

Future Technologies

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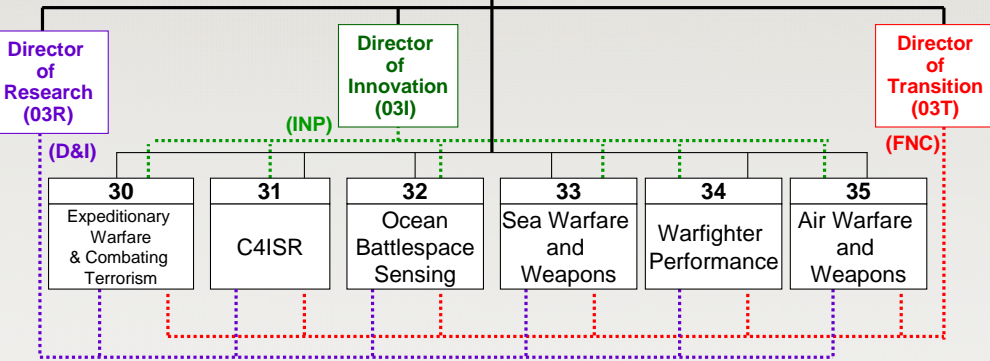
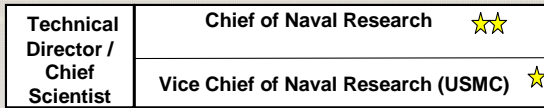
Office of Naval Research

Ship Systems & Engineering Research Division



OFFICE OF NAVAL RESEARCH

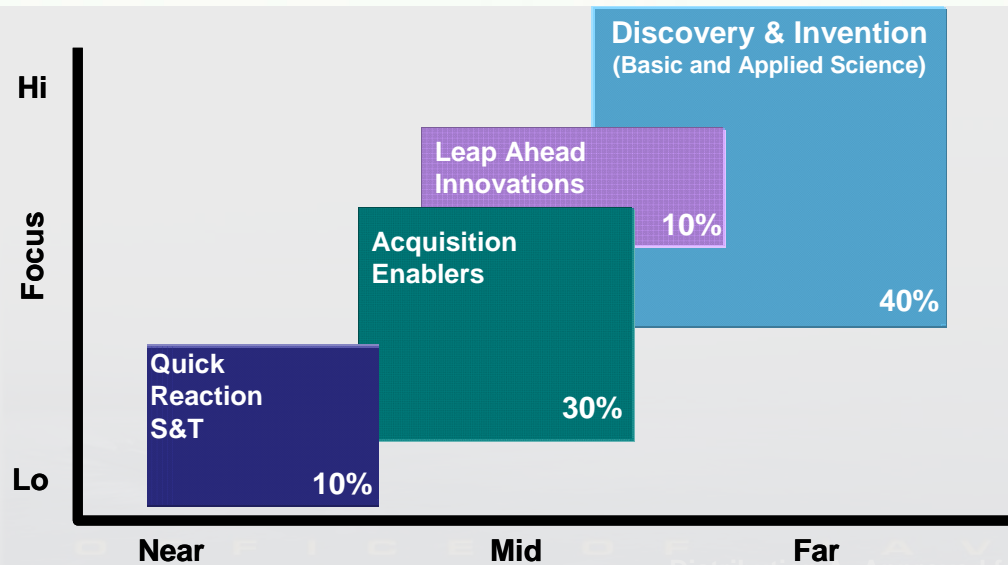
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D&I – Discovery & Innovation INP – Innovative Naval Prototypes FNC – Future Naval Capabilities

Naval S&T Focus Areas

- Power and Energy
- Operational Environments
- Maritime Domain Awareness
- Asymmetric and Irregular Warfare
- Information, Analysis, and Communication
- Power Projection
- Assure Access and Hold at Risk
- Distributed Operations
- Naval Warrior Performance and Protection
- Survivability and Self-Defense
- Platform Mobility
- Fleet/Force Sustainment
- Affordability, Maintainability, and Reliability



A Revolution in Platform Capability




**Ship-to-Ship
Transfer &
Material
Handling**




**Structures &
Affordability**



**Next Generation
Integrated Power
Systems**




The diagram shows a power system flow: Propulsion Motor -> Motor Drive -> Ship Power Distribution -> Motor. A separate Power Distribution System is shown with an arrow pointing to the Ship Power Distribution block.



