SEA FIGHTER (FSF-1)

ex-X-Craft, ex-LSC(X)

Myth and Reality

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SEA FIGHTER Ship Design Manager

NAVSEA 05D4

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Future of the Navy

Aberration and Disaster

SEA FIGHTER (FSF-1)

DESIGN

High-Speed Aluminum Catamaran

ABS Certified – High Speed Naval Craft

DIMENSIONS

Length (overall):	262'/79.9m
Length (at waterline):	240'/73m
Beam:	72'/21.05m
Draft (scantling):	12'/3.6m
Full Load Displacement:	1400 LT
Light Ship Displacement:	950 LT

PERFORMANCE

Maximum Speed (Combat Load*):	50+ kts
Maximum Speed (S/S 4):	40+ kts
Maximum Speed (Diesels only):	20+ kts
Shaft Power (ISO):	2x 33.6KHP
Range @ 20 kts:	4000 NM
Service Life:	5 years

ACCOMODATIONS 32

Future Growth 18

BOATS

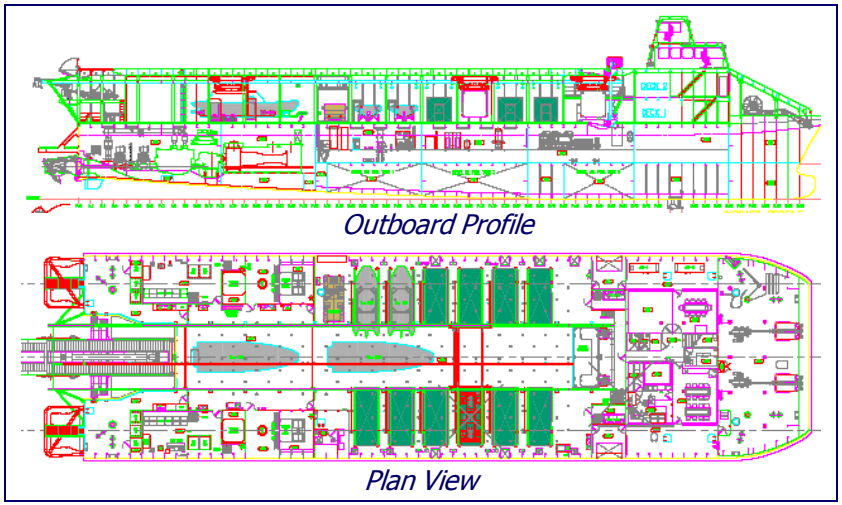
2x 50 person liferafts

1x 11m RHIB; 1 x 4.5m Zodiac

MISSION BAY

Approx 10,000 ft^2 of cargo area capable of supporting containerized mission packages, HMMWV storage, 11 m RHIB operations, UUV/USV operations, etc.

LAN, Electrical, & chill water provided for each container in Mission Bay



Outboard Profile

Plan View

MACHINERY SYSTEMS

2 x LM 2500 Gas Turbine Engines

2 x MTU 16V595 Propulsion Diesel Engines

4 x KaMeWa 125 SII Waterjets (steerable/reversing)

4 x 355kW Diesel Generators

Automated Engineering Controls

ICAS

AUXILIARY SYSTEMS

A/C Plant

Distilling Plant

Refrigeration Unit

Low Pressure Air System

MATERIAL HANDLING EQUIPMENT

Overhead X-Y Crane: capable of transporting one fully-loaded TEU container from elevator to storage location in Mission Bay or to stern ramp

Elevator: capable of transporting one fully-loaded TEU container from Flight Deck to Mission Bay.

RAMPS

Stern Ramp: capable of launch/recovery of vehicles up to size & weight of 11 m RHIB

RO/RO Ramp: capable of loading vehicles up to the size of a fully-loaded HMMWV

AVIATION FACILITIES

2 x SH-60R/MH-60S; HH-65

Day IFR, Night NVD/NVG;

Refueling capability;
no hangar/maintenance facilities

NAVIGATION

Integrated Bridge System

Fly By Wire Control

GPS Satellite Navigation

Electronic Charts

X- Band & S- Band Navigation Radar

Fathometer

Solid State Wind Birds

C^4I

1 x HF; 1 x VHF; 2 x UHF

GMDSS

Internal PCS System

Secure Voice Communications

Ship's LAN (SIPR / NIPR)

GCCS-M

MMIS

Ku Band SATCOM

ARMAMENT

4 x .50 cal machine gun stations

*Combat Load is the Light Ship Condition plus 150 tons of payload and adequate fuel and stores to operate for 5 hours at 50 knots and 5 days at loiter speed (12 kts).

