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ONR Long Endurance Undersea Vehicle Propulsion Future Naval Capability (FNC)

Industry Day Briefing

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Background

- **Current and future Naval UUVs[1] require longer endurance propulsion systems**
  - **10-40 hours to several days or weeks**
  - **High Energy density batteries insufficient to meet needs**
  - **Solutions beyond battery-only technology capabilities are required**

1 -This refers to propelled vehicles, not gliders.

Long Endurance Undersea Vehicle Propulsion FNC Program Research Opportunity

- **Develop and demonstrate energy dense air-independent, rechargeable/refuelable energy system technologies for a 21” diameter unmanned undersea vehicle (UUV) capable of the threshold and objective metrics outlined below**
- **The program is expected to employ a phased approach to achieve a Technology Readiness Level (TRL) of 6 by the end of the program**
  - **PMS 406 is the transition sponsor for this program**

	Threshold Metrics	Objective Metrics
Nominal Power Density (Watts/liter)	10	20
Energy Section Length	76.2 cm (30’’)	76.2 cm (30’’)
Energy Volume (liter) 47.0 cm (18.5’’) (ID) x 76.2 cm (30’’)	132	132
Energy Mass (kg) w/o hull & bulk	132 (neutrally buoyant)	132 (neutrally buoyant)
Energy (kWh)	42	80
Duration (hrs)	≥30	≥30

Program Plan

- **Multiple awards are anticipated in the form of Indefinite Delivery/ Indefinite Quantity (IDIQ) contracts**
- **Program duration of five years - FY12 to FY16**

Phase	Time Period	Metric
Phase I Base	Up to 18 months	Must achieveTRL-4 (Component and/ or breadboard validation in laboratory environment)
Phase I Option	6 months	
Phase II	Up to 30 months	Must achieve TRL-6 (System/subsystem model or prototype demonstration in a relevant environment)

Program Eligibility

- **UUV Energy is on the Militarily Critical Technologies List (MCTL), and therefore may have ITAR restrictions**
  - **All Key Personnel must be U.S. Citizens**

- **Proposers must possess an active PKI certificate (External Certificate Authority - ECA) from 30 days after contract award through the duration of the performance period**
  - **Will be required for access to a secure sharing web site for report and briefing materials submission**

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Phase I Base Objectives

- **Performance period up to 18 months in duration**
  - **Conduct subscale (>1 kW) component and/or full-scale critical component and integration testing and analysis as a basis to meet at a minimum the THRESHOLD metrics and the THRESHOLD mission profile at a TRL 4 system level demonstration**
  - **Develop a preliminary Energy System 3D Solid Model demonstrating attainment of the performance metrics**
  - **Provide a development plan that addresses how the desired performance and environmental metrics will be met**
  - **Generate a table listing the weights and volumes of all the representative full-system energy section components, TRLs of the subcomponents, and necessary Balance of Plant (BOP) items**
  - **Conduct a Preliminary Hazards Analysis**

Phase I Option Objectives

- **Performance period 6 months in duration**
  - **Finalize the design and initiate full-scale system component procurement for the Phase II demonstration, final BOP integration strategy and the test plan detailing the conditions for the final TRL 6 demonstration**
  - **Conduct Critical Design Review**
  - **Conduct system level cost analysis**
  - **Determine projected procurement cost of each system in production lots of 4, 10 and 100 per year over 10 years**
  - **Determine consumable costs per mission**
  - **Determine manpower requirements for the turnaround of the vehicle's energy section**

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Phase II Objectives

- **Performance period up to 30 months**
  - **Projects will have met at least the THRESHOLD metrics during the Phase I base period and demonstrate likelihood to meet OBJECTIVE metrics**
  - **Provide a TRL-6 land based demonstration in a UUV energy section hull**
    - **A full scale UUV Energy Section hull and interface documentation will be provided by the government**
  - **Develop all necessary Standard Operating Procedures (SOP)s, operational and maintenance schedules, drawings, and parts list for the energy system**

