Ship to Shore Connector (SSC)

A Turning Point in Naval Ship Design

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Amphibious Warfare Program Office
PMS377
SSC Program

- Replacement for the LCAC
- Deploys in LPD, LSD, LHD Amphibious Well Deck Ships
- Transports weapon systems, equipment, cargo and personnel
  - High speed (over 35 knots)
  - High payload (74 Short Tons)
  - Over the Horizon (25nm or greater)
  - Over-the-beach operations
  - Through NATO Sea State 3 (significant wave height of 4.1 ft)
- Operate independent of tides, water depth, underwater obstacles, ice, mud, or beach gradient

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Evolution of LCAC to SSC

1970’s

LCAC
- 79 currently in operational inventory
- Designed for 20-year service life
- Capable of carrying a 60 TON (M60) payload at speeds over 35 knots
- Amphibious assault from 15 nautical miles offshore

1980’s

JEFF A / JEFF B
- Prototypes leading to LCAC
- JEFF B was selected as the LCAC baseline

1990’s

LCAC
- 79 currently in operational inventory
- Designed for 20-year service life
- Capable of carrying a 60 TON (M60) payload at speeds over 35 knots
- Amphibious assault from 15 nautical miles offshore

2000’s

LCAC (SLEP)
- Rotating machinery refurbishment
- C4N Replacement
- Enhanced Engines & Deep Skirt
- +10 yrs Service Life
- 27 Craft Completed + 11 In-process

2010’s

SSC
- R&D funded craft to be delivered FY18
- Designed for 30 Year Service Life
- 74 TON (M1A1) payload & OTH assault from 25 nautical miles
- Increased reliability & availability
- Pilot/Co-pilot cockpit
- Procuring 73 craft over 8 year period

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SSC Program History

• **2005** - Program Studies and Analysis began

• **2006**
  - Oct Initial Capabilities Document (ICD) approved by JROC
  - Nov Concept Decision DAB

• **2007**
  - Nov AoA Final Report signed by N85 & DASN Ships
  - Dec USN Resource, Requirements Review Board (R3B) (Gate 2)

• **2008**
  - Mar SSC Design Site officially established
  - Apr DAB approved start of Preliminary Design (PD)
  - Apr – Sep Set-Based Design (SBD)
  - Nov NAVSEA Stakeholders Steering Board (SSB) #1
    Approved Baseline Design and PD effort continued
SSC Program History (Cont.)

• 2009  -  Mar  NAVSEA SSB #2 approved Functional Baseline Design
         -  Mar  NAVSEA Preliminary Design Review (PDR) to SEA 05
         -  Apr  Milestone A DAB
         -  May  Contract Design (CD) begins
         -  Sep – Oct  First Technical Data Package (TDP) TWH
             Reading Session
         -  Dec  Industry Day and Release of Draft
             Specifications and Drawing to industry

• 2010  -  Mar  Final TDP Reading Sessions
         -  May – Jun  SSB/Critical Design Review (CDR)
         -  Jul  TDP Certified
         -  Aug  USN Resource, Requirements Review Board
             (R3B) (Gate 4/5)
SSC - Innovative Approach

- Returned to Navy led design process
- Design team distributed throughout US
  - NSWCCD, West Bethesda & Philadelphia
  - SPAWAR, Charleston & San Diego
  - NUWC, Keyport
  - NSWC, Dahlgren
  - NSWCPCD, Panama City
  - NRL
  - Contractor design expertise
SSC - Innovative Approach (Cont.)

- First ship design implementation of Set-Based Design (SBD)
- Government Design locks in major details
  - Increased payload and more severe environment
  - Improved maintainability and reliability
  - Optimized Total Ownership Costs (TOC)
- Builder does what he knows best
  - Design for producibility
  - Reduce Acquisition Cost
Set-Based & Preliminary Design Schedule

Subsystem Trade Studies

Integration Period

Proposed Baseline Review

PD-1

PD-2

Review

CD Prep

Apr 21

Jun 21

Aug 18

Sep 26

Nov 3

Dec 19

Jan 5

Feb 20

Mar 26

May 1

Month

0

1

2

3

4

5

6

7

8

9

10

11

12

Set-Based Design

Preliminary Design Phase

Design Space Brief

Trade Space Parameters

Trade Space Parameters

Point Design Output

Point Design Output

Functional Baseline

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Trade Space Definition.. Element Partitioning..