SEA FIGHTER Summary

Purpose:

- Experimental platform evaluating the hydrodynamic performance, structural behavior and propulsion system efficiency of high speed hull form technologies
- Evaluate mission modularity
- LCS risk reduction

Science & Technology:

- Hydrodynamic experimentation (experimental data suite)
  - Measure fluid flow, motions, dynamic loads, stresses, and speed/power requirements
- Advanced NVG compatible flight deck

Performance Specifications

Propulsion:	(2) Gas Turbine Engines (2) Propulsion Diesels (CODOG)
Propulsor:	(4) Waterjets (steerable/reversible)
Speed:	≥ 50 knots in calm seas in Combat Loading Condition* 40 knots in Sea State 4
Range:	4000 NM/trans-oceanic range @ 20 knots
C^4I:	(2) COTS surface search radars; LAN; HF, VHF, UHF radios
Survivability:	Operational through S/S 4; survivable through S/S 6
Mission Bay:	Support mission packages in ISO 20'x8'x8' containers - multi-purpose stern ramp (launch/recover up to 11m RHIBs) - side RO/RO access (support fully loaded HMMWV)
Flight Deck:	Landing spots and fuel for (2) SH-60Rs (Day VFR; Night NVD/NVG prototype system No hangar or maintenance facilities
Crew:	26 w/10-person USCG augment (berths for 32)
Initial Sea Trials:	February 2005
Delivery:	April 30, 2005

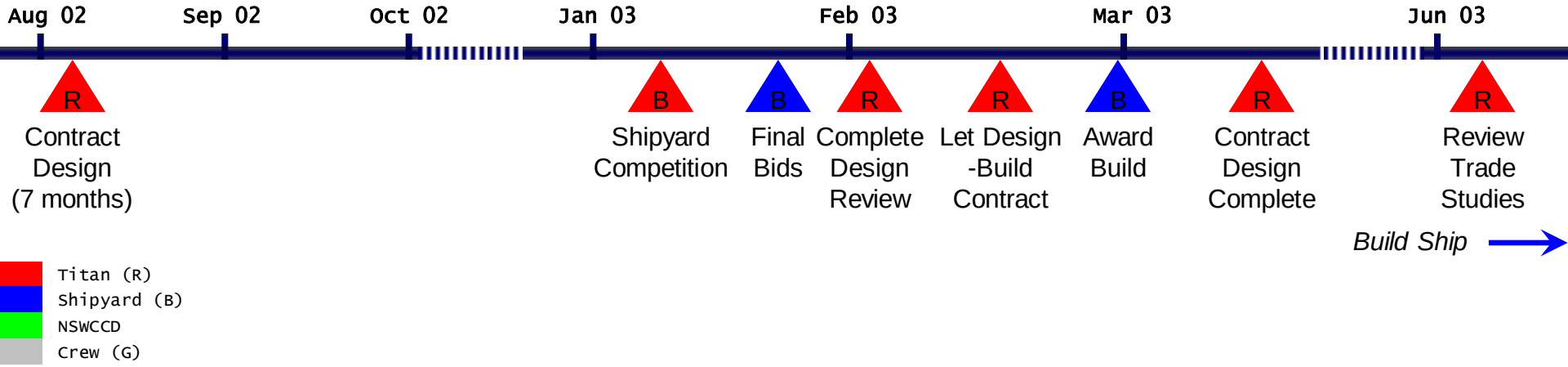
“Combat Loading” Condition

X-Craft shall achieve speeds of 50 knots (109°F ambient, 96°F seawater temp) in the Primary Combat Loading Condition.

- Primary Combat Load is the Light Ship Loading Condition plus 150 tons of payload and adequate fuel and stores to operate for 5 hours at 50 knots and 5 days at loiter speed (12 knots)
- Secondary Combat Load is the Light Ship Loading Condition with 150 tons of payload and adequate fuel and stores required to perform the following mission:
    - Transit 800 NM at 20 knots
    - Operate 4 hours at 50 knots
    - Operate on station at “loiter speed” for 21 days
    - Transit 800 NM back to port at 20 knots