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Program Goals

Threshold and Objective Metrics

	Threshold	Objective
Nominal Power Density (Watts/liter)	10	20
Energy Section Length	76.2 cm (30’’)	76.2 cm (30’’)
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Duration (hrs)	≥30	≥30

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Additional Desired Metrics

Specification	Metric
Platform Diameter Size	53.3 cm (21'')
Energy Density	300-600 Wh/liter, neutrally buoyant
Endurance	≥ 30 hours
Start/Stop Cycles	3-5
Refuelability	Yes, without breaking the hull
Scalable	Yes, up to 91.4 cm (36'')
Open vs. Closed Cycle	Closed
Operating Depth	152.4 M (500') (depth independent desirable)
Power Profile	Will be Provided
Peak Power	Will be Provided
Orientation: Roll, Pitch	± 45 Degrees
Refueling Turn-around Time	2 hour threshold/ 1 hour objective
Maintenance Specifications	Corrective maintenance tasks: < 5 hours threshold; < 2 hrs objective. Depot level maintenance interval: > 180 days or >300 hours operating hours threshold; > 360 days or > 600 operating hours objective
Safety	Will be Provided
Key Interfaces	24-32 volts; conduit; health/remaining energy monitor

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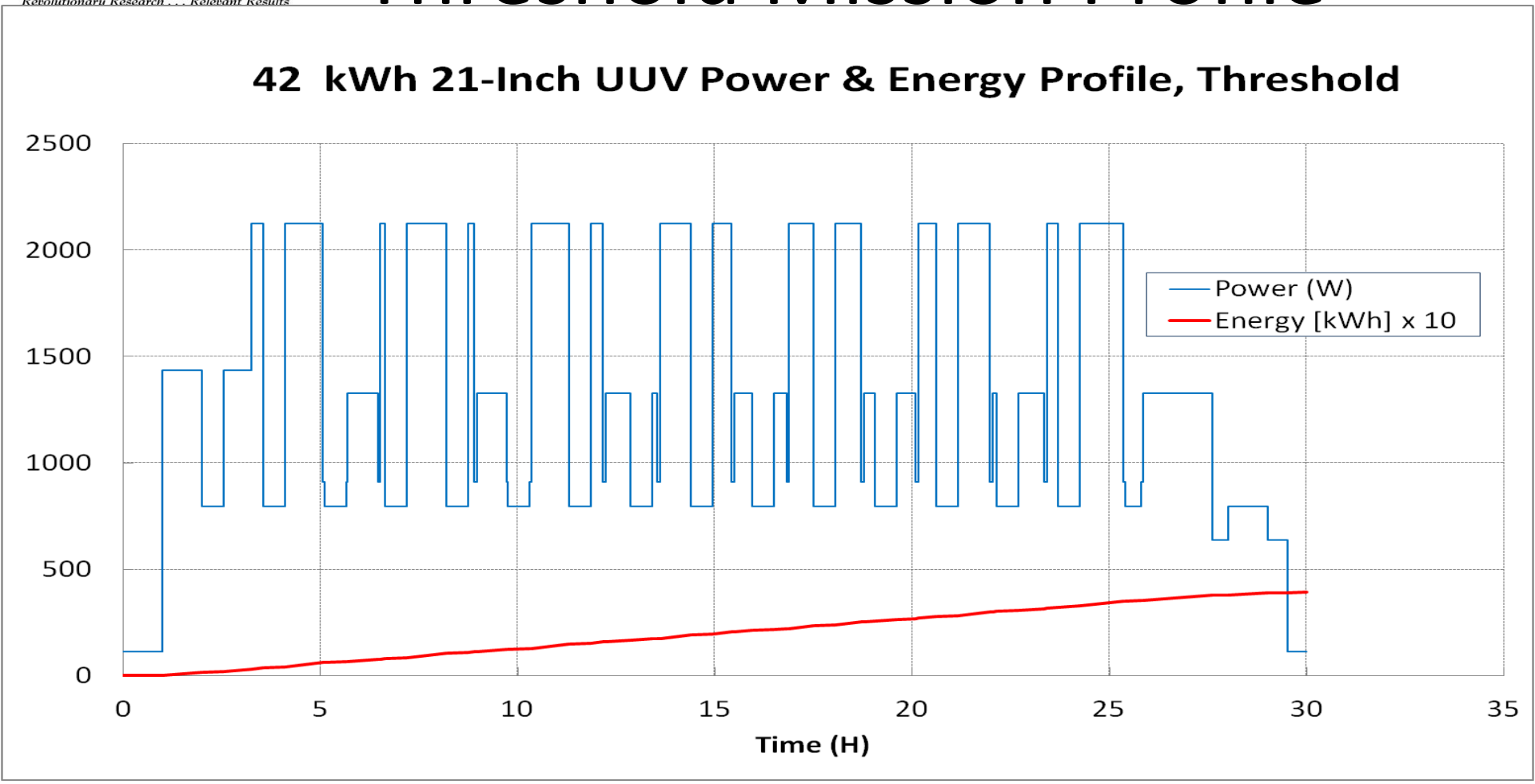
Environmental Metrics

