LX(R) Analysis of Alternatives
Design Space Exploration

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LX(R) AoA

• The Navy recently conducted the Analysis of Alternatives for the next Amphibious Assault Ship, to replace the Harpers Ferry Class Ships (LSD 41/49)

• Traditionally, the Navy develops 5 – 20 ship concept alternatives during an Analysis of Alternatives.

• During the LX(R) AoA **22,000** concept design alternatives were developed for the Navy’s next amphibious assault ship.
Navy Concept Design Capability

- 1980 to Present - Naval architecture software (ASSET) is built and maintained by the Naval Surface Warfare Center Carderock Division.

- 2010 to Present - CREATE program develops the Rapid Ship Design Environment (RSDE): automates the ASSET design process, enables thousands of designs to be generated in a short time.

- 2013 to Present - ERS invested in critical tool and process development that enables a revolution in the way the Navy does its Analysis of Alternatives.
### LSD 41/49 Equivalent Baseline Design

**DIMENSIONS**
- Length, Overall: 187.7 m (616 ft)
- Length LWL: 176.9 m (580 ft)
- Beam, DWL: 28.0 m (92 ft)
- Draught, LWL: 6.7 m (22 ft)
- Displacement: 19,552 MT
- Installed Power: 39,000 kW
- Service Life: 40 Years (7% wt)

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Stowage</td>
<td>10,760 sq. ft.</td>
</tr>
<tr>
<td>Troop Berthing</td>
<td>408 + 109 Surge</td>
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<tr>
<td>Number of LCAC</td>
<td>3</td>
</tr>
<tr>
<td>Cargo Stowage</td>
<td>30,500 cu. Ft.</td>
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<tr>
<td>Aviation Facilities</td>
<td>2 spots</td>
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<tr>
<td>Sustained Speed</td>
<td>22.3 kt</td>
</tr>
<tr>
<td>Unrefueled Range</td>
<td>8,400 nm @ 18kt</td>
</tr>
<tr>
<td>JP-5 Stowage</td>
<td>50,000 gal</td>
</tr>
</tbody>
</table>
Alternate Configurations

Standard Vehicle Deck Configuration

“Gallery” Vehicle Deck Configuration with Vehicles Above the Well
LX(R) AoA

- Explored 60 design parameters, all major capability trades for a new LX(R)

- Parameters such as:
  - # Landing craft
  - Vehicle capacity
  - Cargo capacity
  - Troops
  - Aviation support capability
  - Arrangement options
  - Survivability features
Engineering Disciplines Exercised during LX(R) Design Space Exploration

Ship Design

Ship Arrangement

Vulnerability Analysis

Ship Motions

Ship Structures

Annual fuel consumption.

Machinery Reliability.

Intact & Damaged Stability

Cost – Acquisition & Lifecycle

Distribution Statement A: Approved for Public Release
Design Space Data in Aggregate

Ship Cost (FY 13) vs. Sustained Speed for Mechanical Propulsion
2 LCAC Designs

- 2 Shaft, 2 Engines
- 2 Shaft, 4 Engines
- 1 and 2 Shaft, 2 Engines
- 2 Shaft, 4 Engines

- Military Spec Designs
- Tailored High Specification
- Tailored Medium Specification
- Tailored Low Specification

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Lead Ship Cost versus Vehicle Square

Constant Parameters:
- Build Specification: As noted
- Well Deck Space: As noted
- Vehicle Square: As noted
- Cargo Cube: 28,000 cu. ft.
- Troops: As noted + 109 surge
- Aviation: 2 x CH-53 Landing and Fuel (No Hangar)
- JP-5 Capacity: 50,000 gal
- Propulsion: Twin shaft, Mechanical Drive
- Range (18 kts.): 8,000 nm
- Hull Not Whipping Hardened, No Magazine Armor
- 2 Vehicle Deck Configurations Shown for 3 LCAC Ships

LSD 41/49

LPD 17

More Survivable

Distribution Statement A: Approved for Public Release
For the requirements, the Baseline design is optimal for minimal additional cost, more vehicle square is achievable under cost cap. All other requirements held constant.

Enhanced Design Space Exploration:
- Military Spec
- 3 x LCAC
- 14,500 sq ft vehicle
- 30,500 cu ft cargo
- 408 troops
- 2 helo deck
- No hangar/det
- 50,000 gal JP-5

Baseline Design Space Exploration:
- Military Spec
- 3 x LCAC
- 10,760 sq ft vehicle
- 30,500 cu ft cargo
- 408 troops
- 2 helo deck
- No hangar/det
- 50,000 gal JP-5
Design Space Exploration Study Conclusions

Maximum Vehicle Square for 3 LCAC Military Spec Ship under the cost cap

- **18 knot Speed**
- **Baseline Ship Cost**
- **Cost Target**
- **Weight Limit with Full Service Life**
- **Required Deck Area**
- **Area Required (m²)**
- **Area Available (m²)**

Maximum Vehicle Square for Military Spec Ship under the cost cap – **18 knots.**

*= Target & 18kt
- Military Spec
- 3 x LCAC
- 17,400 sq ft vehicle
- 30500 cu ft cargo
- 408 troops
- 2 helo deck
- No hangar/det
- 50,000 gal JP-5

*Note, this design has **two main propulsion engines**
ERS and CREATE Inform Navy Acquisition Decisions

ERS and CREATE Investment in Design Space Exploration and Set Based Design have enabled the Navy to thoroughly inform Senior Leadership on major Navy Acquisition Decisions.