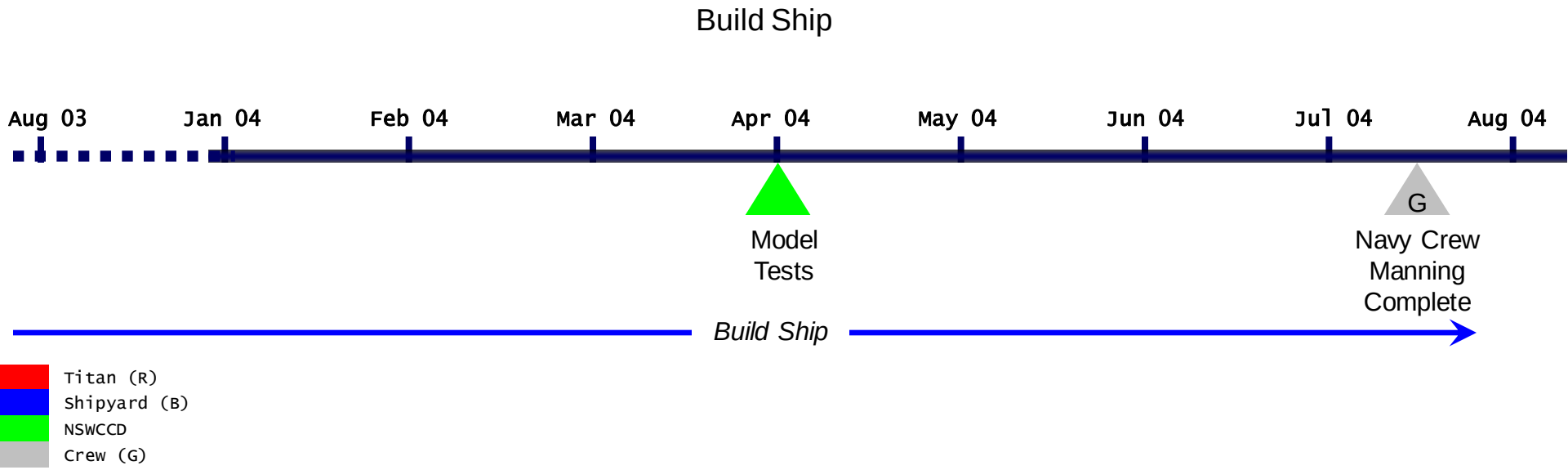
SEA FIGHTER Schedule

Contract Design ⟶ Build Ship



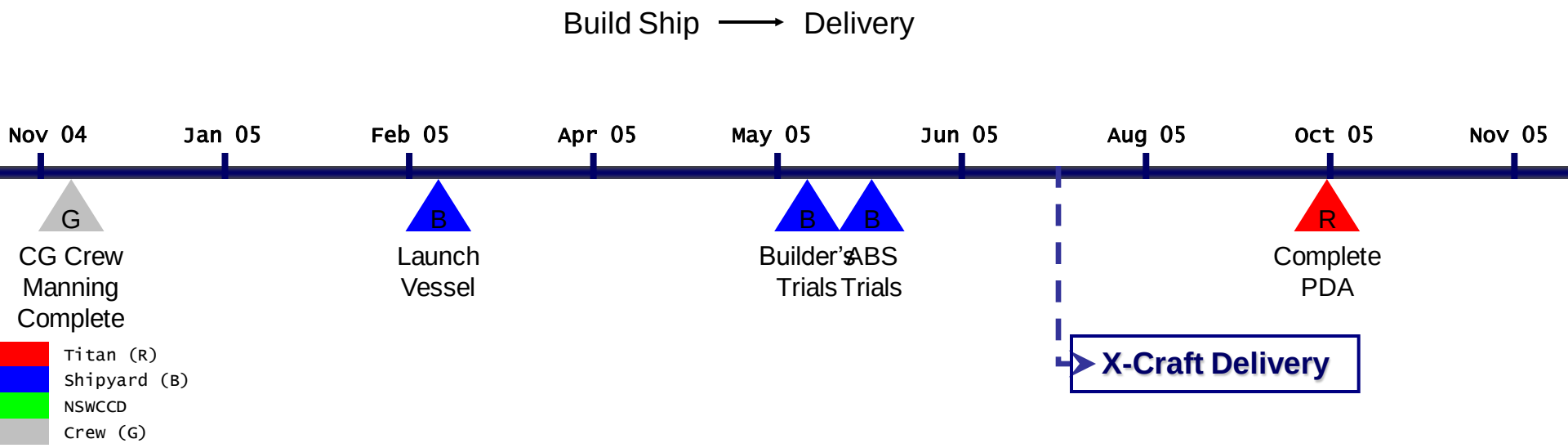
- Aug 02: Contract Design (6 months)
- Dec 02: Initiate Shipyard Competition
- 17 Jan 03: Final Shipyard Bids
- 14 Feb 03: Complete Design Review
- 24 Feb 03: Let Design/Build Contract
- 28 Feb 03: Award Build Contract
- Mar 03: Contract Design Completed
- Jun 03: Begin Construction
- Jun 03: Review Trade Studies

SEA FIGHTER Schedule



- April 2004 – August 2004: Model Testing
- July 04: Navy Crew Manning Complete

SEA FIGHTER Schedule



- Nov 04: Coast Guard Crew Augment Manning Complete
- Feb 05: X-Craft Launch
- May 05: Builder's Trials
- May 05: ABS Trials (1 Week)
- July 1, 2005 : X-Craft Delivery
- October 2005: Complete Post Delivery Availability
- October 2005: Begin Experimentation

System Experiments Conducted

- Dynamic Interface Trials
- Spartan Scout
- Coast Guard Deepwater Mission LOE
- Sea Horse USSV
- UK SSTD System
- *Ship Performance Trials*