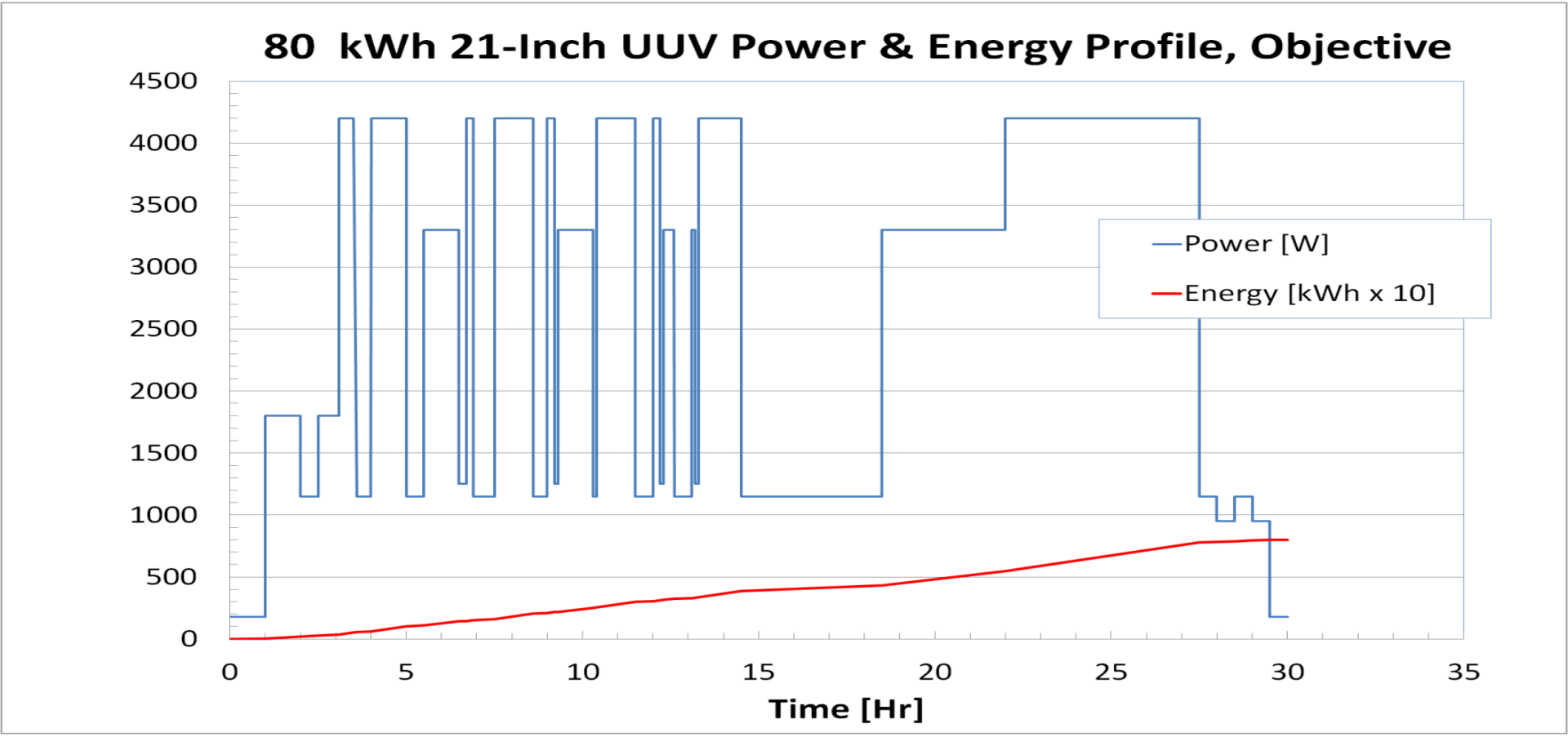
Specification	Metric
Environment (Operating Conditions)	
Salinity	0 to 50 parts per thousand (ppt)
Salinity Variation	± 10 ppt during a single sortie
Water Temperature	-1.1°C – 35.0°C (30°F to 95°F)
Air Temperature	-28.9°C to 50°C (-20°F to 122°F)
Temperature Shock	-28.9°C to 50°C (-20°F to 122°F)
Shipboard Shock	MIL-S-901D (Grade B) while secured to transportation pallet
Shipboard Vibration	MIL-STD-167-1
Humidity	0-100 % relative humidity
Salt Fog	Marine Environment
Fungus	Avoid Materials that promote fungal growth
Icing/Freezing Rain	Operate where icing may occur from sea splash/spray
Electromagnetic Environment	MIL-STD-461F (RE101, RE102, RS101, RS103)
Environment (Non Operating Conditions)	
Transportation Altitude	0 to 12,192 M(0-40,000 ft) (pressurized or non-pressurized)
Transportation & Storage Temperature	-40.0°C to 108.9°C (-40°F to 160°F)
Transportation Shock & Vibration	Withstand ground, air, rail, ship transport (MIL-STD-1366E guidance)

