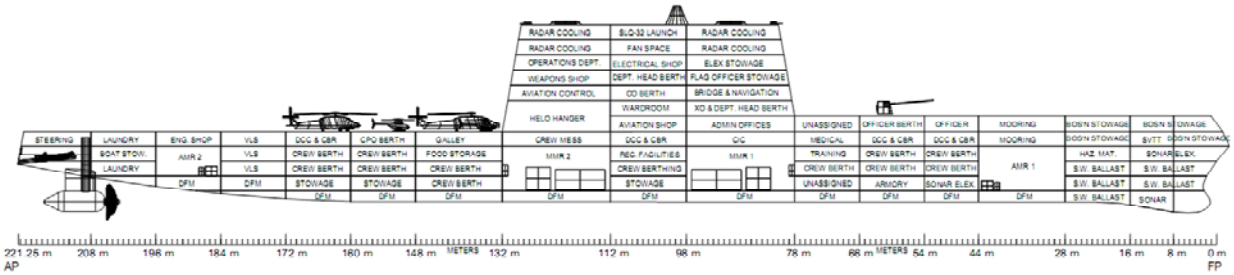
Executive Summary



This report describes the Concept Exploration and Development of a Ballistic Missile Defense (BMD) Cruiser (CGX) for the United States Navy. This concept design was completed in a two-semester ship design course at Virginia Tech.

The CGX/BMD requirement is based on the CGX Initial Capabilities Document (ICD) and Virginia Tech CGX Acquisition Decision Memorandum (ADM), Appendix A and Appendix B.

Concept Exploration trade-off studies and design space exploration are accomplished using a Multi-Objective Genetic Optimization (MOGO) after significant technology research and definition. Objective attributes for this optimization are cost, risk (technology, cost, schedule and performance) and military effectiveness. The product of this optimization is a series of cost-risk-effectiveness frontiers which are used to select alternative designs and define a Capability Development Document (CDD) based on the customer's preference for cost, risk and effectiveness.

CGX/BMD variant 13 is a low to medium risk, high cost, and very high effectiveness alternative on the non-dominated frontier.

CGX/BMD will address the need for a new Aegis-type ship with more capable core systems and modular systems similar to DDG-1000, with particular emphasis on providing robust ICBM defense. CGX/BMD will have the ability to operate forward deployed to conduct BMD operations from advantageous locations at sea that are inaccessible to ground-based systems. CGX/BMD will employ large, powerful, phased-array radar, and a large battery of SM-3's and KEI's to defend a large down-range territory against potential attack by ballistic missiles.

CGX/BMD has a hybrid flare-tumblehome hullform to balance between seakeeping capability and reduced radar cross section. Its large installed power plant and IPS will enable CGX/BMD to adapt to changing mission conditions and provide flexibility for future growth.

Concept Development included hull form development and analysis for intact and damage stability, structural finite element analysis, propulsion and power system development and arrangement, general arrangements, machinery arrangements, combat system definition and arrangement, seakeeping analysis, cost and producibility analysis and risk analysis. The final concept design satisfies critical operational requirements in the CDD within cost and risk constraints.

Ship Characteristics

Parameter	Value
Hull	Hybrid flare-tumblehome
LWL	221.4 m
Beam	23.5 m
Depth	16.0 m
Draft	7.6 m
Cp	0.678
Cx	0.871
Full Load Displacement	24,940 MTON
Power and Propulsion	Full IPS 2 pods FPP, PMM 4x 36MW MT30 marine turbines 2x 5.1MW CAT 3616 diesels 2X 5MW PEM fuel cells EMR PWR
Total Installed Power	155.2 MW
Sustained Speed	32.7 knots
Endurance Speed	20 knots
Endurance Range	8007 nm
CPS	Full
Vulnerability (Material)	Steel
Ballast/fuel system	Clean, separate ballast tanks
Total Manning	452 (31 officers, 35 CPO, 386 enlisted)
AAW/BMD/STK	SPY-3/VSR+++ DBR, IRST, AEGIS BMD 2014 Combat System, CIFF-SD, SLQ/32(R) improved, MK36 SRBOC with NULKA
ASUW/NSFS	1xMK45 5"/62 gun, SPS-73, Small Arms, TISS, FLIR, GFCS, 2x7m RHIB, MK46 Mod2 3x CIGS
ASW/MCM	Dual Frequency Bow Array, ISUW, NIXIE, 2xSVTT, mine-avoidance sonar
CCC	Enhanced CCC
LAMPS	2 x Embarked LAMPS w/Hangar, 2xVTUAV
SDS	SLQ-32(V) 3, SRBOC, NULKA, ESSM
GMLS	160 cells MK57, 8 cells KEI
OMOE (Effectiveness)	0.852
OMOR (Risk)	0.286
Lead Ship Acquisition Cost	$4.454 Billion
Avg. Follow Ship Acq. Cost	$3.676 Billion
Avg. Ship Acq. Cost	$3.650 Billion