Enclosed Composite Mast

8 months from proposed upgrade to installation

Manufactured by a yacht builder

Flight Deck Operations

2 x wheeled helicopters up to SH-60 size on Flight Deck

6-man flight deck crew

Navy nonskid coating

Night Vision Goggle compatible lighting suite

Ship Operations

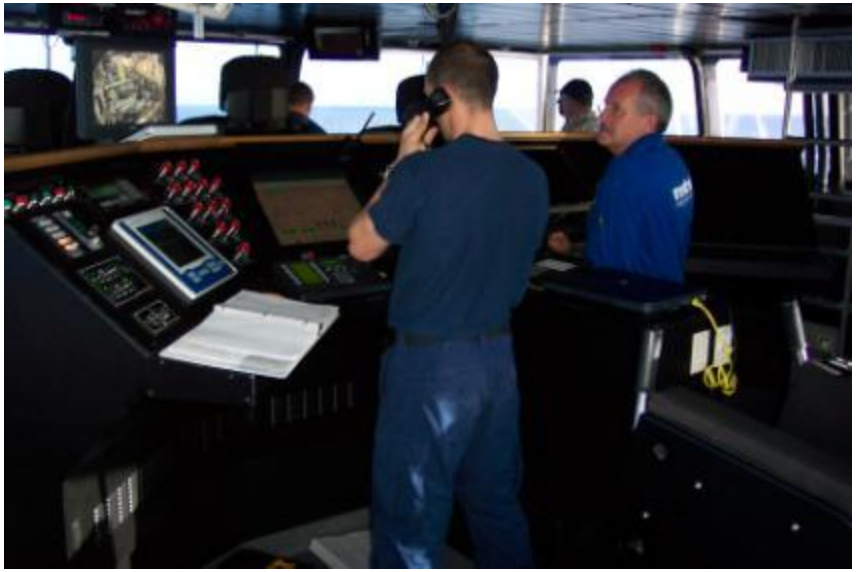
OOD, Navigator and Engineer all in Pilothouse, plus one rover

Fly By Wire controls

Integrated Machinery Controls

Integrated Bridge Systems

Unmanned Machinery Spaces



Modular Payload

Based on ISO 20’ container size

Capacity for 12 on SEA FIGHTER

Provided w/ electricity, phone, LAN and chill H_2O


NAVU 920142 0
PA 2264

X-Y Crane

- Unique to SEA FIGHTER
- Electrically powered
- 16 tonne limit (ISO Container)
- Can move length of mission bay & boat ramp (X)
- Can move to mission module locations (Y)

Stern Ramp

- Combined Boat Ramp – Ro/Ro Ramp
- Hydraulic actuation
- Aluminum structure
- Separate cradle (accommodates 7m & 11m RHIB)

Ship Propulsion

CODOG Powerplant

Reversible, steerable waterjets

54.6 knot top speed

Problems with:

System integration

Cathodic corrosion

Lube system leaks

Ride Control System

- 2 x T-Foils forward (vertical motions)
- 2 x Interceptor aft (vertical motions)
- 2 x Active Skeg aft (directional stability)
- Hydraulic Actuation
- Unique to SEA FIGHTER

Hull Form

- Semi SWATH catamaran
- All aluminum hull structure
- ABS Class

  ✠A1, HSC Naval Craft, OE, ✠AMS, ✠ACCU, NIBS, R2-S

  – IMO HSC 2000
- Safe Operational Envelope (SOE)
  – Defined by ABS and NAVSEA
  – Included in ABS Appendix to Class

Safe Operating Envelope

Science Package (SP-DAS)

- Integrated System of Sensors
  - Ship motion accelerometers
  - Strain gauges
  - Shaft RPM and torsion meters
  - Pressure taps on waterjets and inlets
  - Vibration accelerometers on waterjets
  - Wave height sensor
  - Feed from navigation system
- SP-DAS system collects and records data from all sensors

