



MILITARY SEALIFT PENTAMARAN SHIP DESIGN

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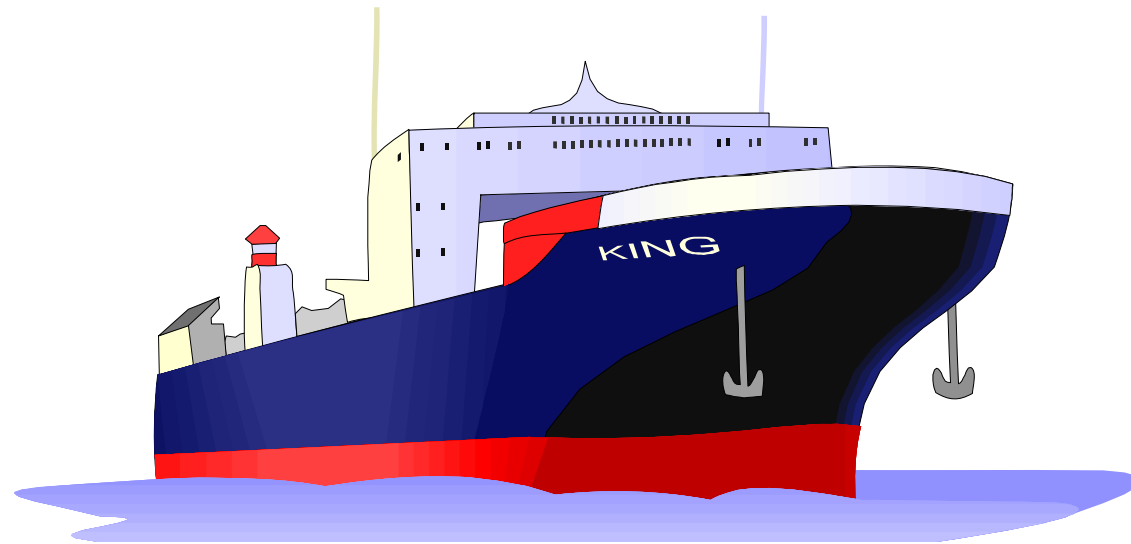
November 10, 2005



Sealift Mission

- **Provide for the Expeditionary Logistics of U.S. Joint Forces in any Theater**
- **Provide for High Speed Surge and Medium Speed Sustainment as Required**
- **Provide for Long Range Inter-Theater and Medium Range Intra-Theater Moves**
- **Provide for the Specific Needs of the Army, Navy, Air Force and Marines**

Sealift Ships



Objective

- **Payload – the more the better**
- **Speed – the higher the better**
- **Range – the greater the better**