**INtegrated
TOPside**

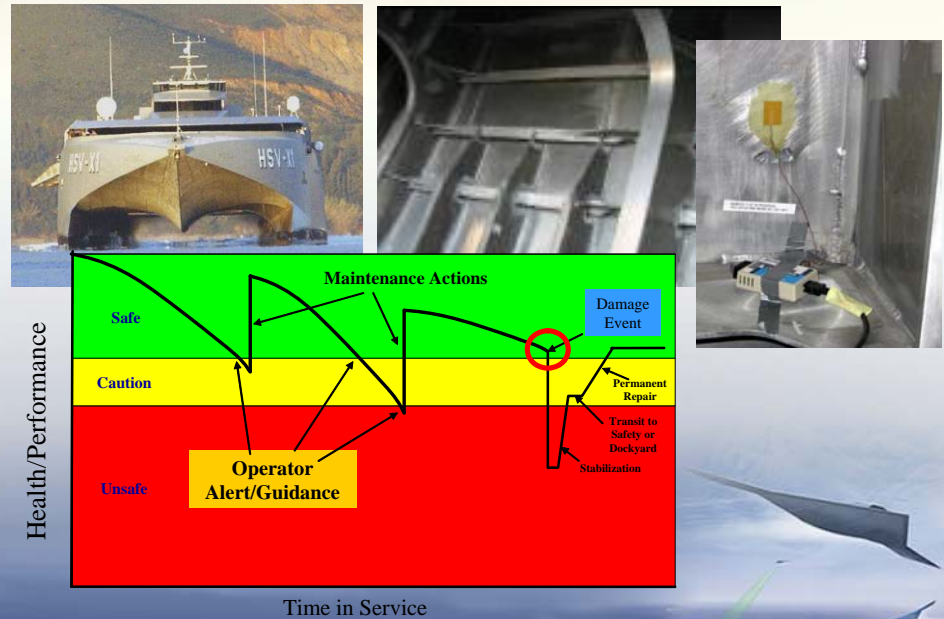
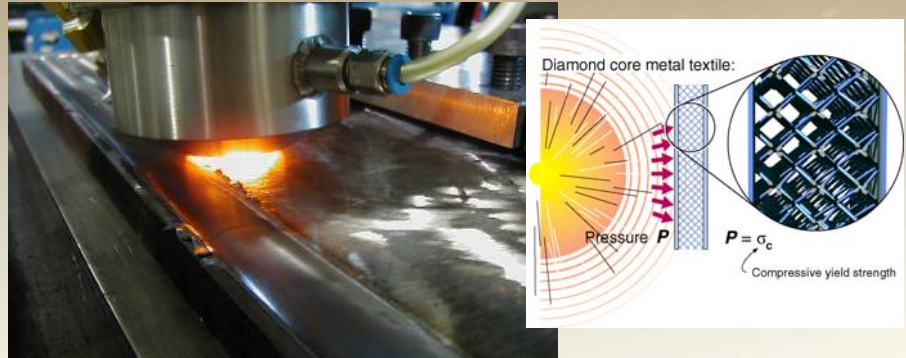


**Launch and
Recovery of
Unmanned
Vehicles**



**Fighting at
the Speed
of Light**

- **Low Cost, High-Strength Materials & Processes**
 - HSLA-65 Steel, Titanium, Marine-grade 10% Nickel Steel, Friction Stir Welding
- **Hull Structural Health Monitoring**
 - Aluminum, Composites, Unconventional Hullforms
 - Real-Time Feedback/ Monitoring, Service Life Prognoses



