An Approach to Affordable Shipbuilding

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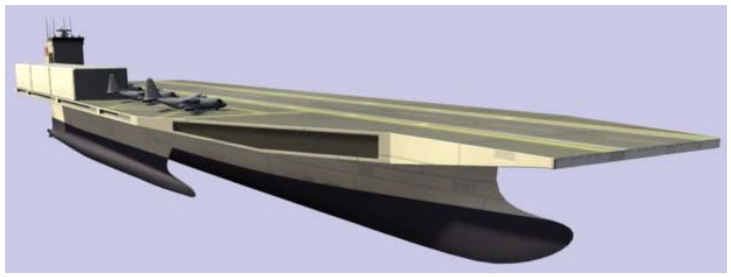

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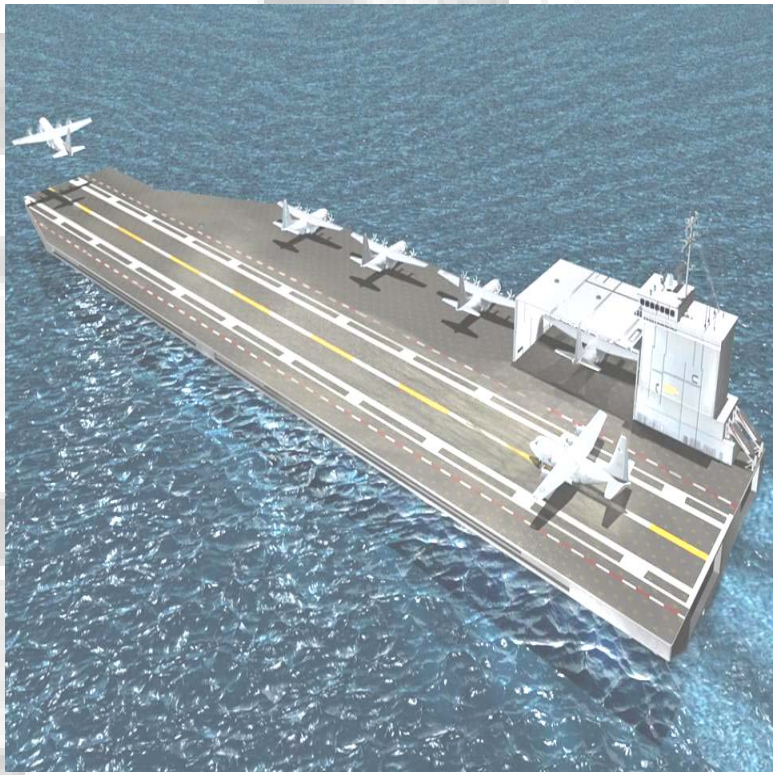


CCDoTT
Center for the Commercial Deployment of Transportation Technologies

Sponsored by CCDOTT 1999-2006 High Speed Trimaran Technology Development Program

US Technology Industry Driven

- **Cal State University Grant Project**
- **Ship Design Firm Driven (not a DoD Initiative)**
- **ONR Only a Funding Conduit**
- **(Administered under ONR 333 – Innovative naval Prototypes)**
- **ONR Goals:**
  1. **Drag Minimization – side hulls net drag = zero**
  2. **Superior Seakeeping – 35 knots in SS 6**
  3. **Agile & Maneuverable – turns in half IMO turning radius**
  4. **High Payload Fraction – 37% of Light Ship Weight**
  5. **Mission Flexibility – HALSS is a multi mission ship**
  6. **Survivable, High Performance Platforms – above plus side hulls protect multi compartment center hull**
  7. **Reduced Costs – significant design and construction cost reduction**

HALSS Support of the Sea Basing and Afloat Forward Staging Base Missions

- **HALSS helps Early Insertion & Logistic Support:**
  - **Deploys at High Speed (35 Knots) to move MEB Rotary Wing, military loads for Force Employment, PAX/Troops & airplanes fuel from CONUS directly to sea base**
  - **Operate fixed wing aircraft between advanced base and the sea base**
    - **High priority material**
    - **Personnel movement to sea base**
    - **Evacuate casualties**
- **HALSS helps Force Deployment:**
  - **Operate fixed wing aircraft for theater operations**
    - **Air-to-air refueling for rotorcraft, tactical aircraft**
    - **Offload military payload at Austere Port or by Air Drop**
    - **Special mission support**
  - **Arrange and Configure military loads in preparation for early entry to the Theater operations**

HALSS Principal Characteristics

Flight Deck Length	**1,100 FT**
Flight Deck Width / Docking Hull Beam	**274 FT / 180 FT**
Draft	**37.9 FT**
Depth	**100 FT**
Payload:	
Combat forces sustainment	**8,900 ST**
Aircraft Fuel Supply	**2,650 ST**
Fixed Wing Aircraft	**Six C-130J**
Stowage Factor	
Main (Flight) Deck	**185,900 SQFT**
II Cargo Deck	**141,000 SQFT**
III (Crossover) & IV Decks	**51,100 SQFT**
HALSS Stowage Factor	**46.7 SQFT/MT**

