory tests, the AGS gun mount demonstrated its ability to achieve the required 10 round per minute firing rate. The gun was cycled through a 56 round firing mission using virtual ammunition and a simulated magazine. At the completion of factory testing, an empty case was successfully loaded into the barrel, a simulated round fired, and then extracted from the chamber into the empty case tray. The magazine also completed factory testing and proved the ability to deliver rounds to the gun mount at the required rate. Inert ammunition, encased in eight-round pallets, was successfully moved through the entire range of motions required to store, prepare, and transfer the ammunition to the gun mount. The AGS EDM is now assembled at a land based test site in Utah preparing for gun mount and magazine firing testing with slug ammunition and live propelling charges. By DD(X) Ship CDR completion in September 2005, AGS land-based testing will have demonstrated the required firing rate from a 56-round magazine and gun. The completion of AGS land-based testing prior to the end of DD(X) Ship CDR is in accordance with Congressional guidance included in the FY 2005 Defense Appropriations Conference Report (108-622).

Similarly, the projectile EDM has addressed reliability, safety, producibility, cost, and performance of the projectile. Major LRLAP tests and events already completed to demonstrate gun launch survivability, range and guide to target include:

- Baseline Design Review (BDR);
- Wind tunnel validation of design;
- Warhead area testing;
- Airframe and rocket motor tests; and
- Initial guided flight testing.

The wind tunnel test objectives were to obtain aerodynamic force and moment data for the LRLAP airframe for different mach numbers, angles of attack, flight configurations (canards deployed/not deployed), fin designs and canard deflections. These data were used to verify and adjust the models used to calculate projectile stability, range, lift to drag ratio, and canard control forces, which were required for autopilot control algorithms.

LRLAP initial guided flight tests have been completed at the Point Mugu, CA, test range. These tests included gun launch, GPS acquisition, controlled flight to aim point, supersonic and subsonic maneuvers as well as range extending glide out to 59 nautical miles.

Integrated Deckhouse and Apertures (IDHA)

The IDHA is unique to DD(X) in that the structural design is integrated with the functional equipment, to achieve minimum weight, signature and recurring maintenance burden. The apertures are load bearing structural elements of the design, and the composite structure acts as the lightning, grounding, and Electro Magnetic Interference shielding path.

The IDHA EDM has conducted extensive risk mitigation through testing to validate the design of the deckhouse and integrated antennas used in the DD(X) design. Major IDHA EDM tests and events already completed include:

- IDHA EDM CDR;
- Material qualification testing;
- Subcomponent testing;
- Fabrication of the large scale deckhouse article (approximate 60 foot cube, weighing 145 tons) for China Lake Radar Cross Section (RCS) and EMI testing; and
- RCS testing.

The IDHA conducted RCS testing at China Lake and fully met the DD(X) requirements for reduction of radar signature.

Dual Band Radar (DBR)

The primary function of the DBR on DD(X) is to detect and track advanced and conventional air targets, surface targets, and support the engagement of threats. In this capacity, DBR is the ship's principle self defense sensor and engagement support system. DBR also has the capability to perform periscope detection, surface search, volume search, local air traffic, cued acquisition, sector search, and other special search and track modes.

DBR refers to an integrated radar suite composed of the MFR, which is X-Band frequency, and the VSR, which is S-Band frequency. The MFR will provide multi-function surveillance that meets DD(X) performance requirements for missile search and track, guidance and illumination, surface search, navigation, and periscope detection. VSR will complement the MFR by providing situational awareness, air control, track identification, and counter battery locating data. The VSR will provide cue quality track data to the MFR and complement that radar for ship self defense.

The DBR EDM has conducted extensive risk mitigation through testing. Major DBR EDM tests and events already completed include:

- DBR EDM CDR and
- MFR land-based testing at Wallops Island.

DBR MFR firm track range and clutter rejection was verified through land-based testing at Wallops Island. By completion of DD(X) Ship CDR, land-based EMI and RCS testing will be completed in conjunction with other deckhouse testing at China Lake, and manufacturing of the DBR will be in progress.