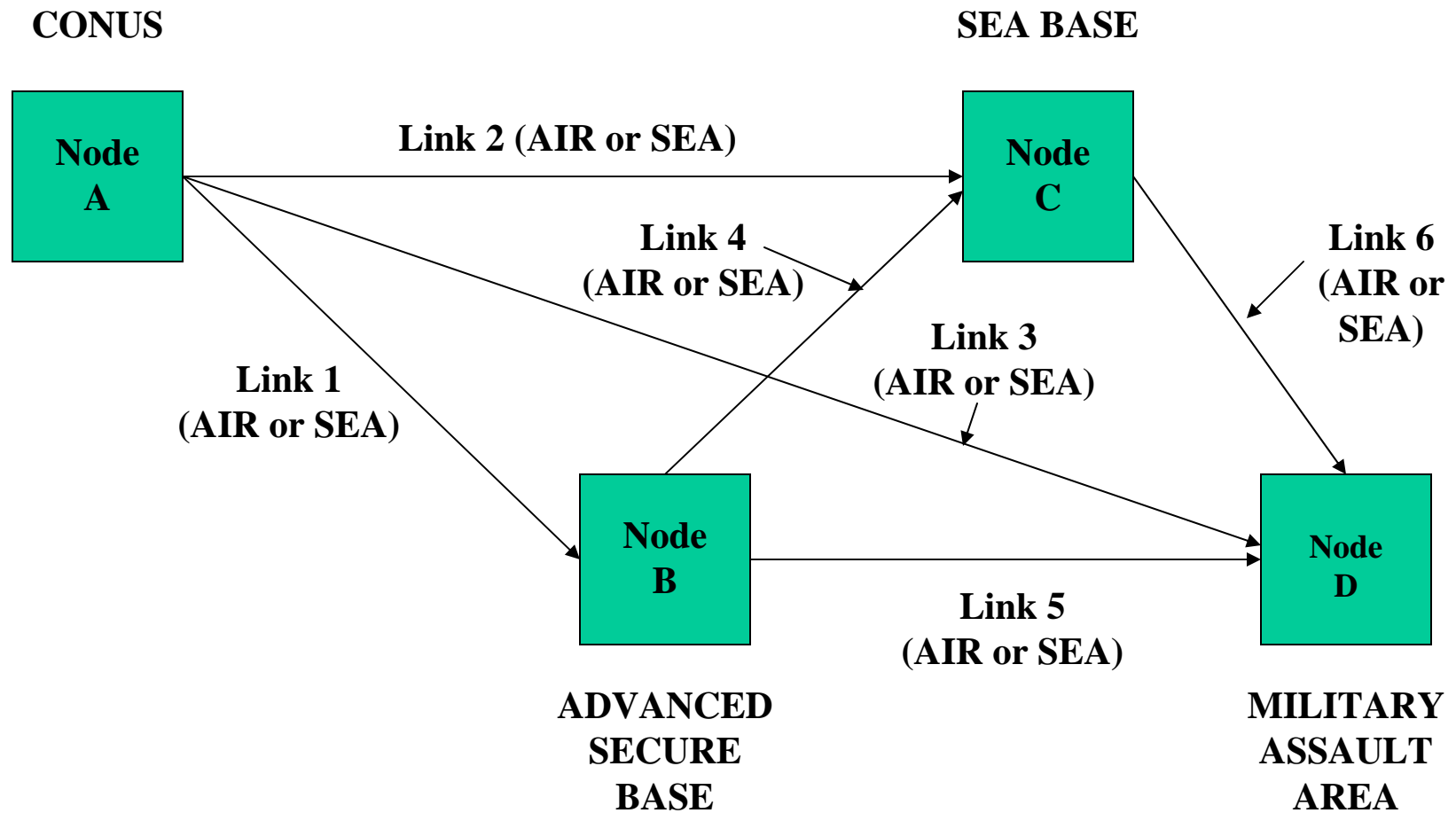
The goal should clearly be to maximize these performance parameters relative to the total ownership cost for the ship or craft over its useful life.

Metrics

- **Payload Delivery Rate (PDR) – Link**
- **Payload Flow Rate (PFR) - Node**

Payload Delivery Rate (PDR) is defined as Payload multiplied by Speed (load times distance per unit time). Payload Flow Rate (PFR) is defined as Payload Delivery Rate (PDR) divided by Distance (load per unit time).

Sea Basing Conceptual Model



Characteristics of Links

- **D Distance in Nautical Miles**
- **L% Percentage of Flow**
- **MS% Modal Split (AIR or SEA)**
- **PDR Payload Delivery Rate in ST-NM/HR**
- **V Platform Speed in Knots**
- **P Platform Payload in Short Tons**
- **T Platform Transit Time in Hours**
- **N Number of Platforms Required (One Way)**

Characteristics of Nodes

- **PFR Payload Flow Rate in ST/DAY**
- **H Handling Rate in ST/HR by Mode (*)**
- **W Waiting (Dwell) Time in Hours**
- **T Processing Time in Hours**
- **S Storage Capacity in Short Tons**

(*) Varies inversely with severity of environmental conditions.