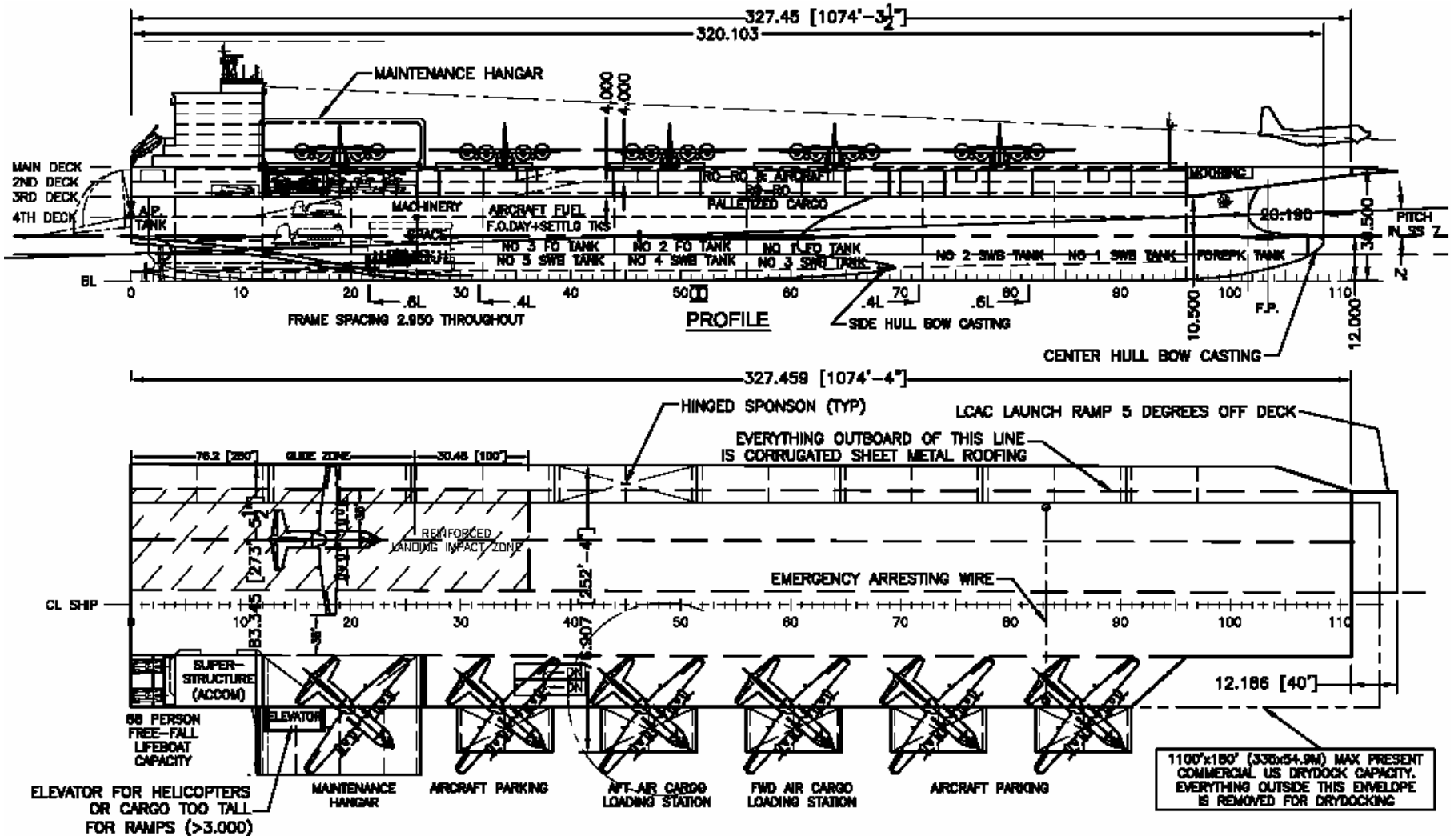
Unrefueled Range of Sea Voyage - CONUS to Advanced Base or to JOA

10,000 NM at 35 knots

>15,000 NM at 25 knots

Followed by 10 days endurance in JOA

HALSS Refined Arrangement – C-130 J OPS

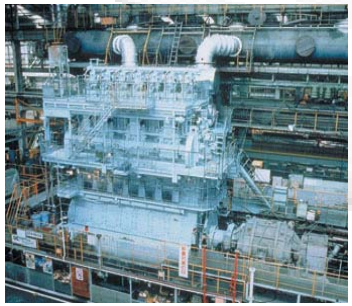


- Flight deck configuration assures aircraft launch and recovery into the wind enabling maximum takeoff and landing weight under most conditions.
- At transit helos, LCACs & HOVER BARGES can be carried on the main deck.
- Sponson deck is removable to reduce beam to facilitate construction and dry-docking.

Baseline Machinery & Propulsion System

Diesel – Diesel / Electric @ Propeller Option:

HALSS Center Hull: 2 x Sulzer RTA 96 (102 RPM) @ 2 x Lips FP Propellers



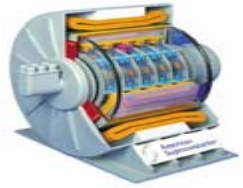
Sulzer low-speed RTA and RT-flex 69 or 80 MW or MAN Equivalent Engines

World's Largest Fixed Pitch Propeller 66 MW - 94.5 Ton

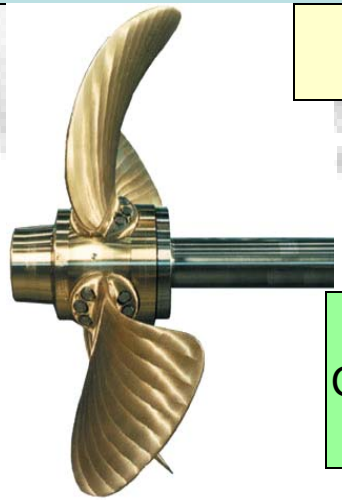
Side Hulls: 2 Electric Motors powered by 4 x Wartsila 16V46 @ 2 x Lips CP Propeller

