

# ***Portable High-Energy Semiconductor Diode Lasers for Interior Ship Coating Removal***

**(N03-105 Technology for Shipbuilding Affordability)**

## **ONR Small Business Innovation Research Program**

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**Tampa, FL**

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**LANCORP ASI**



# ***Future Navy Requirements***

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- **Ship Staffing**

- Less crew therefore fewer people to perform preservation

- **New Class of Ship Construction**

- (DD(X), CG(X), LCS)
- Use of Advanced Materials in Construction
  - More Composites
  - “Softer” Substrates due to lighter materials
  - Varied Substrates -Metal matrix composites
  - Require a softer but aggressive removal method
  - Require a “selective’ removal method
- New Coatings
  - Will require a more environmentally friendly way of removal
  - Aggressive, fast and safe removal



# ***Common Navy & Shipyard Technology for Ship Preservation***



Wire Wheels



Abrasive Blasting

- Slow,
- Loud (to everyone),
- Messy,
- Labor intensive,
- Non-selective,
- Good only on metal surfaces



Needle Guns



Grinders



# ONR Phase II SBIR - Portable Solid State Diode Laser Systems for Surface Preparation

**Challenge:** To create an affordable portable high power laser system to remove coatings from all types of surfaces for spot stripping: must be user friendly, efficient, and easy to maintain.



**SOLUTION:** Our approach has been to focus on solid state diode laser technology, which allows for versatility of surface preparation and surface enhancement, and fiber fed at 1000 Watts.

# ***Technology Solution***

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- A Hand-held portable 1000 Watt high power semiconductor diode laser (HPDL) to vaporize coatings.
- Innovative Application gun with integral vacuum & filtering system to capture all process residues with 100 feet umbilical reach.
  - Reduce waste by >90%
- Safe to use – automatic shutoffs/defaults
- No preparation, no cleanup
- Safe on Non-Metal and Metal substrates
- Adjustable Power from 0-1000 Watts
  - Pulsed or continuous wave

# *System Description*

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- **Weight Laser unit est. 400 lbs**
  - Chiller 300 lbs
  - Workhead – 7lbs
- **Power 208V-3 Phase (also 480V 3 phase)**
- **Dimensions 55"l x 55h" x 28"w**
- **Reach – 100 Feet from unit**
- **Mobility :Casters, 4 Lifting Eyes, 4 Retractable handles**
- **Rate: 100-200 sqft/hr/mil**
- **Integral vacuum**

**The operator controls the laser power and traverse speed as the work-head is manually manipulated across surfaces to vaporize coatings.**

**A variety of work-heads allow for the beam to be contained and the effluent captured while giving the operator maximum reach for getting behind objects or covering flat areas.**