Characteristics of Systems

- **N-A Total Number of Aircraft by Type (Payload/Speed/Range) Required**
- **N-S Total Number of Ships by Type (Payload Speed/Range) Required**
- **TT Total Time from Node A to Node D by Route and Modal Sequence**
- **CA Total Acquisition Cost Estimate \$**
- **CO Total Operational Cost Estimate \$/Year**



Final Report



FAST SHIP
PERFORMANCE ASSESSMENT

A Parametric Analysis

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August 31, 2000

Submitted to: Advanced Technology Office (ATO)
Defense Advanced Research Projects Agency (DARPA)

Delivery Order MDA972-00-M-0011

Definition

Define Ship Technical Effectiveness (STE):

$$\mathbf{STE = LDR * OPC * DDR - SFC * (1 + MF / 100) * DI}$$

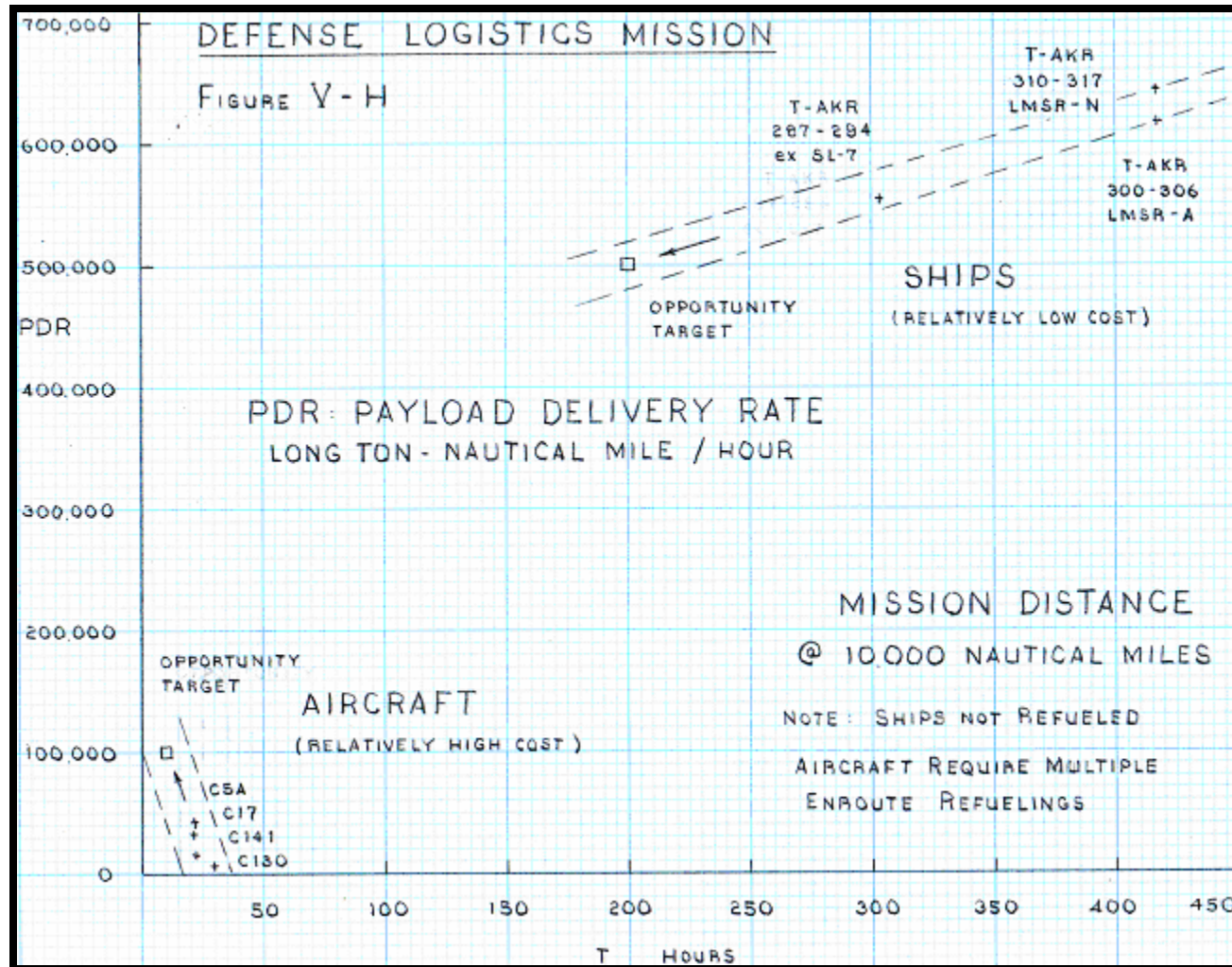
$$\mathbf{PDR = STE * BPI}$$

$$\mathbf{PFR = STE * BPI / DI}$$

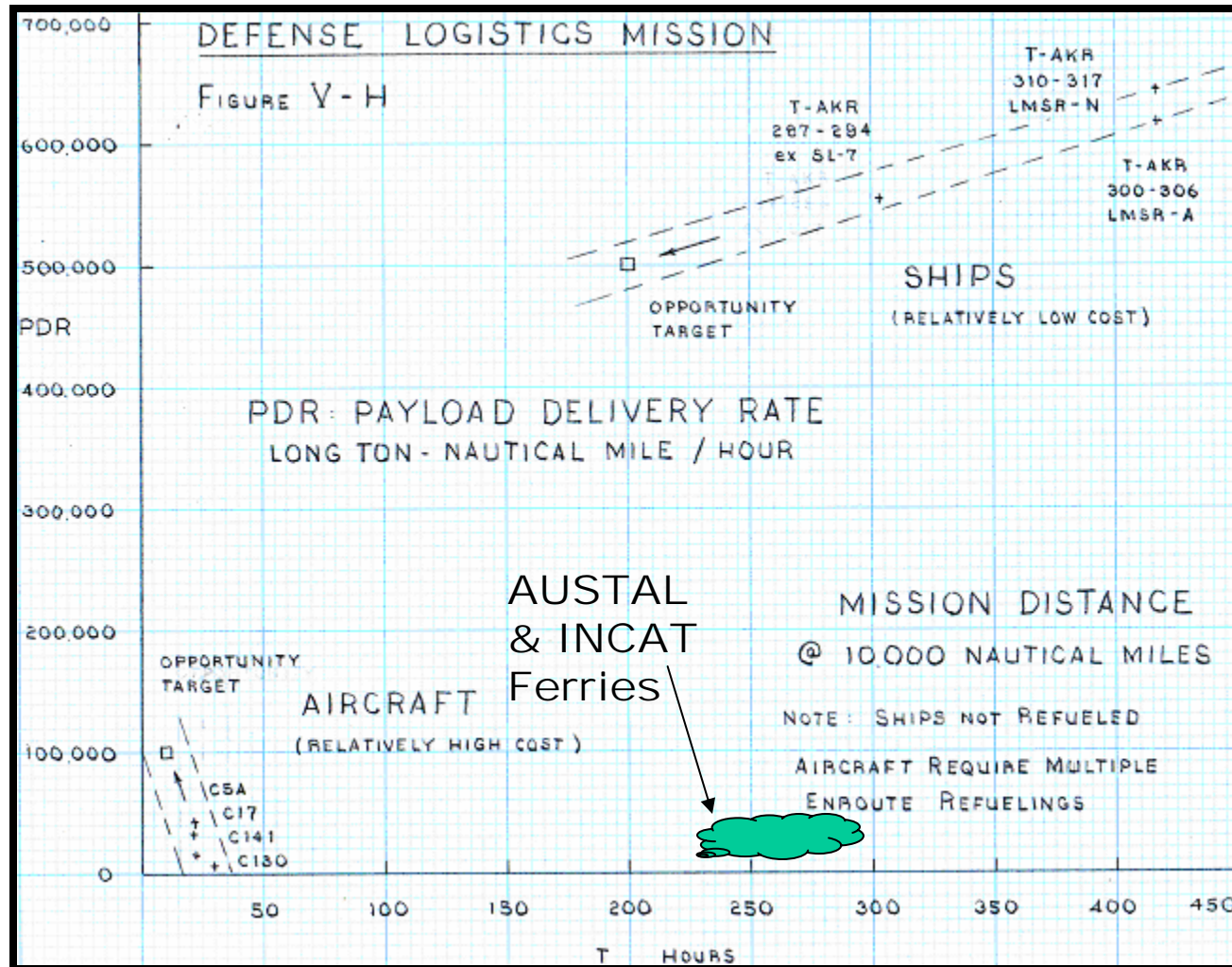
Key Parameters

- **Lift / Drag Ratio (LDR)** is a measure of the hydrodynamic efficiency of the hull form at any given speed and displacement.
- **Overall Propulsive Coefficient (OPC)** is a measure of the efficiency of the engine/transmission/propulsor system at any given power and speed.
- **Deadweight / Displacement Ratio (DDR)** is a measure of the efficiency of the ship design to provide for payload and fuel carrying capacity.
- **Specific Fuel Consumption (SFC)** is a measure of the efficiency of converting the energy of the fuel into engine power at any given rating.