Option – LJ200/axial

Wärtsilä Medium-Speed Diesel



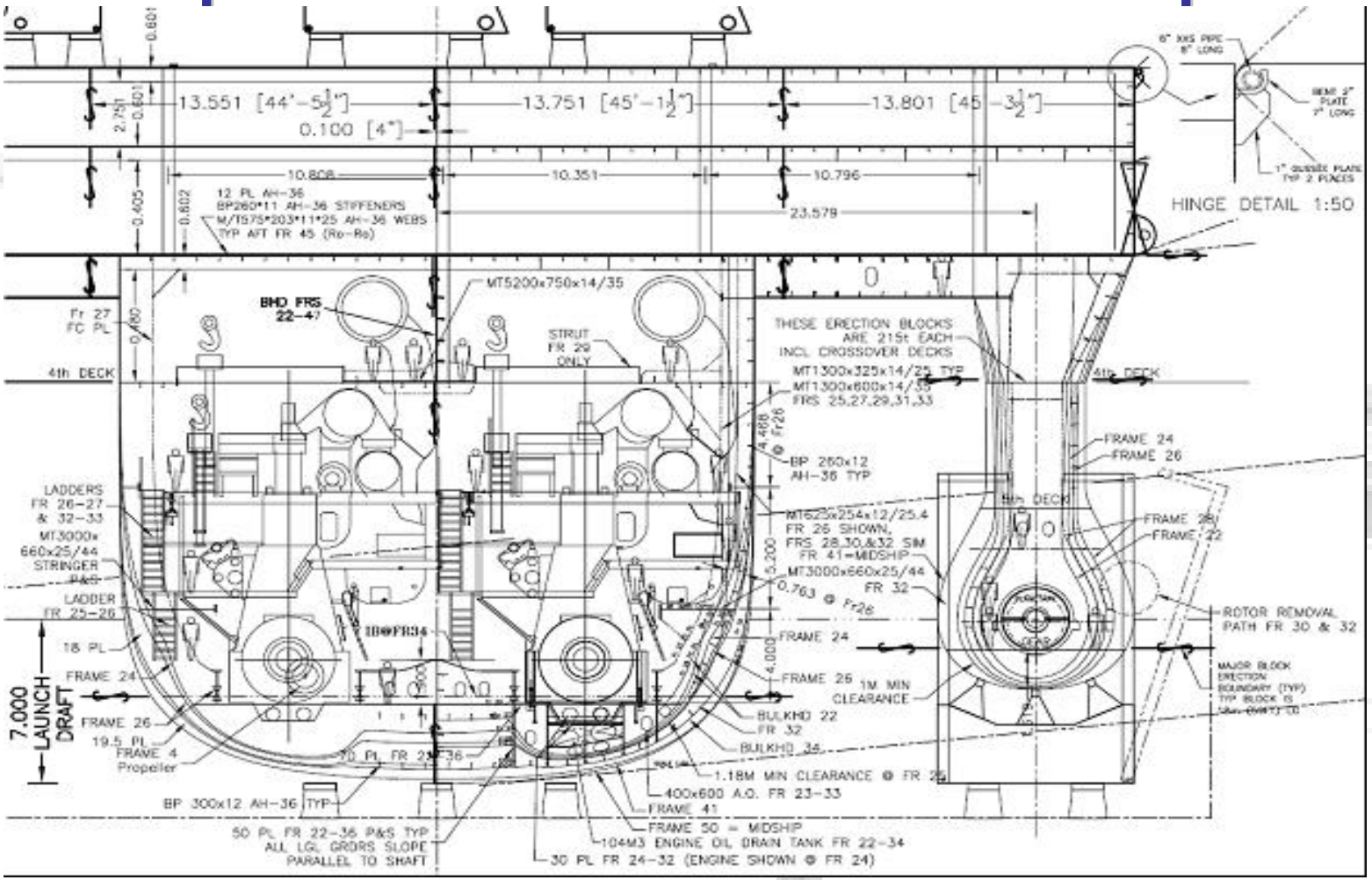
36 MW HTS Superconducting AC Motor OR 500 RPM conventional motor w/ reduction gear



World's Largest Controllable Pitch Propeller 44 MW

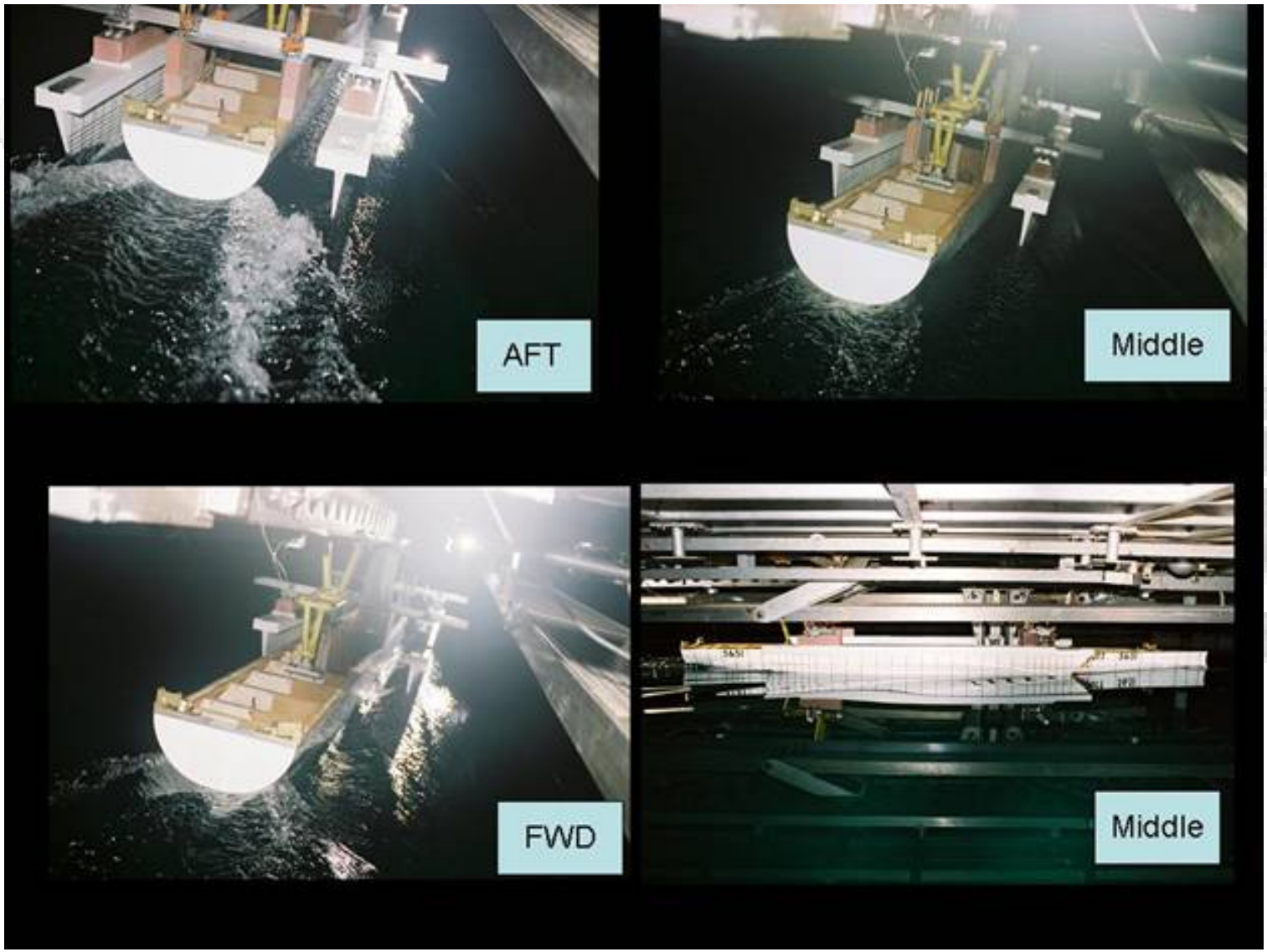
HALSS Propellers:
Center hull FPP ~ 68.6 MW - 8 m
Side hull CPP ~ 31 MW - 4.8 m