Threshold Mission Profile



- **Phase I base should achieve this profile at a MINIMUM TRL-4 in bench-top demonstration**
- **Tabular profile of data will also be provided**

Objective Mission Profile



- **Phase II base should achieve this profile at TRL-6 in a land-based UUV energy section demonstration**
- **Tabular profile of data will also be provided**

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Summary

- **Slides from today's briefings will be posted by noon EST 9 February 2011 on FedBizOps & the ONR web site**
- **Any upcoming BAA will be posted on FedBizOps & the ONR web site**

- **Industry Day questions https://secure.onr.navy.mil/events/regdetail.asp?cid=715**
  - **MUST use template available at FedBizOps & the ONR web site**
  - **MUST submit to the following e-mail address: IndustryDayQuestionsUUVEnergy@ONR.navy.mil**
  - **Deadline for Industry Day question submittal:**

February 11, 2011 by 1600 EST

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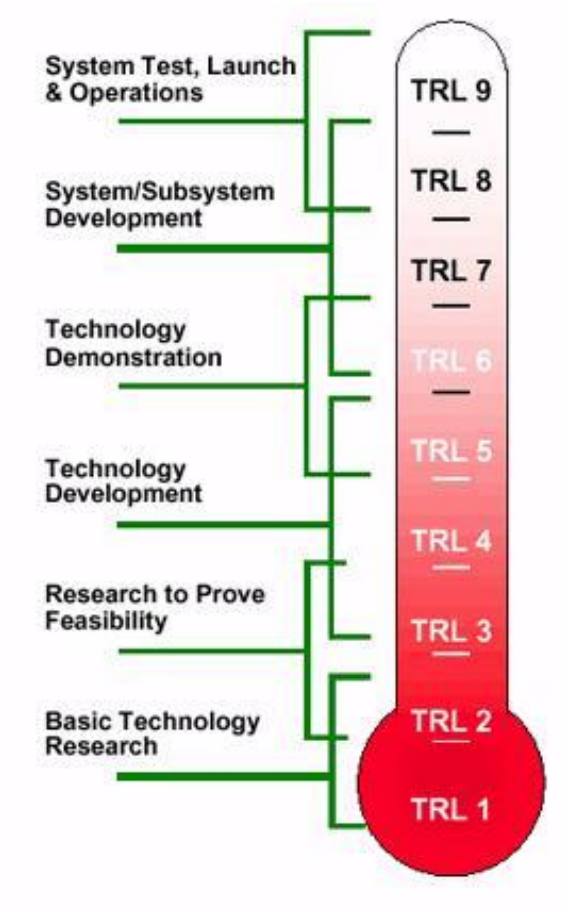
Technology Readiness Levels



Actual Application of the Technology in It's Final Form and Under Mission Conditions.
Technology Has Been Proven to Work in It's Final Form and Under Expected Conditions.
Prototype Near or at Planned Operational System. Major Step From Level 6, Requiring the Demonstration of an Actual Prototype in an Operational Environment.
Representative Model or Prototype System, Which Is Well Beyond the Breadboard Tested 5 Is Tested in a Relevant Environment
Fidelity of Breadboard Technology Increases Significantly Enough to Justify Being Ready for Testing in a Simulated Environment