Next Generation Integrated Power Systems

Allows all Ship Systems to be Electrical

- Right Power, Right Place, Right Time
- Drive to increase capability at reduced fuel consumption

Power Density

Enabling Technologies

- High Speed Generator
- Advanced propulsion motors
- Common power conversion

- Power and energy control
- Zonal ship service distribution
- Energy Storage

Medium Voltage
Direct Current (MVDC)
6 kVDC

- Reduced power conversion
- Eliminate transformers
- Advanced reconfiguration

High Frequency
Alternating Current (HFAC)
4-13.8kVAC
200-400 Hz

- Power-dense generation
- Power-dense transformers
- Conventional protection

Medium Voltage AC
Power Generation (MVAC)
4-13.8 kVAC
60 Hz

Electric Ship

Now

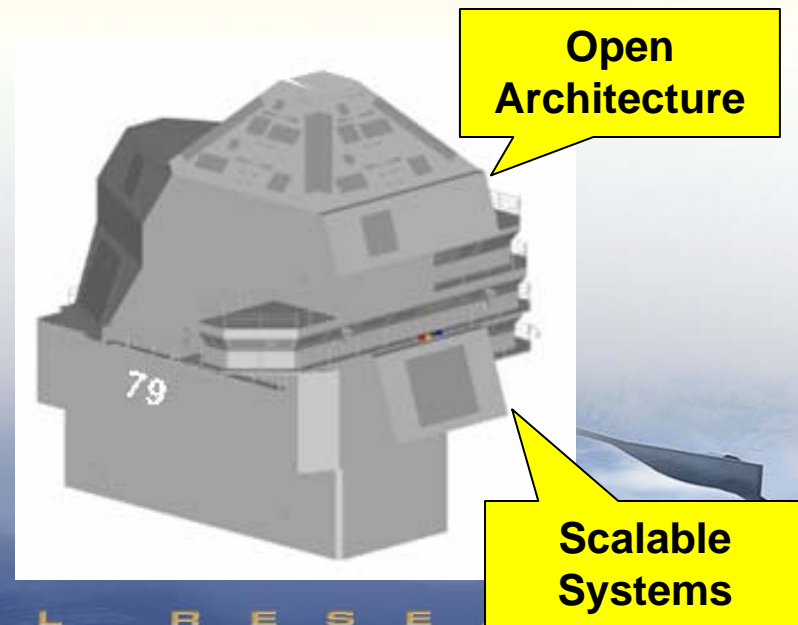
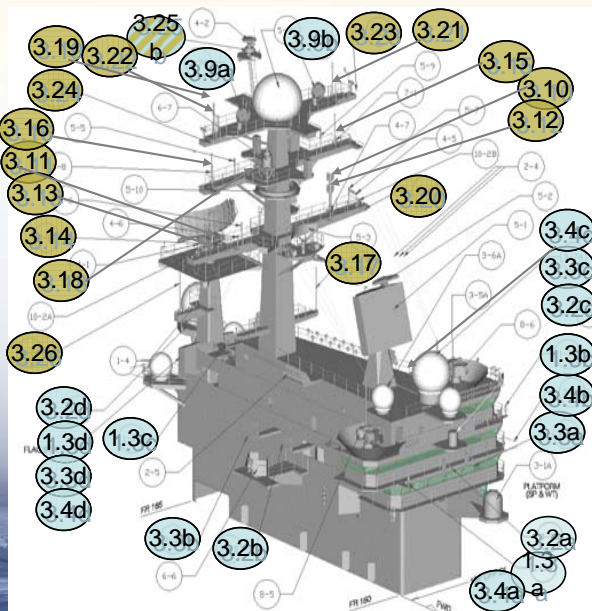
Near

Future

“Directing the Future of Ship’s Power”

INTOP is a...