Low Speed Diesel+Diesel Electric Propeller

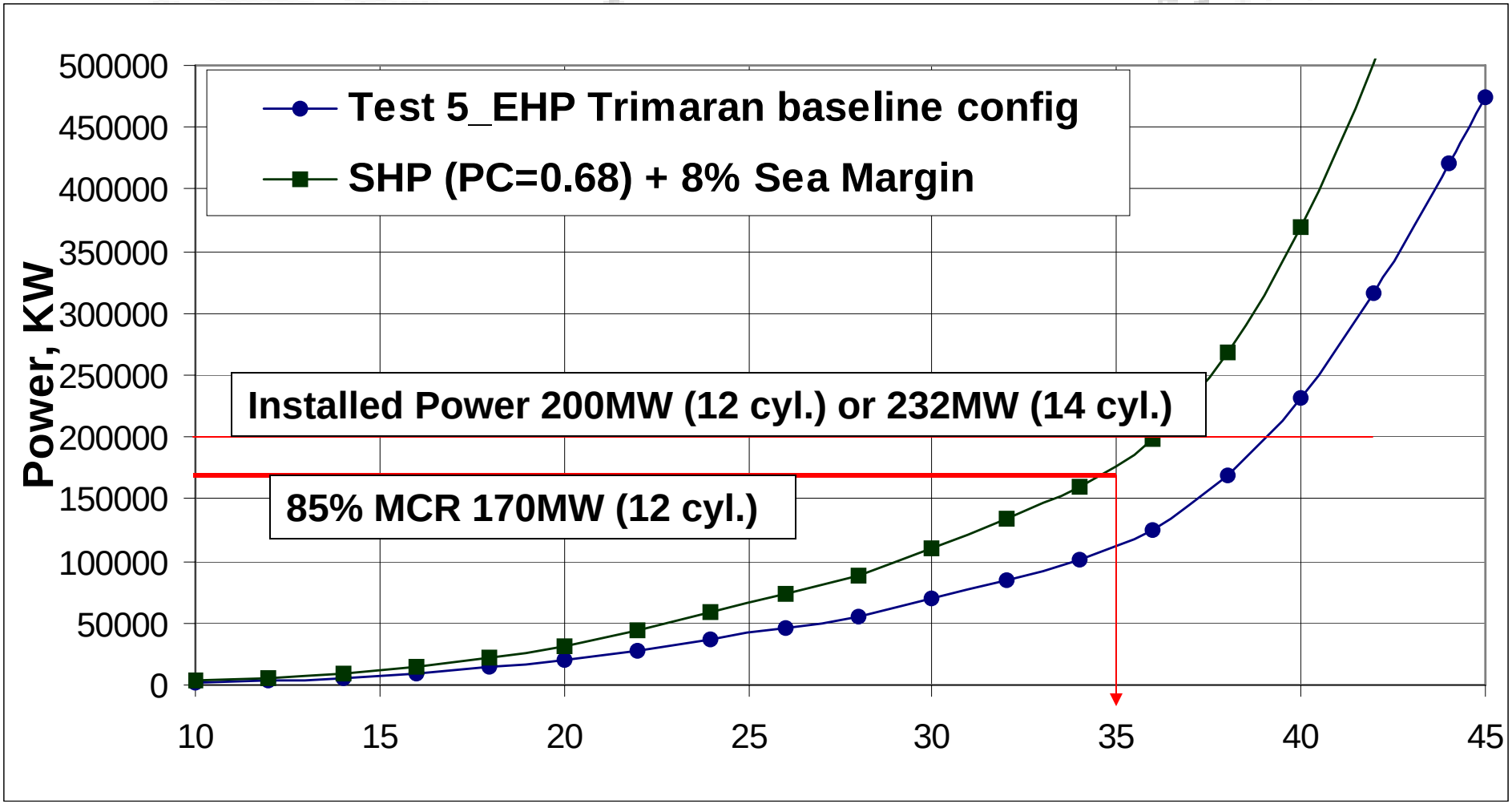


- Twin 68.6MW Sulzer 12 RT-flex 96C engines directly connected to 102 RPM FPP are commercially available and provide the best combination for the power.
- Additional power for boost and for maneuvering is provided by medium speed diesel engines driving 514 RPM generators in the center hull, powering electric motors in the side hulls with FPP, CPP or Waterjet propulsors.