- Hull
- Machinery
- Auxiliaries
- C4N
- Performance (Skirt)
- HSI

Trade Space Formalization & Reduction

Element-Specific Exclusions:

- Little craft level impact parameters/options
- Dominated Options

Combination-Specific Exclusions:

Final Screen for Balancing

Dominated Combinations/Options

Failed Configurations

Balancing

Craft Evaluation

Recommended Design with Backups

10-20 High Value Configurations

11 “Key” Design Parameters/13K+ Configurations

>125 Candidate “Key” Design Parameters

High Value Options

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Trade Space Reduction Progress

Trade Space Reduction

Candidate Vital PVs

LOG 10 (Option Count)

Vital PVs

LOG(# options)

Formal Start of Reduction Efforts

Start of Integration

Craft Scoring

Balancing Checks

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SSC Contract Design

1 May '09
1 Aug '09
1 Nov '09
1 Feb '10
1 Apr '10
1 June '10

Evolving Baselines
Evolving Baselines
Evolving Baselines
Evolving Baselines

CD 1
CD 2
CD 3
CD 4

CD Prep

Technical Warrant Holder Approved Requirements & SDS Draft

PDR

Design Team/SEM/Program Office Reading Session & Draft Spec

Evolving Baselines

Configuration Management Begins

Design Freeze

Distribute Technical Data Package to TWH's & Industry

Final TWH Reading Session

Final Certification of TDP

Contract Data Package Delivery

26 Mar '09
LCAC/SSC Comparison

- Length, Overall: 28.0 m (91.8 ft)
- Beam, Overall: 14.5 m (47.8 ft)
- Depth: 1.27m (50 inches)
- Design Payload: 54.43MT
- Flight Crew: 3

- Length, Overall: Same as LCAC
- Beam, Overall: Same as LCAC
- Depth: 1.422m (56 inches)
- Design Payload: 67.13 MT
- Flight Crew: 2

Changes driven by increased payload and improved reliability and maintainability
Machinery Design Improvements

**LCAC**

- 12 x Steel Shaft Segments
- 8 x Gearboxes
- 2 x 60 kVA APUs
- 4 x 3955hp GTEs
- 4 x 63in dia Lift Fans

**SSC**

- 4 x Composite Shaft Segments
- 2 x 85 kVA APUs
- 2 x Gearboxes
- 2 x 85 kVA APUs

- 4 x 5300hp GTEs
- 6 x 69in dia Lift Fans
- 2 x 150 kVA CSGs

**400 Hz Electrical Dist Split Plant**

**60 Hz Electrical Dist Parallel Plant**

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Addressed LCAC Top 25 RMA Drivers

- LCAC Lessons Learned
  - Top 25 Maintenance Drivers
  - Prototypes

- Advanced Fire Fighting
  - no HALON

- Electrical-Hydraulic Actuators

- Extensive use of composites

- 60 Hz Electrical Distribution System

- AA 5083 & advanced internal coating system

- Maintainability Demonstrations

- Utilize ICAS & CBM to Optimize Equipment Preventive Maintenance Periodicities

- Material History / Metrics Database

- ICAS

- Test Time \( \rightarrow \) Reliability \( \rightarrow \) Require Equipment & Craft-Level Reliability Growth Testing
Addressed LCAC Top 25 RMA Drivers

Gear Driven Bow Thrusters

Simpler & More Efficient Drive Train

Gearbox Driven Generators

Improved HVAC

Simplified Window Arrangement – fewer unique parts

Improved HF Antennas – improved comms reliability
R&M Implementation

**R&M Program Related Requirements:**
- Reliability (12 hr mission)
- Operational Availability (Ao)
- Materiel Availability (AM)
- Mean Time To Repair
- Maximum Time To Repair Values
  = Machinery Equipment
  = Auxiliary Equipment
  = C4N Equipment
- C4N Software False Alarm Rate
- Specified Removal Methodologies
  = Main Engine and Gearbox

**Design Influence**
- Implement Comprehensive R&M Program
- Develop and apply maintainability design criteria (Gov’t approved)
- Perform R&M Allocations / Modeling / Predictions / Analyses
- Include quantitative R&M requirements

**R&M Validation Testing**
- Reliability Growth Testing and Failure Reporting Program (FRACAS)
- Maintainability Demonstrations (M-Demos) required on six major equipment groupings

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Way Ahead

- Award Detail Design & Construction (DD&C) contract
- Maintain requirements throughout DD&C
- NAVSEA involvement in design risk items
- SUPSHIP oversight of construction
- Test to ensure craft meets requirements

SSC design process is attractive for future Naval ship designs