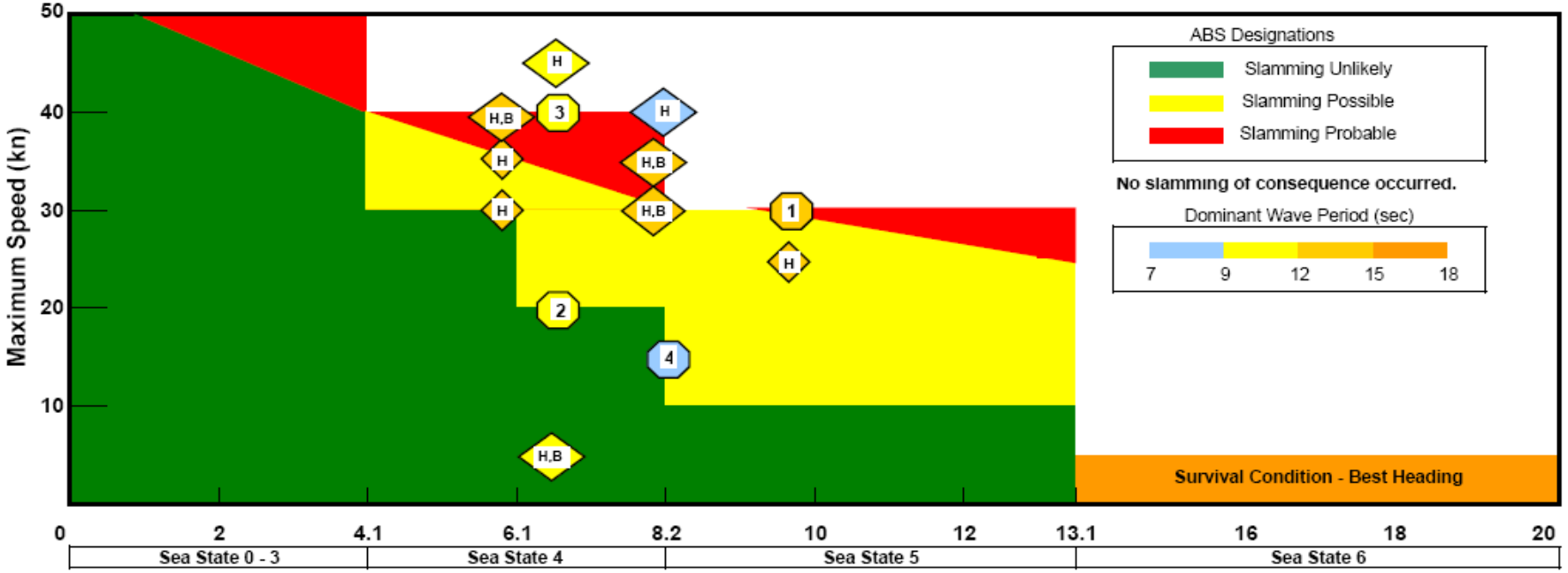
Ship Performance Trials Performed

- October 2005 – Calm Water
  - Maneuvering, Powering, Propulsion System
- December 2005
  - Support to NAVAIR Dynamic Interface Trials
  - Maneuvering Trials
- January 2006
  - Rough Water Trials, Noise and Vibration, Human Factors
- April 2006
  - Rough Water Trials, Slamming, Wave Measurement
- June 2006
  - Maneuvering, Powering, Flow analysis

PRELIMINARY

FSF-1 Sea Fighter Rough Water Trials
January and April 2006

Head and Bow Sea Run Overlaid on the Operational Envelope for 1400 mt and Below



1 Octagon 1 - 26 Jan 06

2 Octagon 2 - 19 Apr 06

3 Octagon 3 - 19 Apr 06

4 Octagon 4 - 20 Apr 06

H,B Represents Head and Bow Sea conditions run to evaluate the edge of the envelope

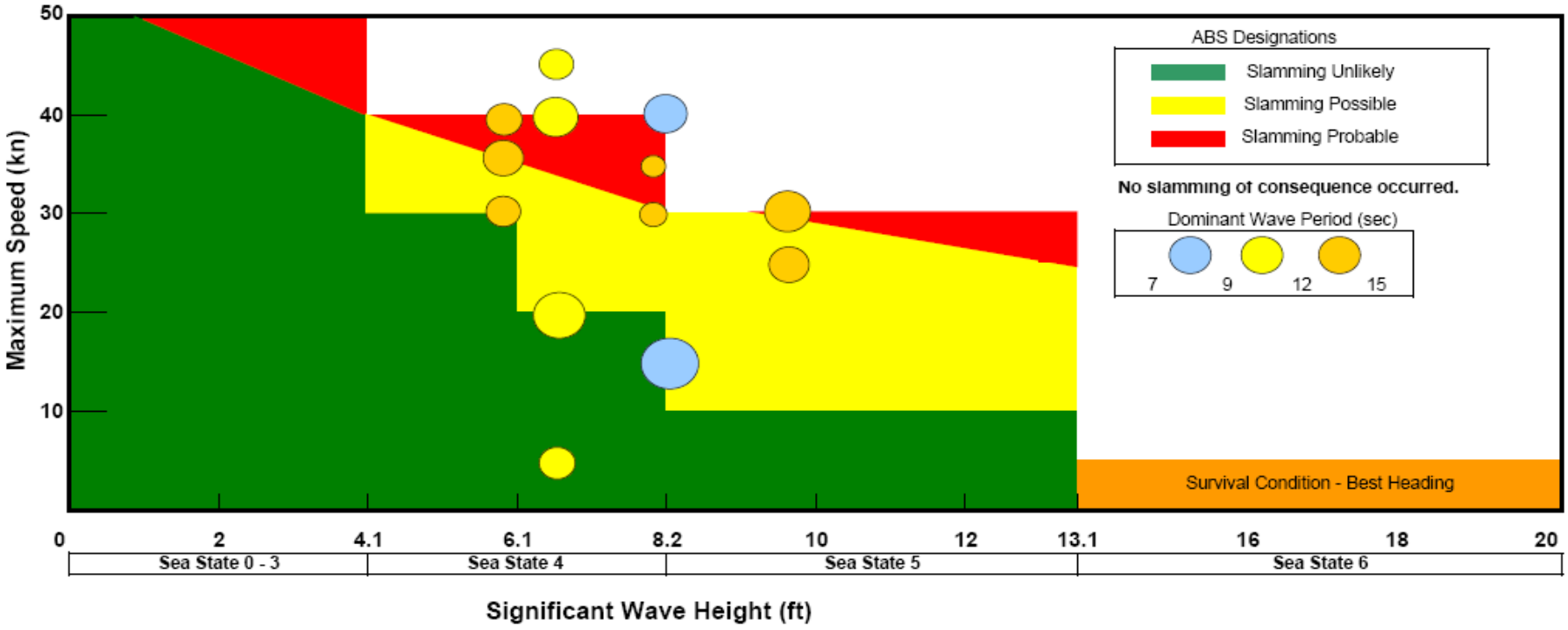
H Represents Head Sea conditions run to evaluate the edge of the envelope

NOTE: Octagon/Triangle color denotes dominate wave period.