Flow Visualization at Three Staggers at 35 knots



HALSS Power Prediction based on Test Results



Three Types of US Shipyards Large Enough to Build HALSS Were Defined

1 - COMMERCIAL Shipyard

- **Commercially Competitive Yard building commercial Vessels**
- **These yards have no recent history of designing and building military ships**
- **Larger Mid-tier yards building large ATBs, OSVs & Dredges as well as Commercial Vessels**

2 – DUAL-USE Shipyard

- **Large Yard designing & building both commercial vessels and sealift cargo and fleet support ships for the USN**

3 – COMBATANT Shipyard

- **Large Yard designing and building surface combatant and large amphibious ships for the USN**

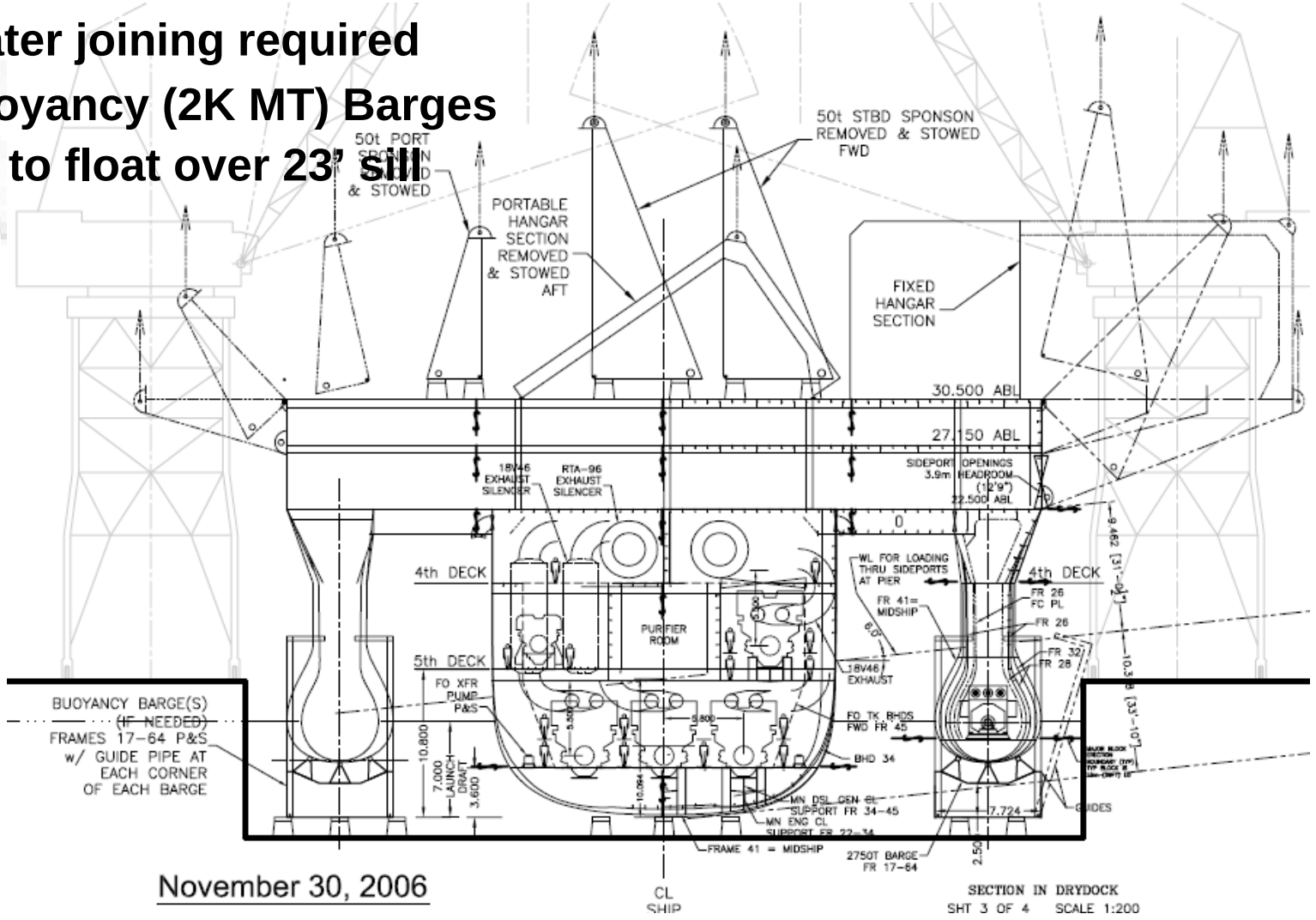
Affordability of Large Ships for the USN - New Approach to Designing & Building

- **Strictly Commercial Design and Construction**
  - Beyond just using commercial vessel technical standards
  - Achieve major cost reductions using commercial ship acquisition practices
  - Acceptance based on yard meeting Classification rule requirements by commercial owner style plan approval & inspection
  - No SupShip or large MSC design and Construction oversight
- **Prime to a Large E&C Firm Outsourcing Outfitted Units & Blocks to Mid- tier Yards**
- **Use an Overall Program Management Organization (PMO)**
  - Manages detail design, construction and testing of HALSS with significant subcontracting of design & engineering and preoutfitted units, blocks and grand blocks – even possibly entire side hulls or bow
  - No ITAR – International citizens are welcome on the team
  - Outsourcing includes Offshoring to international shipyards and using technical consultants for their ship design & affordable ship expertise