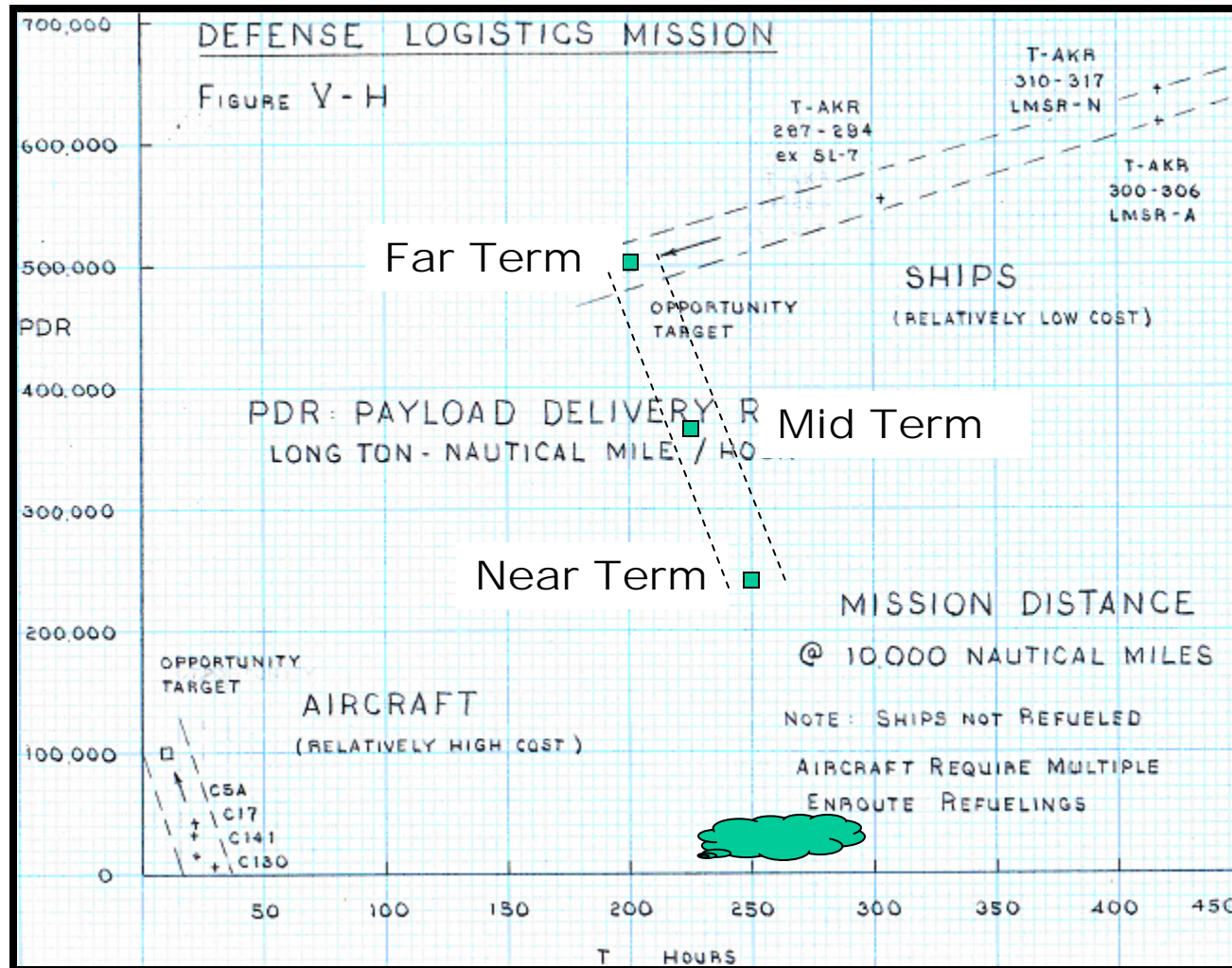
Expeditionary Logistics



Expeditionary Logistics



Expeditionary Logistics



Opportunity Targets

- **Far Term (Difficult) (DARPA)**
 - **Payload: 10,000 metric tons**
 - **Speed: 50 knots**
 - **Range: 10,000 nautical miles**
- **Mid Term (Challenging) (ONR)**
 - **Payload: 8,000 metric tons**
 - **Speed: 45 knots**
 - **Range: 7,000 nautical miles**