- Multi-function, multi-beam aperture that radically reduces the number of antennas required
- Scalable family of EW, RADAR (not high power) & communications capability to support multiple classes of ships
- Modular / open RF design (apertures and electronics) to facilitate best of breed technology and cost effective upgrades



Fighting at the Speed of Light & Hypervelocity

Free-Electron Laser

- High- energy laser defense system

Electromagnetic Railgun

- Pulsed-power system
- 10 rounds/minute
- 6 minute flight
- 200 nautical miles

Weapons of Mass Destruction Detection

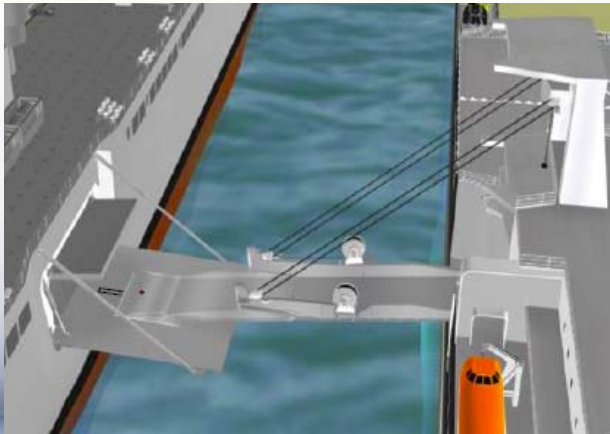
- Multiple detection methods
- Surveillance without boarding

Ship-to-Ship Transfer & Material Handling

Flexible, responsive afloat warehousing technology

- Enables improved ship-to-ship logistics
- Improves sustainment of assembled Naval forces
- Reduces response times to humanitarian mission requirements

**Interface Ramp
Technologies**



**Large Vessel Interface
Crane Technology**



**High Rate
Vertical/Horizontal
Material Movement**



T-Craft Challenges



Problem:

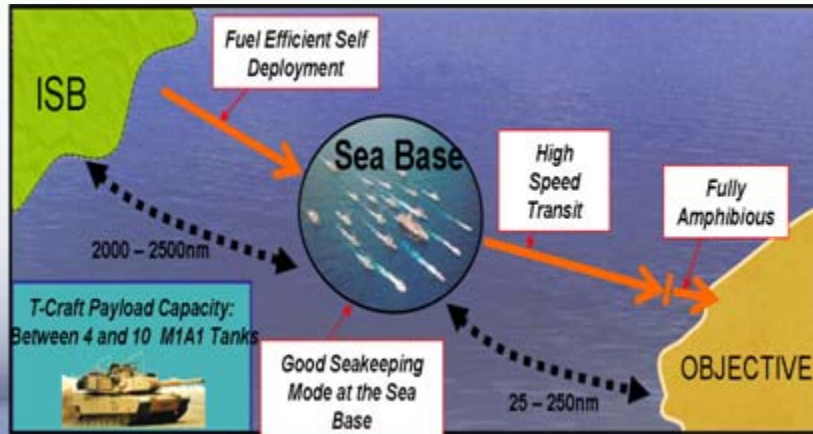
Current Navy surface connectors have to be carried into theater within the well decks of our Amphibious ships. These Amphibious connectors carry small payloads over small distances and can only operate in low sea states.

Challenges:

- Self deploying over a long distance in high sea state unloaded
- Significantly higher payloads (4 to 10 times)
- Fully loaded unrefueled range >500nm at 40kts
- Cargo Transfer at the Sea Base in high sea states
- The ability to traverse sand bars and mud flats
- Fully amphibious landing capability

Technical barriers:

- Transition of Propulsion systems from in-water to out-of-water
- Variable/retractable skirt geometry
- High strength, lightweight, long-wear materials
- Active ride control systems
- Human system integration
- Vehicle transfer at the sea base
- Complexity of mechanical drive system
- Hybrid electric drive options
- Light weight structural materials



Launch and Recovery of Unmanned Vehicles

High-level Autonomy

- Dynamic mission planning/re-planning
- Advanced perception, vision-guided maneuvers
 - Obstacle avoidance
 - High Sea State Launch/Recovery

Autonomous Approach



Auto - Latch





ONR

Revolutionary Research . . . Relevant Results