Basic Technology Components Are Integrated to Establish That the Pieces Will Work Together.
Active Research and Development Is Initiated. This Includes Analytical and Laboratory Studies to Physically Validate Analytical Predictions of Separate Elements of Technology.
Invention Begins. Once Basic Principles Are Observed, Practical Applications Can Be Invented. The Application Is Speculative and There Is No Proof of Detailed Analysis to Support the Assumption.
Lowest Level of Technology Readiness. Scientific Research Begins to Be Translated Into Technology's Basic Properties.

References

Mil-Std-882D Task 202	https://assist.daps.dla.mil/docimages/A/0000/0003/6027/000000198718_000000141972_DJLKNMXRWC.PDF?CFID=24160174&CFTOKEN=97572158&jsessionid=5c30dbe089c6fbefce5740556634e187b109
DI-SAFT 80101B	https://assist.daps.dla.mil/quicksearch/basic_profile.cfm?ident_number=209470
Mil-S-901D (Grade B)	http://www.assistdocs.com/search/document_details.cfm?ident_number=2640&StartRow=1&PaginatorPageNumber=1&doc%5Fid=MIL%2DS%2D901D&status%5Fall=ON&search%5Fmethod=BASIC
Mil-STD-167-1	http://www.assistdocs.com/search/document_details.cfm?ident_number=35544&StartRow=1&PaginatorPageNumber=1&doc%5Fid=MIL%2DSTD%2D167%2D1&status%5Fall=ON&search%5Fmethod=BASIC
Mil-STD-461 (RE101,RE102,RS101,RS103)	http://www.assistdocs.com/search/document_details.cfm?ident_number=35789&StartRow=1&PaginatorPageNumber=1&doc%5Fid=MIL%2DSTD%2D461&status%5Fall=ON&search%5Fmethod=BASIC
Mil-STD-1366E	http://www.assistdocs.com/search/document_details.cfm?ident_number=35789&StartRow=1&PaginatorPageNumber=1&doc%5Fid=MIL%2DSTD%2D461&status%5Fall=ON&search%5Fmethod=BASIC