Vertical Launch System (VLS)

The DD(X) VLS EDM includes two components: the Peripheral VLS (PVLS) and the Advanced VLS (AVLS). Previous VLS designs have placed the vertical launcher cells in consolidated configurations. The DD(X) launcher survivability requirements are more demanding than in previous ships because of the reduced manning. The PVLS is a component of ship structure that isolates each MK 57 VLS four-cell module to achieve maximum survivability in the event of enemy engagement. Thus, any enemy fires into a VLS cell that causes sympathetic detonation will result in blasts outwardly away from the hull instead of inward. Each MK 57 VLS four-cell module stows the missile within the PVLS structure. The PVLS structure is constructed of high strength steel to mitigate blast to prevent cascading damage due to sympathetic detonation in the event of attack.

The MK 57 VLS, also known as the Advanced VLS (AVLS) is an unmanned, launching system capable of stowing, preparing and launching missiles in support of multiple DD(X) mission areas including land attack warfare, air and surface dominance, and integrated undersea dominance. The MK 57 is a new VLS developed for DD(X) and future ship Classes that functionally replaces the existing MK 41 VLS. The MK 57 VLS provides the capability for preparation, rapid launch, and simultaneous engagements and salvo firings of a variety of missile types. The encanistered missiles are stowed within the launcher's below-deck cells, similar to the MK 41 VLS. The MK 57 is compatible with the existing inventory of VLS canisters. MK 57 VLS is sized so it can accommodate a three-inch growth in diameter, a 20-inch growth in length, and a 1500 pound weight increase over the MK 41 VLS.

The VLS EDM has conducted a great deal of risk mitigation through testing. Major VLS EDM tests and events already completed include:

- MK 57 launcher CDR;
- PVLS EDM CDR;
- MK 57 cold flow test model validation of the gas management system;
- PVLS quasi-static pressure test;
- PVLS most credible detonation event testing; and
- Mk 57 electronic module testing.

The DD(X) program has conducted two missile detonations in prototype launchers which validated the PVLS directs blast outward and will protect the ship in the event of a missile detonation.

Hull Form Scale Model (HFSM)

DD(X) will incorporate a Wave Piercing Tumblehome Hull (WPTH), in which the topsides angle inboard above the waterline rather than outward as with existing surface combatants. The tumblehome design is critical to meeting low RCS signature objectives. The HFSM EDM uses physical and numerical models to demonstrate seakeeping, intact and damage stability, maneuvering, resistance, and propulsion.

The HFSM EDM has conducted substantial risk mitigation through testing. Major HFSM EDM tests or events already completed include:

- Hull form stability model tests;
- Topside aerodynamic wind tunnel tests; and
- Maneuvering, powering, sea keeping, and load tests.

A quarter scale model has been constructed and tested to validate performance in a seaway and resistance to underwater explosion. By the completion of DD(X) Ship CDR, the results of model tests will have been reviewed and included in powering predictions, and sea keeping, loads and stability analysis.

Total Ship Computing Environment (TSCE)

TSCE encompasses all computing resources and associated software for DD(X). TSCE will provide DD(X) with a fully integrated total ship command and control capability encompassing all sensors, weapons, and ship control systems. The automated decision processes will improve speed of command and support optimized manning. TSCE is joint interoperable, and consistent with the Navy vision for open architecture and FORCEnet.

The TSCE EDM has conducted a great deal of risk mitigation through testing. Major TSCE EDM tests or events already completed include:

- TSCE EDM CDR;
- Software Releases 1 and 2 Certification; and
- Software releases are being exercised and tested in the software integration facility in Tewkesbury, MA.

Out of an estimated 6.6 million equivalent lines of software code, 1.7 million have been delivered to and certified by the government.

Autonomic Fire Suppression System (AFSS)

AFSS is an autonomous fire suppression system that will support reducing the damage control manning requirements for a broad range of shipboard fire scenarios including the highly stressing combat damage environment. AFSS is designed to automatically: (1) isolate damage to firemain piping components, (2) detect fire, smoke and heat conditions, (3) activate suppression systems and (4) suppress fires using a variety of suppression systems including water mist for suppressing peacetime machinery space fires and combat induced fires and sprinkling for magazines. Innovative automation technologies are employed and include smart valves with onboard processing and sensing capability for isolating fire main ruptures and novel piping architectures for directly attacking the blast damage area with water mist.

The AFSS EDM has conducted extensive risk mitigation through testing. Major AFSS EDM tests or events already completed include:

- AFSS EDM CDR;
- Ex-PETERSON Weapons Effect Test (WET) at sea; and
- Ex-SHADWELL fire testing.