Opportunity Targets

- **Near Term (Achievable) (USTRANSCOM)**
 - **Payload: 6,000 metric tons**
 - **Speed: 40 knots**
 - **Range: 4,000 nautical miles**



Conclusions

- **There are challenging objectives to be achieved in high speed ships/craft for U.S. defense interests.**
- **There are innovative ship system technologies that can contribute to achieving these objectives.**
- **Multi-hull ship configurations of many varying types offer unique creative approaches.**
- **Advanced hull structure, engines, transmissions and propulsors are also part of the solution.**

**ADVANCED TECHNOLOGY
MILITARY SEALIFT / COMMERCIAL EXPRESS
PENTAMARAN SHIP DESIGN**

**DEFENSE
LOGISTICS
MISSIONS**

**USMC MEU
USWC – NAHA
USEC - MERSIN**



**LINER
CONTAINER
MARKETS**

**TRANSATLANTIC
TRANSPACIFIC
NORTH-SOUTH**

PAYLOAD: 4000 – 6000 TONS

SPEED: 40 KNOTS @ 95.6 MW

RANGE: 4000 – 6000 N. MILES



NGA ADX Pentamaran

- The pentamaran containership design has the following characteristics:
 - Length – 279 meters (oa); 274 meters (wl)
 - Beam – 45.5 meters; Draft – 7.9 meters
 - Speed – 40.8 knots (trial condition)
 - Deadweight – 7,900 metric tons
 - Displacement – 19,000 metric tons
 - Propulsion – 4 Pielstick 18PC4.2B diesels
 - Propulsors – 4 KaMeWa 225 SII waterjets

Pentamaran Example

- **At 19,000 metric tons displacement and 40.8 knots (100% MCR) in calm water:**
 - **LDR = $19000 * 9.8 / 3316 = 56$**
 - **OPC = 0.73**
 - **DDR = $7900 / 19000 = 0.416$**
 - **SFC = 184 g/kw-hr**
- **At 1,897 metric tons fuel capacity and 10% fuel margin :**
 - **Range = $1897 * (10^{**}6) * 40.8 / 1.10 * 95600 * 184 = 4000$ nm**

Pentamaran Metrics

- **Payload Delivery Rate (PDR)**
 - **$PDR = 6000 * 40.8 = 244,800 \text{ mt-nm/hr}$**
- **Payload Flow Rate (PFR)**
 - **$PFR = 244800 / 4000 = 61.2 \text{ mt/hr}$**
- **Ship Technical Effectiveness (STE)**
 - **$STE = 244800 * 5.046 / 95600 = 12.92$**
 - **$STE = 56 * 0.73 * 0.416 - 184 * 1.10 * 4000 / 198184$**
 - **$STE = 17.01 - 4.09 = 12.92$**

SYNTEK Background

Founded in 1994 in the United States, BMT SYNTEK Technologies, Inc. is a high level technical and engineering professional services firm. Based in Arlington, Virginia, SYNTEK supports a variety of clients ranging from the United States government to an impressive roster of major domestic and international corporations.



SYNTEK Business

SYNTEK's goal is to help clients maximize the potential of their organizations in the competitive global market. We provide strategic guidelines to structure and implement solutions to complex system-level problems to achieve our clients' business objectives. SYNTEK is a wholly-owned subsidiary of British Maritime Technology (BMT).



SYNTEK Capabilities

- Unique Corporate Experience
 - Understand DOD Mission Requirements
 - Analysis of Alternatives and Prioritization
 - Acquisition Strategy and Implementation
 - Assessment of Key Operational Issues
 - Knowledge of Integrated Logistics Systems
 - Evaluate High Performance Ship Technologies
 - Challenge of Achieving Sea Basing for USN



Sea Power 21 Goals
and Objectives