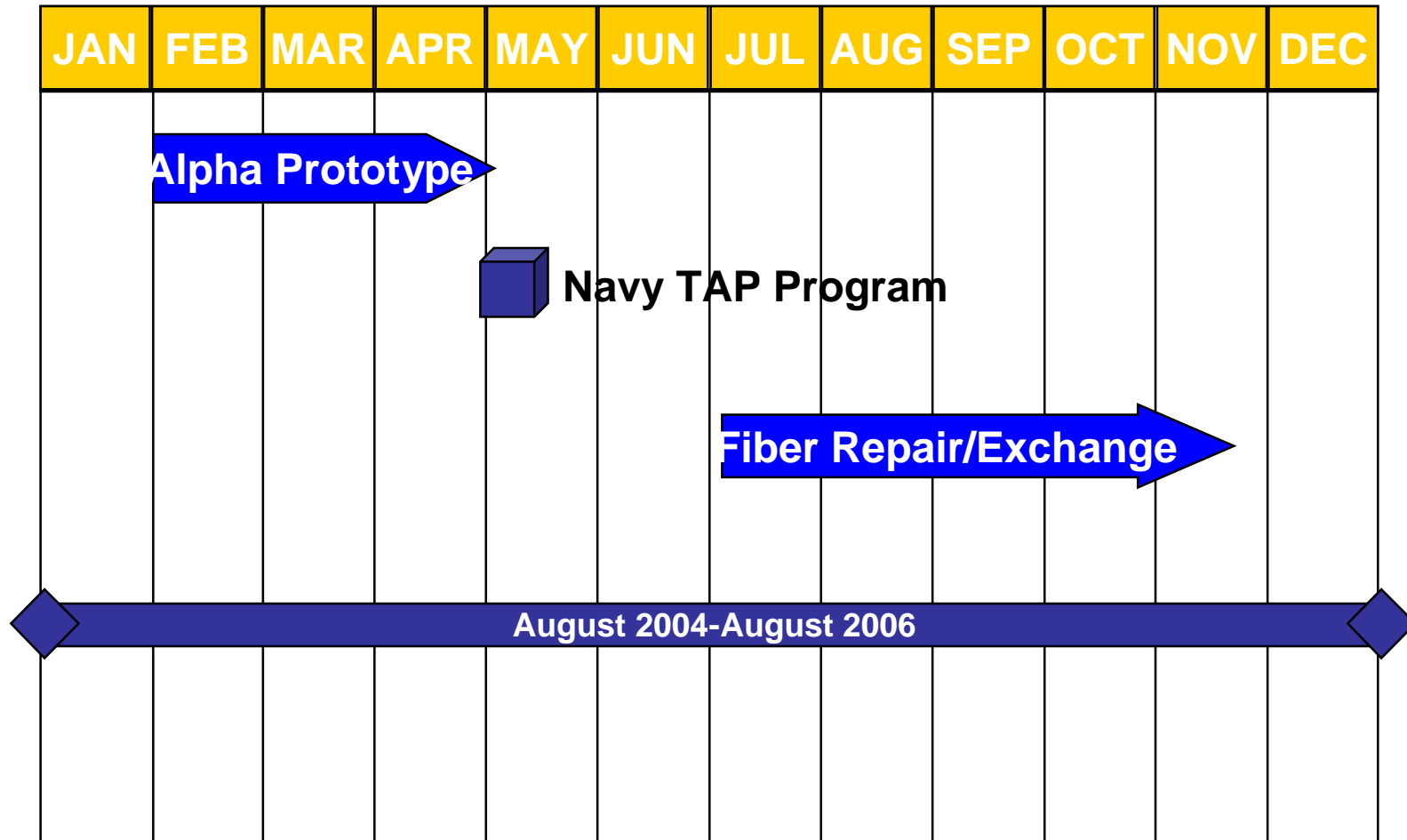


# Technology Development Milestones

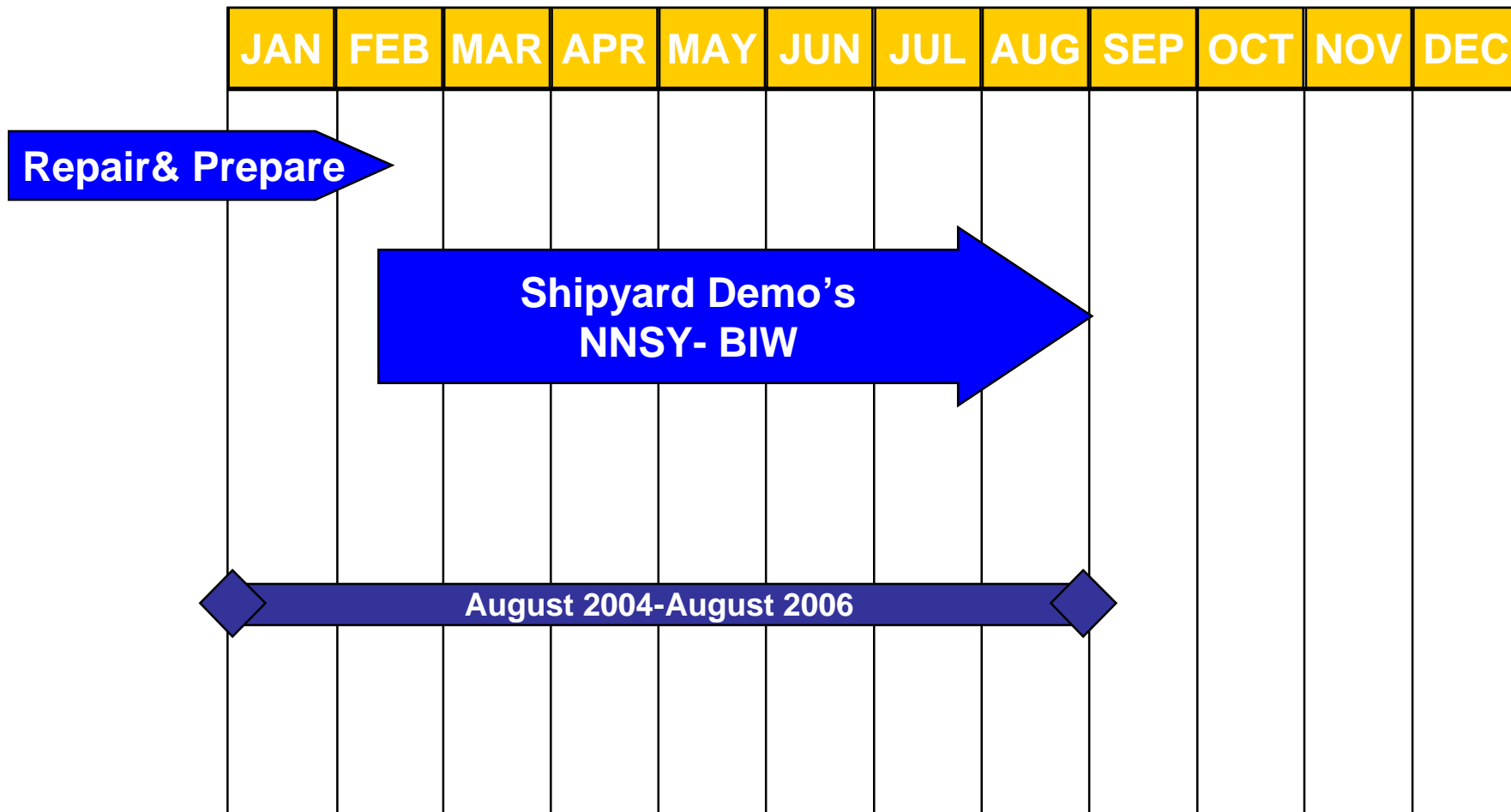
Milestones	TRL (more)1 to 9(less)	Risk-Test	Measure of Success	Date
Feasibility testing (removal @1000 W)	3	Remove Standard Navy Coatings	Rates of 100 ft <sup>2</sup> /mil achieved, clean substrate.	Phase I Nov 2003
Environmental Testing (gas/solid)	4	Effluent tests Off gas, Solids	No apparent hazard detected	Phase I Oct-Dec 2003
Construct Prototype 1KW fiber coupled laser, portable and manual operation	5	Phase II Alpha Prototype	Rates improved over Phase I, Portable system. Functional for field tests (note Fiber Damage/Repair delay)	May 2005
Shipyard Tests	7	Functionality	Meets shipyard criteria for production	Mar 2006 - Aug 2006
Navy Transition	8	Safety, ease of use & production rates	Shipyard worker & sailor acceptance	Aug-2006 - >>>>