PRELIMINARY

FSF-1 Sea Fighter Rough Water Trials
January and April 2006

Stbd Bow Vertical Acceleration (g - Std Dev) in Head Seas Overlaid on the Operational Envelope for 1400 mt and Below

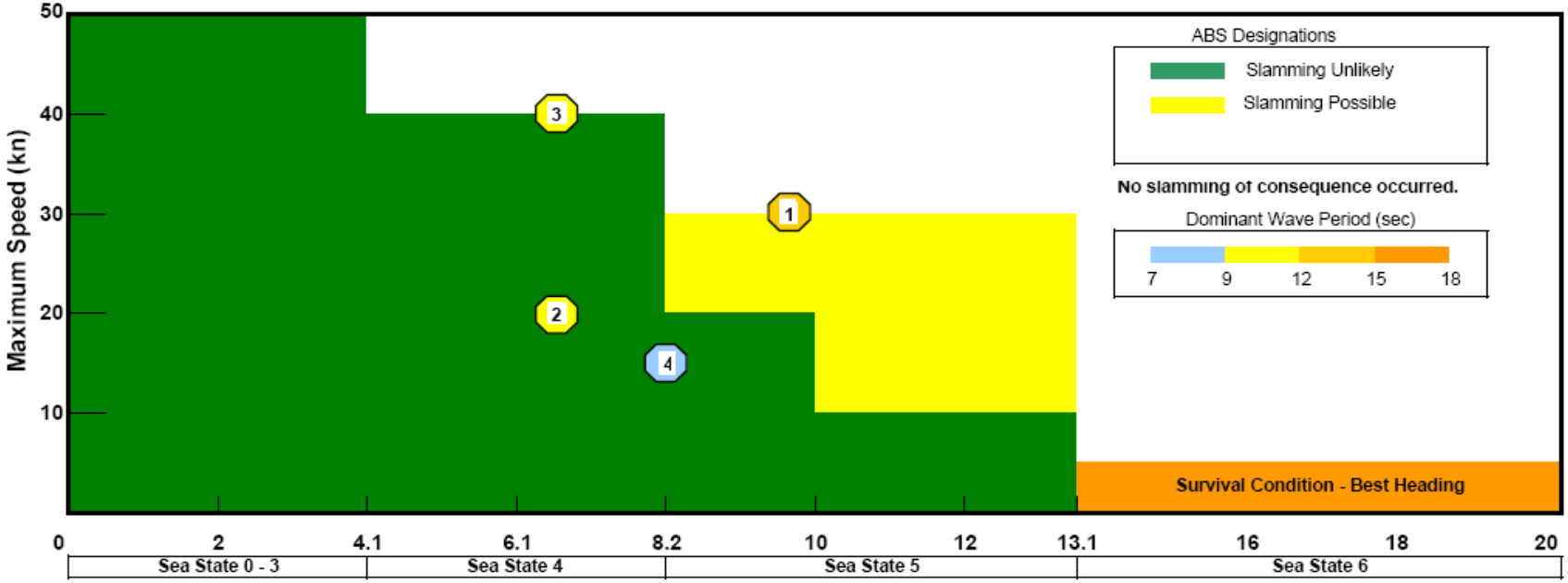


NOTE: Circle diameter denotes relative magnitude. Circles shown in legend represent 0.1 g (Std Dev). Circle color denotes dominate wave period.

PRELIMINARY

FSF-1 Sea Fighter Rough Water Trials
January and April 2006

Beam, Stern Quartering and Following Seas Overlaid on the Operational Envelope for 1400 mt and Below



1 Octagon 1 - 26 Jan 06

2 Octagon 2 - 19 Apr 06

3 Octagon 3 - 19 Apr 06

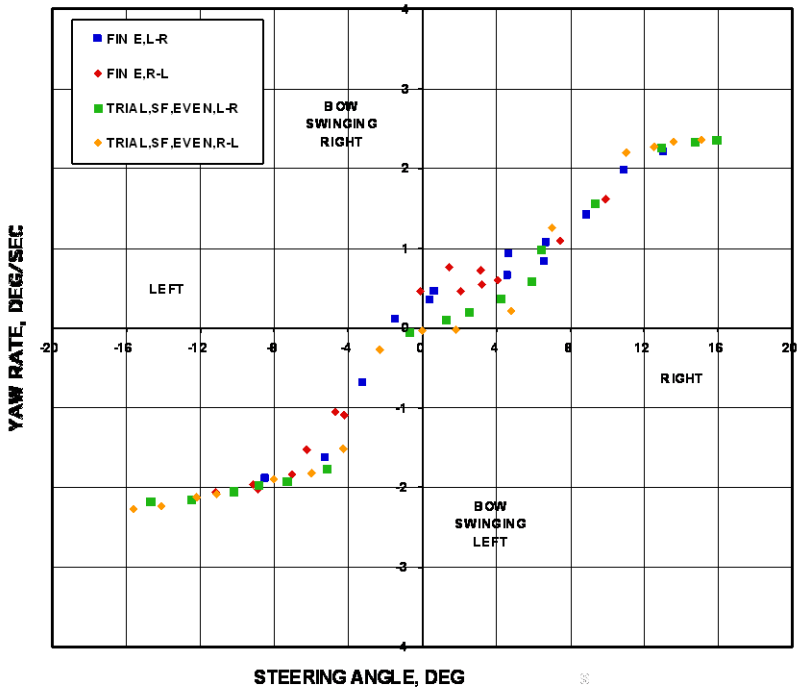
4 Octagon 4 - 20 Apr 06

NOTE: Octagon color denotes dominate wave period.