HALSS Fits in Sparrows Point Dock

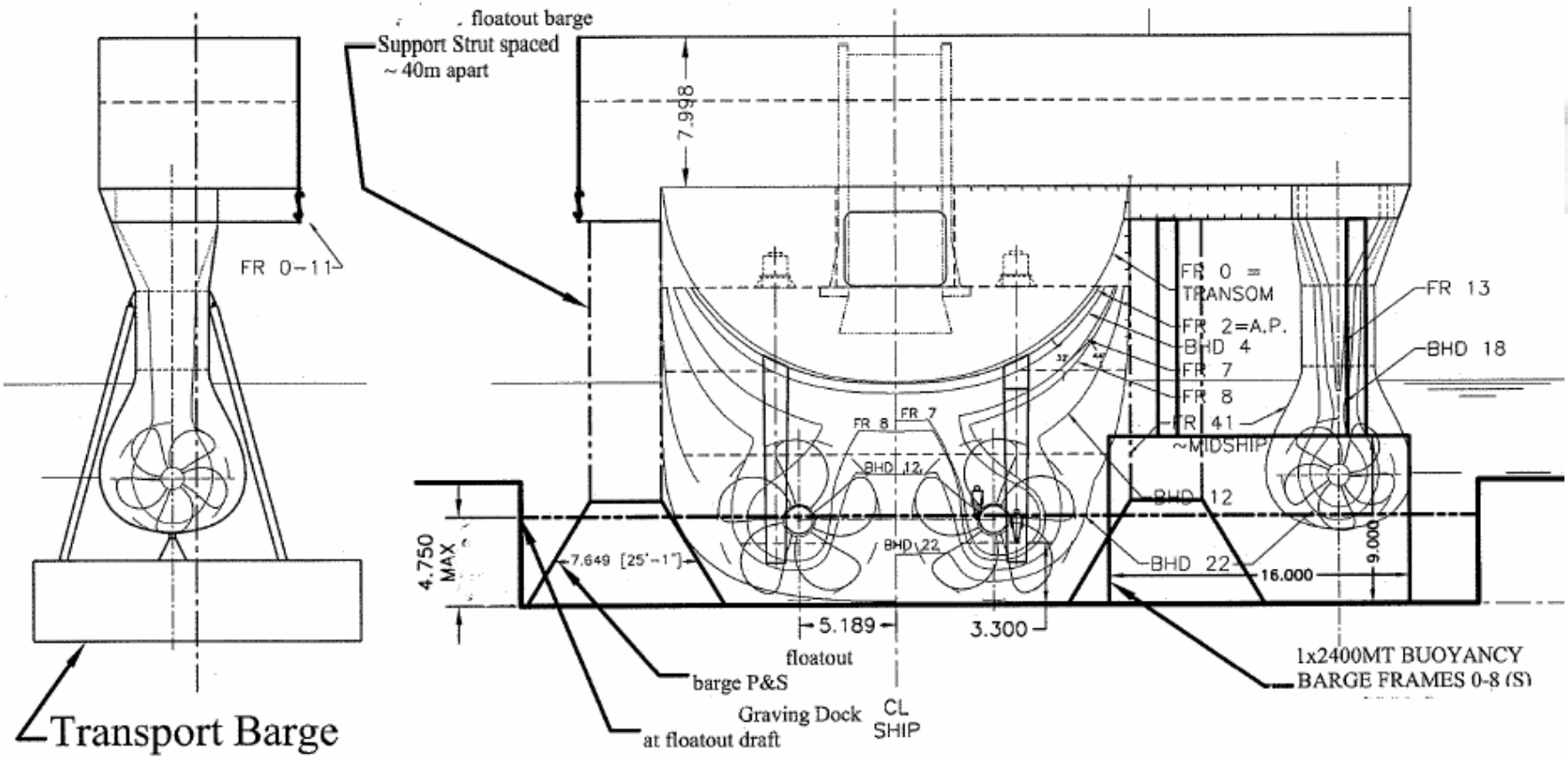
- No in water joining required
- Four Buoyancy (2K MT) Barges required to float over 23’ sill

Dock currently in operation



Two Hulls in Notional US Dock

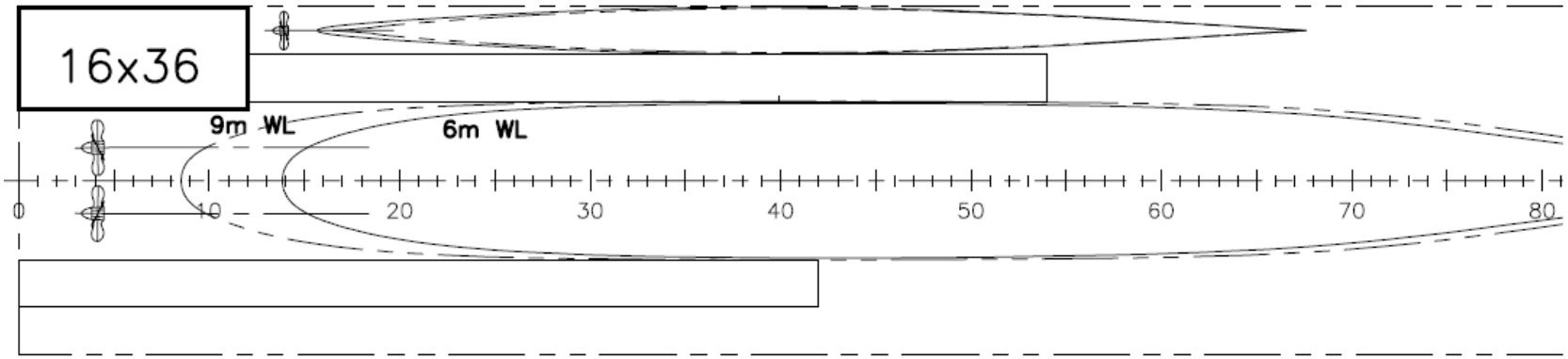
- Joining in water required
- Port side hull built at yard or subcontracted & barged to yard
- Five Large Buoyancy Barges required (16K MT of added lift)



Notional US Dock Buoyancy Barges

- 5 Barges are needed:

Barge	Weight MT	VCG m-BL	LCG m-AP	TCG m-CL
Side Keel barge Fr 15-66 (S)	-3,000	1.5	121.500F	23.580S
7.4x5x126 Barge btwn hulls 12-54 (S)	-3,970	2.375	99.000F	17.000S
16x36x4.75m barge Fr 0-12 (S)	-2,450	2.375	19.500F	19.352S
7.4x5x126 Barge btwn hulls 0-42 (P)	-3,970	2.375	63.000F	17.000P
16x36x5 Barge Fr 84-96(S)	-2,400	42.935	270.000F	18.500S
Totals	-15,790	2.209	107.879F	10.295S