TRL-Technology Readiness Level

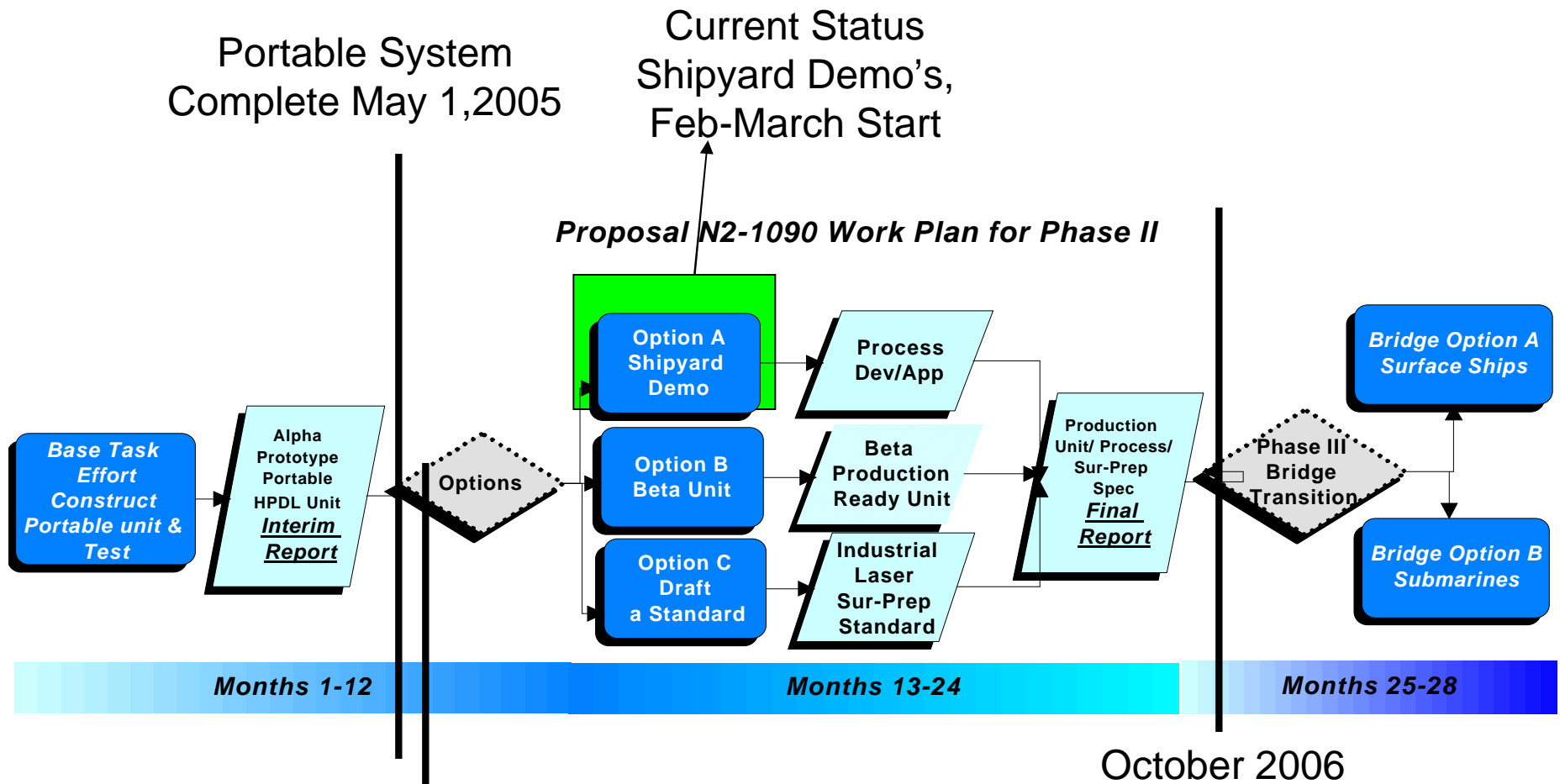
# Project Update-Timeline 2005



# Project Update-Timeline 2006



# Phase II Development Timeline



*June, Fiber damaged (warranty issue) Fiber sent back for repair after evaluation Delays field testing*

**Note: After system checked-out, fiber sent to Optoskand in Sweden, July-August they were on vacation – received fiber back end of November.**

# Shipyard Demonstration Goals

- Measure Performance & Quality
  - NNSY Strip on actual ship hull mockup used for surface preservation training
  - BIW Strip on ship parts in shop
  - Process & application development
    - Where are the critical areas that will benefit? Tanks? RADCON? Spot removal?
  - Determine & compare performance vs Present methods
    - Is there a significant payback?
  - Gather Feedback directly from the shipyard worker
- Functionality/Human Factors Engineering
  - Specifically for shipyards, determine enhancements & changes to equipment.
  - Determine hazards & steps to overcome
  - Operator ergonomics.
- Overall Goal - In general to determine if laser decoating is a technology that can be easily transitioned into a shipyard environment in the near future or if it should wait.

# Phase II Participants



**LANCORP Advanced Systems Inc**



**Penn State Applied Research Lab**



**General Dynamics Marine Systems**



**Northrop Grumman Shipbuilding**



**Dawson-MacDonald Co**



**The Sherwin-Williams Company**



**Indirect – Providing additional testing input: NNSY, PNSY & NSRP members**

# **Contact Information**

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