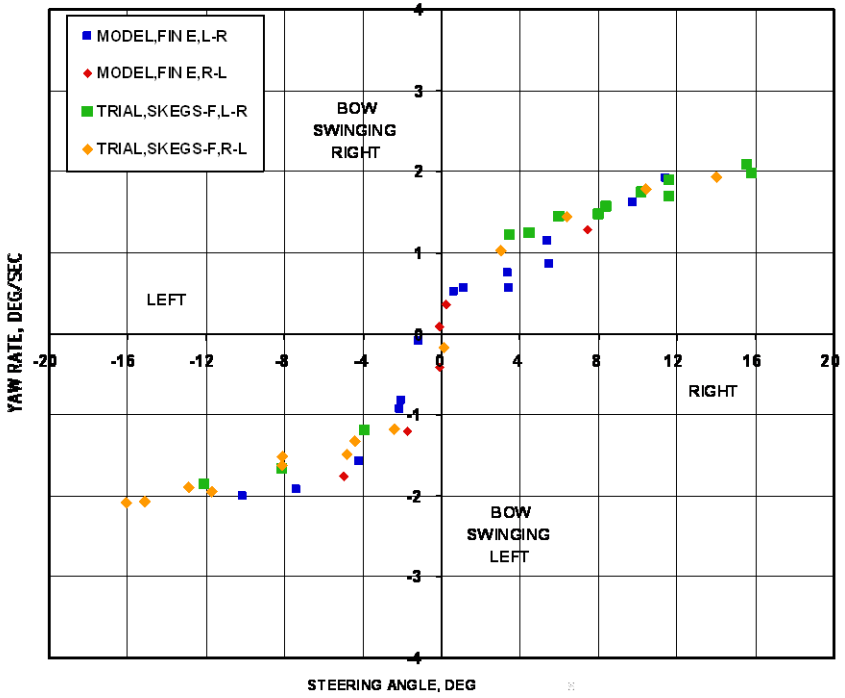
Calm Water Trial Events

- Standardization Runs
  - Gas Turbine and Diesel
  - Heavy (1400 t) & Light (1200 t)
- Course keeping
- Turns
- Spirals & reverse spirals
- Zig-Zag (10, 20, 30 degree)
- Acceleration & deceleration (crash stops)
- Waterjet cavitation & performance