First Ship Prices with Non-recurring Costs Included

Prices in Billions of 2007 Dollars

Commercial Yard Primed by an E&C Firm **$1.60**
With $115 Million Allowance for PMO costs and Prime Management Fee

Dual-use Yard Expected Minimum Final Costs **$1.92**

Dual-use Yard Possible Bidding Price **$1.66**

Combatant Yard Expected Minimum Final Costs **$4.62**
Float out and Joining Price: Add $9 to $12 million for cost of buoyancy barges and joining hulls in the water (depending on the shipyard)

Study Findings for First Ship:

Dual-use yards are 20% more costly than commercial yards

Combatant yards are 190% more costly than commercial yards

First Ship Prices Adding Expected Risks Experienced in Last Decade

Expected Final Cost to the Navy in Millions of 2007 Dollars

Cost Element	Commercial Yard Primed by E&C Firm	Dual-use Yard	Combatant Yard
Total First Ship Price with Float out and Joining	**$1603**	**$1926**	**$4627**
Construction Risk	$115	$142	$222
Rework Risk	$12	$31	$438
Experience Risk	$87	$11	$23
Expected Higher Final Cost to the Navy (EAC)	**$1797**	**$2210**	**$5310**

Each of Four Ships in 2007 Dollars w/out Cost Risk

Prices in Billions of 2007 Dollars

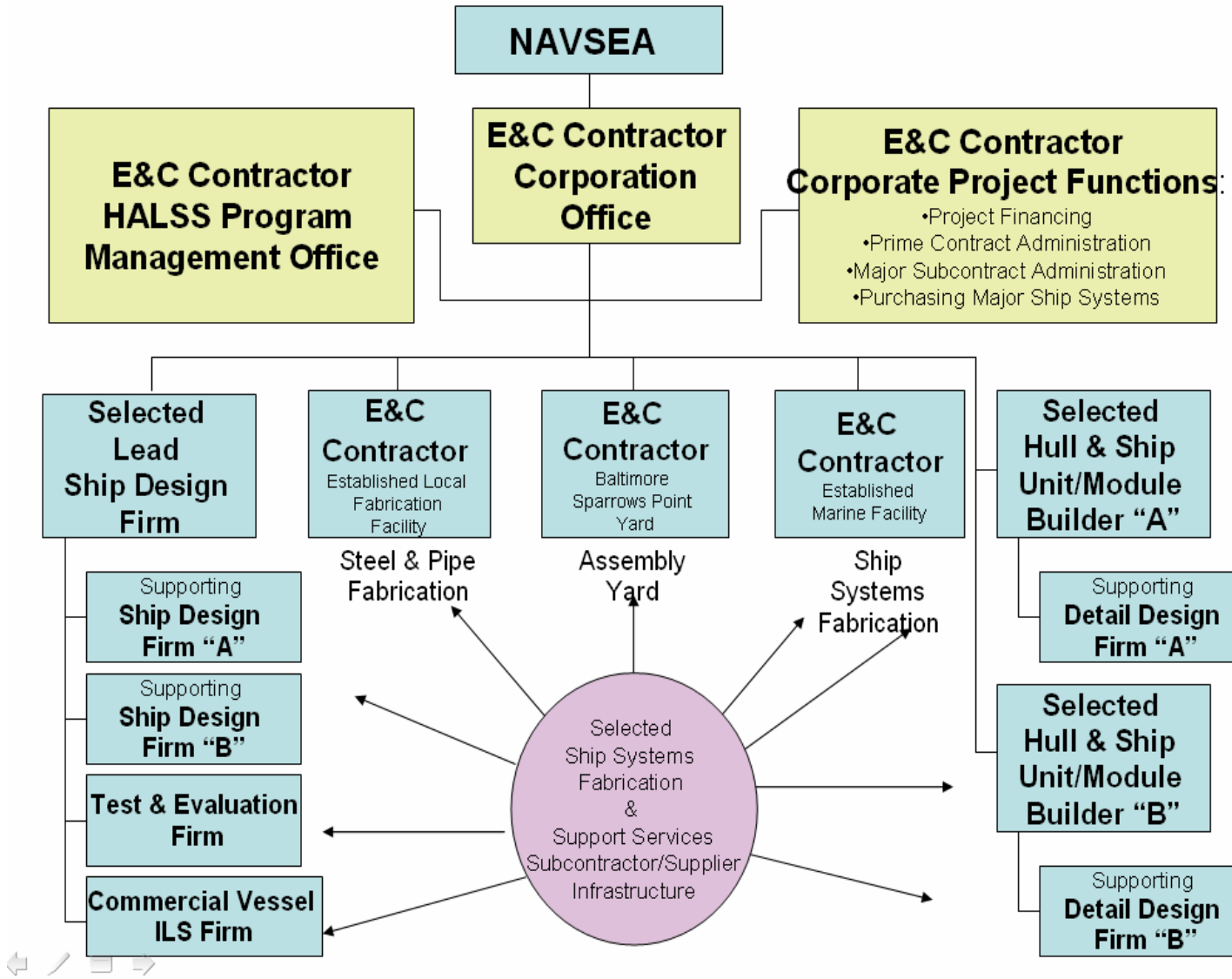
Commercial Yard Primed by an E&C Firm	**$1.19**
Dual-use Yard	**$1.42**
Combatant Yard	**$2.28**

Above prices include a quarter of the cost of a set of float out barges plus the cost of joining the hulls in the water as appropriate

Study Finding: For multiple ship contracts:

- **Dual-use yards are 20% more costly than commercial yards**
- **Combatant yards are 90% more costly than commercial yards**