The WET testing on Ex-PETERSON demonstrated automatic system reconfiguration and fire extinguishing after a major weapons event. In this test, a threat representative warhead was detonated on EX-PETERSON. The AFSS isolated damaged piping systems, automatically cooled surrounding bulkhead and spaces, and extinguished the resulting fire. Firefighting demonstration onboard EX-SHADWELL demonstrated similar results for an aviation fire.

<u>EDM Summary</u>

Over the course of Phase III, the DD(X) program has conducted extensive land-based and/or at-sea testing of the 10 EDMs. The knowledge gained from these efforts has served to mature the ship and system designs. In one instance the Navy resorted to a fall back technology. If the original technology matures and the risk is reduced the Navy can reintroduce the technology in future hulls. As a result of Phase III efforts, the DD(X) program is on track to demonstrate fundamental capabilities at Milestone B (prior to ship construction contract award), to complete necessary testing by ship CDR, and to mature systems in time for ship installation.

Sufficient time exists to incorporate lessons learned from the EDM and meet the in-yard need date with the production system. Given the long production lead time in shipbuilding, the Navy believes it is appropriate to undertake a reasonable amount of risk in the DD(X) lead ship, in order to deliver technological benefits to the rest of the class. The ability of DD(X) to deliver revolutionary capabilities to the fleet with reduced crew necessitates some element of development and production risk. However, the Navy's successful work on the EDMs to date has provided great confidence in our readiness to move forward with DD(X) design and construction. DD(X)'s use of EDMs reflects a best practice in the development of complex weapon systems, and the DD(X) program was defined drawing on lessons from other weapon system development efforts.

The Government Accountability Office recently stated several concerns over increases in weight for several of the EDMs. These increases are against budgets that are intended to be challenging. Margin, or a form of reserve, is maintained to compensate for growth. In ship design, margins are applied to account both for the effects of normal design maturity and also to mitigate the risks associated with development of new ship components. Such risk may result in components placing higher than expected demands on the ship, or in the need to fallback to less risky but less efficient alternatives. This margin applies to both the design and construction phases of ship acquisition. Separate service life allowances are also included to allow ship capability improvement over operating life.

DD(X) is using historically proven and Navy approved design and construction margins, primarily in the areas of weight and center of gravity, propulsion and electrical service power required, manning, and signatures. Many of the DD(X) margins appropriately decrease as design maturity increases. Weight reduction efforts to recover margin are continuous; however, it is important to note that satisfactory margin exists to successfully complete detail design and construction. Again, this is a best practice approach applied to design of all systems from aircraft to ships to satellites.

The DD(X) EDMs are at sufficient maturity to support a Milestone B decision and to achieve maturity prior to ship installation The DD(X) risk mitigation approach maximizes technological innovation, to the benefit of the rest of the Class and the Fleet, within established cost and schedule parameters.

Conclusion

Our mission remains bringing the fight to our enemies. The increasing dependence of our world on the seas, coupled with growing uncertainty of other nations' ability or desire to ensure access in a future conflict, will continue to drive the need for Naval forces and the capability to project decisive joint power by access through the seas. The increased emphasis on the littorals and the global nature of the terrorist threat will demand the ability to strike where and when required, with the maritime domain serving as the key enabler for U.S. military force. DD(X) is a program we need now, to provide our Sailors and Marines these capabilities that they will need to fight and win the wars of the next half century.

Some might say it would be painless and convenient to continue to build DDGs. They are the best warships in the world today. Our job, however, is to build a Navy which is ready for the missions and threats of the future. A DDG hull cannot fit the magazine required for even a single AGS. The ship's stability and electric power system is not sufficient for the DBR, and the SPY-1D(V), while excellent against today's threats, they will not be dominate against the threats of tomorrow in the world's littorals. Only DD(X) brings the firepower and sustained persistence in the littorals that will allow it to dominate the battle-space for the next half century. Indeed, DD(X) may be exactly the tool needed by the nation for the uncertain threats we face today and in the future. DD(X)'s stern boat launch capability and aviation flight deck provides excellent capability for raiding teams and special operations forces. These forces, when necessary, can be provided on call fire support from the DD(X) guns or Tactical Tomahawks. With DD(X)'s radar and surface to air missiles, no aircraft or missile can threaten these forces without facing certain shoot-down. This is a capability America needs to provide the warfighter.

We must invest in technology and systems to enable Naval vessels to deliver decisive, effects-based combat power in every tactical and operational dimension and this is what the DD(X) program brings to the National defense. The Navy looks forward to continuing the strong partnership with Congress that has brought the Navy and Marine Corps Team the many successes of today.