SHIP & MODEL DIRECTIONAL STABILITY COMPARISON

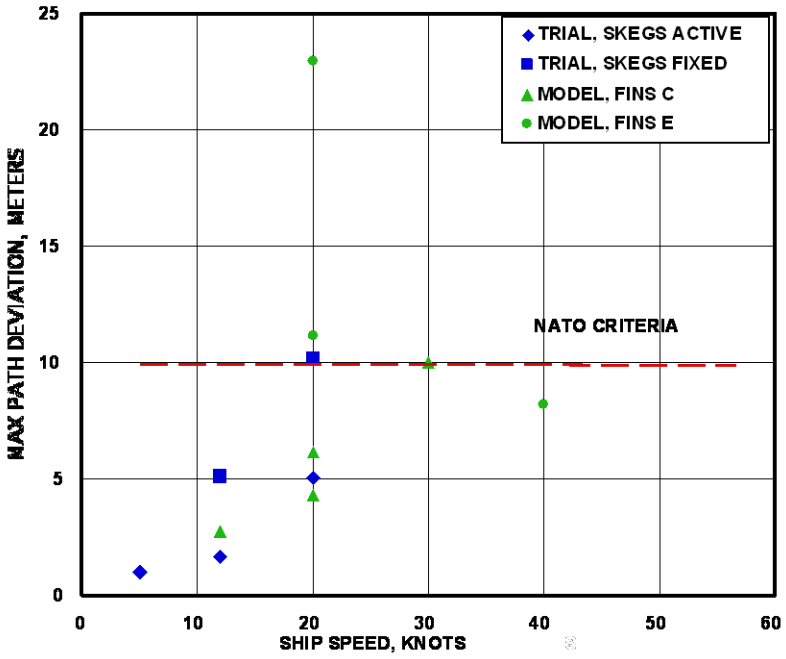


SHIP (SKEGS FIXED) & MODEL (FINS E) - 20 KNOTS

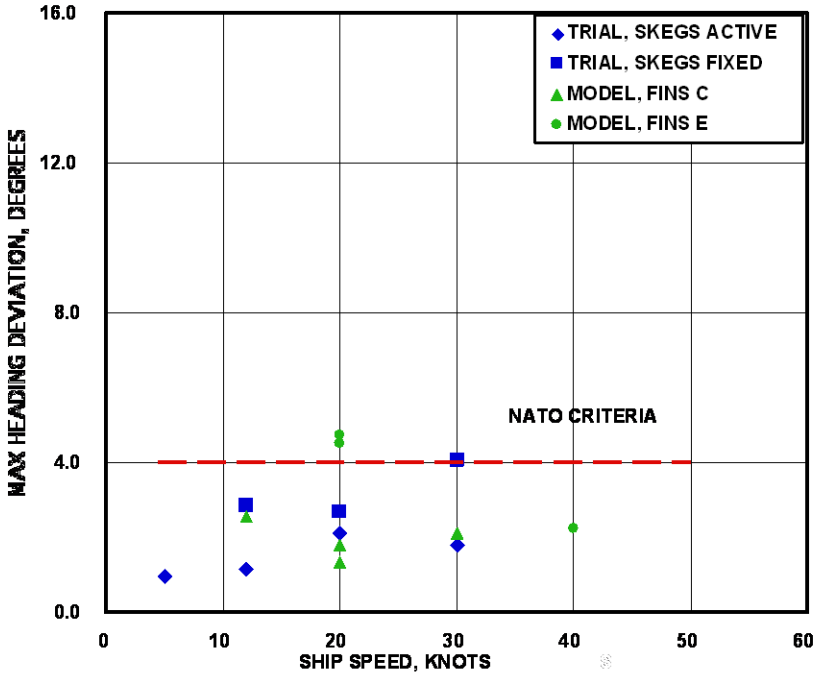


SHIP (SKEGS FIXED) & MODEL (FINS E) - 30 KNOTS

SHIP & MODEL MANUAL COURSEKEEPING COMPARISON

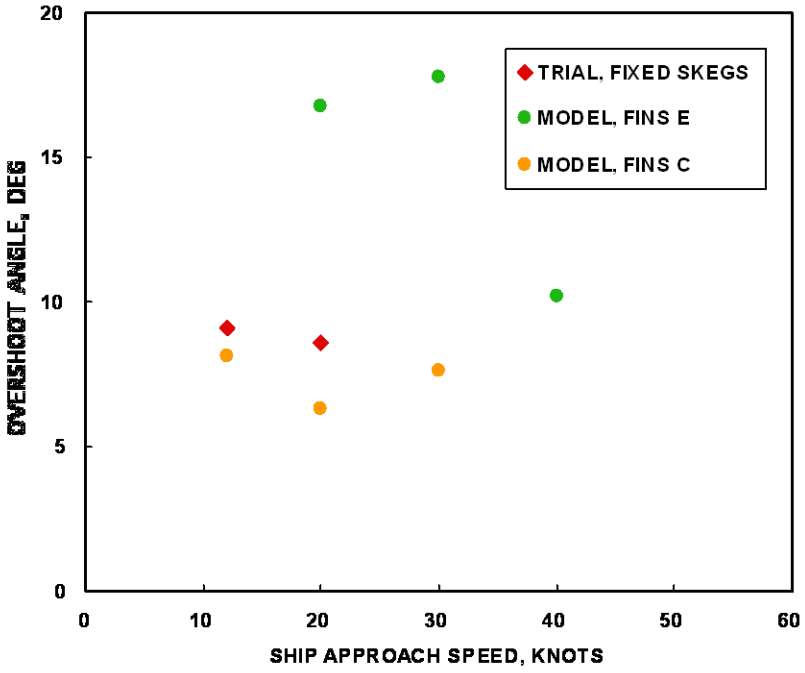


TRACK KEEPING

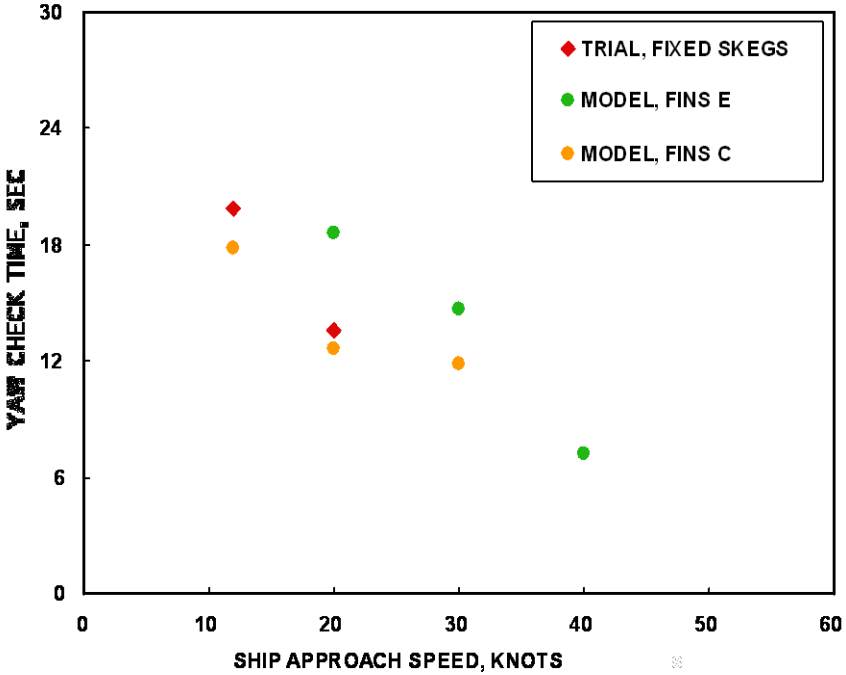


HEADING

SHIP & MODEL ZIGZAG COMPARISON



OVERSHOOT



YAW CHECKING

Ship Performance Trial Conclusions

- The maneuvering characteristics of the SEA FIGHTER are acceptable and safe
- Trials to date have shown good agreement with the model test results
- Safe Operating Envelope is appropriate, but conservative
- Further Rough Water Trials in a greater range of conditions needed

Sea Fighter
CRAFT