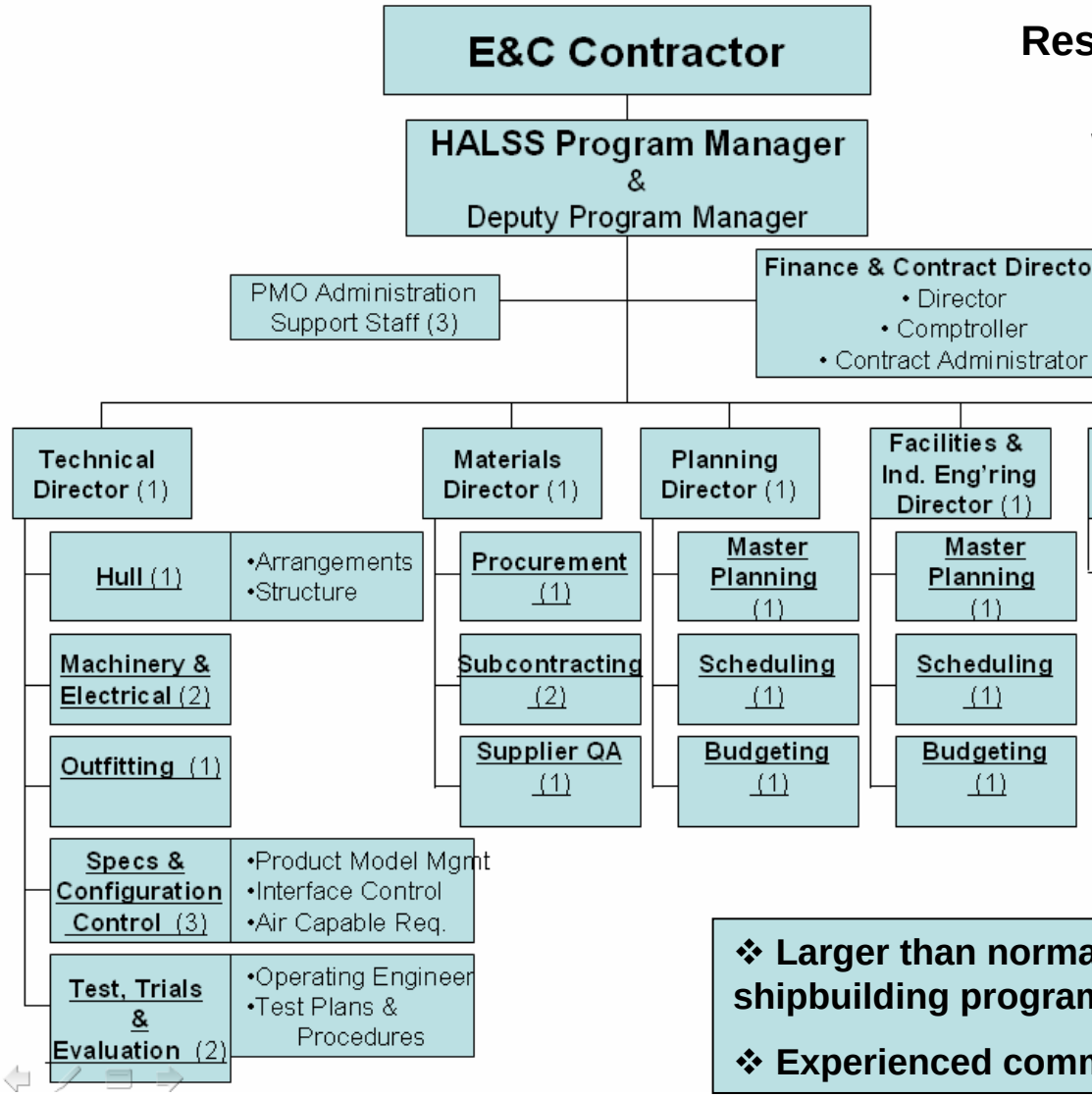
HALSS Contract Team Member Company Organization



Prime has contractual responsibility for the entire shipbuilding contract:

- **Fabs units in its own facilities**
- **Subcontracts major preoutfitted units/blocks**
- **Assembles, completes outfitting and does tests and trials**
- **Maintains HALSS using the SP dock**

E&C Prime Contractor Program Management Organization (PMO)



Responsible for planning, defining and managing the entire HALSS contract work requirements for the prime contractor:

- **Lead ship design firm**
- **Prime's yard(s)& fab facilities**
- **Ship hull & preoutfitted Unit/Module builders**

- **Larger than normal commercial but smaller than navy shipbuilding program staff (peaks at 36)**
- **Experienced commercial ship technical staff of 10**

Risk & Mitigation Strategy

❖ Contract Design Quality

Being able to start with a well engineered design developed by capable NAs and MEs is a major concern of commercial yards

- **Proposed solution for the Navy**

To assign experienced commercial ship designers to prepare a well engineered contract design with a clear and definite descriptive spec (no IPTs)

❖ Detail Design Quality

Biggest challenge for shipyards is not constructing a big ship. The challenge is accomplishing the detail design

- **Proposed solution for the Shipyards**

Form a capable PMO with a strong technical directorate to plan and manage the detail design from start to through final test, trials and guarantee period

Structure a two step procurement:

Phase 1: Funded Functional Design and comprehensive construction plan

Phase 2: Final Detail Design, construction and testing

Emphasize the T&E program including an early planning stage

Employ international ship NAs, designers and shipbuilding experts

Conclusions

- HALSS potentially offers unique military capabilities for CONUS to Sea base logistics and early entry operations
- C-130J operations from HALSS are feasible
- Engineering development including preliminary structural design, CFD analysis, model testing, seakeeping and maneuvering analysis substantiate the feasibility of the design with current technology and reasonable risk
- The ship is buildable in multiple, existing U.S. facilities
- A new approach to acquisition, design and construction is proposed to end the cycle of ever increasing naval ship acquisition cost
- HALSS represents an opportunity to simultaneously solve a clear military need and invigorate the U.S. shipbuilding industry